Astronomy & Astrophysics manuscript no. WRPN˙mike˙I˙language
January 26, 2012

Analysis of chemical abundances in planetary nebulae with [WC] central stars. I. Line intensities and physical conditions ⋆

Jorge García-Rojas[1,2], Miriam Peña[3], Christophe Morisset[1,3], Adal Mesa-Delgado[1,2], and María Teresa Ruiz[4]

1 Instituto de Astrofísica de Canarias, E-38200 La Laguna, Tenerife, Spain
2 Departamento de Astrofísica. Universidad de La Laguna, E38205 La Laguna, Tenerife, Spain
3 Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70264, Méx. D. F., 04510 México
4 Departamento de Astronomía, Universidad de Chile, Casilla 36 D, Las Condes, Santiago, Chile.
e-mail: jogarcia@iac.es; miriam@astro.unam.mx; chris.morisset@gmail.com; amd@iac.es; mtruiz@das.uchile.cl

Received xxxxxxxxxxx; accepted xxxxxxxxxxxx

ABSTRACT

Context. Planetary nebulae (PNe) around Wolf-Rayet [WR] central stars ([WR]PNe) constitute a particular photoionized nebula class that represents about 10% of the PNe with classified central stars.

Aims. We analyse deep high-resolution spectrophotometric data of 12 [WR] PNe. This sample of [WR]PNe represents the most extensive analysed so far, at such high spectral resolution. We aim to select the optimal physical conditions in the nebulae to be used in ionic abundance calculations that will be presented in a forthcoming paper.

Methods. We acquired spectra at Las Campanas Observatory with the 6.5-m telescope and the Magellan Inamori Kyocera (MIKE) spectrograph, covering a wavelength range from 3350 Å to 9400 Å. The spectra were exposed deep enough to detect, with signal-to-noise ratio higher than three, the weak optical recombination lines (ORLs) of O ii, C ii, and other species. We detect and identify about 2980 emission lines, which, to date, is the most complete set of spectrophotometric data published for this type of objects. From our deep data, numerous diagnostic line ratios for T_e and n_e are determined from collisionally excited lines (CELs), ORLs, and continuum measurements (H i Paschen continuum in particular).

Results. Densities are closely described by the average of all determined values for objects with n_e<10^4 cm^{-3}, and by n_e([Cl iii]) for the densest objects. For some objects, n_e([Ar iv]) is adopted as the characteristic density of the high ionization zone. For T_e, we adopt a three-zone ionization scheme, where the low ionization zone is characterised by T_e([N ii]), the medium ionization zone by T_e([O iii]), and the highest ionization one by T_e([Ar iv]) when available. We compute T_e from the H i Paschen discontinuity and from He i lines. For each object, T_e(H i) is, in general, consistent with T_e derived from CELs, although it has a very large error. Values of T_e(He i) are systematically lower than the T_e derived from CELs. When comparing T_e(H i) and T_e(He i) it is unclear whether the behaviour of both temperatures agrees with the predictions of the temperature fluctuations paradigm, owing to the large errors in T_e(H i). We do not find any evidence of low-temperature, high-density clumps in our [WR]PNe from the analysis of faint O ii and N ii plasma diagnostics, although uncertainties dominate the observed line ratios in most objects. The behaviour of T_e([O iii])/T_e([N ii]), which is smaller for high ionization degrees, can be reproduced by a set of combined matter-bounded and radiation-bounded models, although, for the smallest temperature ratios, a too high metallicity seem to be required.

Key words. ISM: planetary nebulae: general – ISM: abundances

1. Introduction

Planetary nebulae (PNe) constitute the evolutionary end point of most stars in the Universe, and they play a major role in the chemical enrichment history of the interstellar medium (ISM) of galaxies. Their chemical compositions allow us to determine the abundances of some chemical elements present in the ISM when their progenitor stars were born and to analyse the contribution of these stars to galactic chemical enrichment by elements processed in the nucleus and ejected into the ISM. Planetary nebulae are produced by stars with initial masses of between ∼ 1 M$_\odot$ and ∼ 8 M$_\odot$ and a large age spread (from 0.1 to 9 Gyr, Allen et al., 1998). The central stars (CS) are evolved stars (post-AGB) in the pre-white dwarf stage. Among them, there is an interesting group that has both very intense stellar winds with mass-loss rates in the range of 10^{-7} – 10^{-5} M$_\odot$ per year (Koesterke, 2001, and references therein) and terminal velocities from several hundreds to several thousands km s^{-1} and a hydrogen deficient chemical composition. All these stars have been catalogued as Wolf-Rayet of the C-sequence (for a quantitative classification scheme of these stars, see Acker & Neiner, 2003, and references therein). Until recently, the [WR] CSPNe were thought to represent about 5-7% of all CSPNe (Tylenda et al., 1993; Acker & Neiner, 2003), but that value should be a lower limit owing to several selection effects, and the real percentage could be larger (DePew et al., 2011). Among these CSPNe, about half of them, the so-called [WC]-early stars, have very high surface temperatures from 80 kK to about 150 kK (spectral classes are [WC4-5], [WO1-3]) while the others, called [WC]-late stars (spectral classes [WC6] to [WC11]) have temperatures between 80 kK and about 30 kK (Koesterke, 2001).

Many papers have been devoted to the analysis of these PNe and their CS because they can provide several clues about the

Send offprint requests to: J. García-Rojas

⋆ Based on data obtained at Las Campanas Observatory, Carnegie Institution.

processes of the chemical enrichment of both the shells and the interstellar medium with freshly made products, the processes of the shell ejection and its additional interaction with the stellar winds, etc. Several mechanisms have been proposed to explain the presence of the strong winds and the peculiar H-deficient chemical composition of [WC] stars, among them a final thermal pulse at the AGB phase (AFTP), a late thermal pulse (LTP), and a very late thermal pulse occurring in the white dwarf cooling track, (e.g., Werner & Herwig, 2006, and references therein).

Recently, DePew et al. (2011) reported the discovery of several more central stars of the [WR] type, which together with the sample reported by Górny et al. (2004) have increased the number of known [WR]PNe central stars, to over a hundred.

Some years ago, we initiated a project to obtain deep high-resolution spectroscopy of PNe around [WC] stars ([WR]PNe), in order to analyse the chemical behaviour of the photoionized plasma as based on collisionally excited lines (CELs) or on optical recombination lines (ORLs). It is known that a discrepancy in the abundances of a factor of two or more is commonly found in photoionized nebulae. This discrepancy is measured through the abundance discrepancy factor, ADF, defined as:

$$\mathrm{ADF}(X^{i+}) = (X^{i+}/H^+)_{\mathrm{ORLs}} / (X^{i+}/H^+)_{\mathrm{CELs}},$$

where X^{i+} is the $i+$ ionic abundance of element X and H^+ is the abundance of ionized hydrogen.

The presence of H-deficient inclusions is one of the mechanisms suggested to explain ADFs larger than one (see e.g., Liu et al., 2006, and references therein). Since [WR] PNe are ionized by H-deficient stars whose atmospheres are almost pure He and C (i.e., Koesterke, 2001) and since they lose mass at high rates, it seems plausible that the presence of tiny H-deficient knots in the ionized plasma could cause large ADFs.

In a previous paper (García-Rojas et al., 2009), three [WR]PNe were analysed based on echelle data obtained with the same instrument as in this work: PB 8, a young nebula around an uncommon [WN]/[WC] central star (Todt et al., 2010); NGC 2867, an evolved nebula around a [WC4] star; and PB 6, a highly excited [WR]PNe around a [WO2] star. Some evidences against the presence of H-deficient metal-rich knots in the PNe coming from a late thermal pulse event were presented, based on the low $(C/O)_{ORLs}/(C/O)_{CELs}$ observed in both objects with detected ORLs of C and O ions (PB 8 and NGC 2867) and the similarity between O II and [O III] heliocentric velocities. These results seem to argue against a "C-rich knots ejected in a late thermal pulse" scenario as the origin of the observed ADFs.

In this work, we present additional high-resolution spectrophotometric data obtained for 12 objects, where the faint O II and C II ORLs have been detected. The main characteristics of these nebulae are presented in Table 1 where the log of observations also can be found. An extensive catalog of lines (hundreds of lines have been detected for each analysed object). For each emission line, we provide the line identification, radial velocity, and observed and dereddened line fluxes. In the following, we describe the observations and data reduction procedures (Sect. 2), the determinations of line intensities and reddening (Sect. 3), and the analysis of the plasma physical conditions as derived from the diagnostic line ratios (Sect. 4). In Sect. 5, we discuss the results. In a forthcoming paper (García-Rojas et al., in preparation, Paper II), we discuss the abundance pattern and the ADFs found for these objects.

2. Observations and data reduction

High spectral resolution data were obtained at Las Campanas Observatory (Carnegie Institution) with the Clay 6.5-m telescope and the double echelle Magellan Inamori Kyocera spectrograph (MIKE) on September 2009 and June 2010. This spectrograph operates with two arms that allow us to obtain a blue and a red spectrum simultaneously (Berstein et al. 2003). The standard set of gratings were employed, providing a wavelength coverage from 3350 Å to 5050 Å in the blue and from 4950 Å to 9400 Å in the red. Long and short exposure time observations were carried out for each object, in order to ensure an appropriate signal-to-noise ratio in the faint lines and unsaturated data in the strongest lines. The log of observations is presented in Table 1, where we list the observing date, the exposure times for each object and the averaged airmass during each set of observations. For all the observed PNe, the slit dimensions were 1″ along the dispersion axis, and 5″ in the spatial direction. A binning of 2×2 was used, obtaining a spacial scale of 0.2608 ″/pix. As usual, series of bias, milky-flats and flats with the internal incandescent lamp were acquired for data reduction. A Th-Ar lamp exposure was observed after each science exposure for wavelength calibrations. The spectral resolution obtained varied from 0.14 Å to 0.17 Å (about 10.8 km s^{-1}) in the blue, and from 0.23 Å to 0.27 Å (about 12.8 km s^{-1}) in the red, as measured from the half-width half maximum (HWHM) of the lines of the Th-Ar comparison lamp.

As shown in Table 1, all the objects were observed at zenith distances smaller than or about 30^o (as recommended by the MIKE User Manual) covering airmasses between 1.004 and 1.25, thus the atmospheric refraction was not expected to affect the spectra.

In the September 2009 run, the seeing was about 1″-1.2″. In the June 2010 run, the seeing was better than 1″, being as good as 0.6-0.7″ for some hours.

Standard data reduction procedures were performed. Two-dimensional (2D) echellograms were bias-subtracted and flat-fielded using IRAF[1] *echelle* reduction packages. We used the *apscatter* task to substract the background-scattered light contribution in the 2D-echellograms. The spectra were extracted with an extraction window of 3.″72 to fit the width of the normalized flat-field windows, and they were wavelength-calibrated using the Th-Ar exposures. The fits to the wavelength function give an rms of about 0.005, which translates into a precision of about 0.01 Å in the wavelength-calibrated spectra. The data were flux-calibrated using the spectrophotometric standard stars Feige 110, LDS 749B, and NGC 7293 (Oke, 1990). For these objects, the slit width was increased to 2″ to maximize the stellar flux entering the slit. The estimated error in the absolute flux calibration was about 5%. We estimated this error by self-calibrating the standard stars by themselves and comparing the computed flux with that obtained from the spectrophotometric data of these stars (Oke, 1990). The bluest (λ<3700 Å) flux calibration of the objects observed on June 6 (He 2-86, M 1-30, M 1-32, NGC 6369) was unreliable owing to problems deriving the stellar continuum associated with strong H I absorption lines in the blue spectrum of the selected standard star.

3. Line intensities and reddening correction

The SPLOT routine of the IRAF package was used to measure the line intensities. In general, as most of the lines have either a double-peak or a complex velocity structure, all the flux in the

[1] IRAF is distributed by the National Optical Astronomy Observatories, which is operated the Association of Universities for Research in Astronomy, Inc., under contract to the National Science Fundation.

Table 1. Object characteristics and log of observations (slit dimensions were always 1″ ×5″)

PN G	Object	R.A	Dec	Spec T	$T_\star$ (kK) kK	obs. date yy-mm-dd	exp. time s,times x s	Av. air mass	comments[a] ref for $T_\star$
002.2−09.4	Cn 1-5	18 29 11.7	−31 29 59	[WO4]pec	<57	09-09-09	30,2×2700	1.07	1
003.1+02.9	Hb 4	17 41 52.8	−24 42 08	[WO3]	86	10-06-05	60,3×1500	1.004	1
300.7−02.0	He 2-86	12 30 30.4	−64 52 06	[WC4]		10-06-06	60,3×1200	1.24	
004.9+04.9	M 1-25	17 38 30.3	−22 08 39	[WC5]	60	10-06-05	60,3×1200	1.033	2
355.9−04.2	M 1-30	17 52 58.9	−34 38 23	wels		10-06-06	60,3×1200	1.008	
011.9+04.2	M 1-32	17 56 20.0	−16 29 04	[WC4]pec	66	10-06-06	60,3×1500 (knot)	1.11	1
019.4−05.3	M 1-61	18 45 55.1	−14 27 38	wels		10-06-05	10,30,60,2×120	1.12	
006.8+04.1	M 3-15	17 45 31.7	−20 58 02	[WC4]	55	09-09-09	60,600,1800,2400	1.03	3
307.2−03.4	NGC 5189	13 33 33.0	−65 58 27	[WO1]	135	10-06-05	3×1800,120 (knot)	1.253	4
002.4+05.8	NGC 6369	17 29 20.4	−23 45 34	[WO3]	150	10-06-06	60,3×1800 (knot)	1.04	4
336.3−06.9	PC 14	17 06 14.8	−52 30 00	[WO4]		10-06-05	60,3×1200	1.15	
285.4+01.5	Pe 1-1	10 38 27.6	−56 47 06	[WO4]		10-06-05	60,900,2×1200	1.15	

[a] (1) Tylenda & Stasińska (1994), (2) Leuenhagen et al. (1996), (3) Zhang & Kwok (1993), (4) Koesterke & Hamann (1997).

line was integrated between two given limits, over a local continuum estimated by eye. In the case of objects with a simple velocity structure showing very tight blends among nebular lines or with telluric emission lines, the analysis was performed via a multiple Gaussian fitting. In Fig. 1, we present the Hβ emission line as seen in the 2D-echellograms for all the objects in our sample, to show the spatially and spectroscopically resolved emission. The extracted spectra are also shown. It can be seen that several objects have very complicated line profiles.

All the lines of a given spectrum were normalized to a particular bright emission line in the common range between both the blue and red spectrum. In the blue range we used Hβ, and in the red range we used either the [O III] λ4959 line or the He I λ5015 line, when the [O III] line was saturated in the long exposure. To produce a homogeneous data set of line flux ratios, all of them were rescaled to the Hβ flux by using the [O III] λ4959/Hβ or the He I λ5015/Hβ flux ratios measured in the blue range. Some lines that were saturated in the long exposures were measured in the short ones and rescaled to the Hβ flux. Differences of up to 10% between the integrated flux of the common lines, in the blue and red ranges, were measured. These differences are probably caused by common lines (namely Hβ, [O III] $\lambda\lambda$4959,5007 and He I λ5015) being at the red and blue extremes of the CCDs, where the flat-field correction might be less reliable. Nevertheless, we were always able to find a reasonable agreement between blue and red measured fluxes of [O III] λ4959 in the short exposure, with differences amounting to a maximum of 11% in two objects (H b4 and NGC 5189), 9% in M 3-15, and remaining below or of the order of the adopted flux calibration uncertainty (5%) in the remaining objects. We do not expect the final results to be substancially affected because only line ratios are used in our analysis.

Owing to the small area covered by our slit and because our objects are extended, we were unable to extract a sky spectrum. However, taking into account the peculiar profile of the emission lines in each object, it was easy to distinguish telluric features from the nebular emission lines. The cases in which nebular emission lines were severely blended with sky telluric features are labelled in the table of line identifications (Table 3).

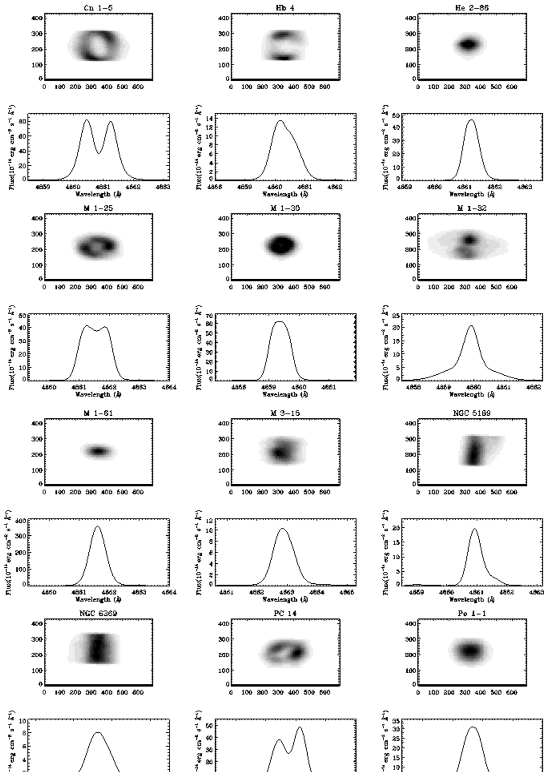

Fig. 1. Portion of the 2D echellograms and the extracted spectra showing the spatially resolved Hβ line for all objects in our sample.

For the reddening correction we assumed the standard extinction law for the Milky Way parametrized by Seaton (1979), with R_v=3.1. The logarithmic redddening coefficient, c(Hβ), was derived in each case by fitting the observed Balmer decrement, F(H I Balmer)/F(Hβ), and the observed F(H I Paschen)/ F(Hβ)

Table 2. Extinction coefficients

Object	c(Hβ)	H I lines[a]	T_e (K), n_e (cm^{-3})	Literature	Ref.[c]
Cn 1-5	0.56±0.05	H16-H3, P25-P10	8700, 5000	0.42, 0.1	1,2
Hb 4	1.81±0.14	H16-H3, P25-P10	10000, 6700	1.76, 2.3	1,2
He 2-86	2.10±0.10	H16-H3, P25-P10	9000, 12000	2.49	1
M 1-25	1.41±0.09	H15-H3, P25-P10	8000, 8000	1.46, 1.0, 1.42	1,2,3
M 1-30[b]	1.00±0.08	H25-H3, P25-P10	7000, 4900	1.01, 1.04	1,3
M 1-32[b]	1.30±0.13	H16-H3, P25-P10	9750, 9250	1.30, 1.9	1,2
M 1-61	1.24±0.10	H16-H3, P25-P10	9000, 15000	1.71	1
M 3-15	2.09±0.13	H6-H3, P25-P10	11000, 5000	2.08, 2.3, 2.12	1,2,3
NGC 5189	0.47±0.08	H16-H3, P25-P10	10000, 500	0.44	1
NGC 6369[b]	1.93±0.06	H16-H3, P25-P10	8600, 1750	1.91, 1.9	1,2
PC 14	0.63±0.06	H16-H3, P25-P10	10000,3000	0.65	1
Pe 1-1	1.80±0.09	H16-H3, P25-P10	10000, 18000	2.16	1

[a] H14, H10, and H8 (blended with other emission lines) and Paschen lines blended with telluric emission lines are excluded.
[b] H7 also excluded
[c] (1) Girard et al. (2007), (2) Peña et al. (2001), (3) Górny et al. (2009).

to the theoretical values computed by Storey & Hummer (1995) for an electron temperature, T_e, and a density, n_e, as given for each object by Girard et al. (2007). In Table 2, we present the reddening coefficient, c(Hβ), the H I lines used for deriving it, the physical conditions (T_e and n_e) adopted for each case, and previous determinations found in the literature. In Fig. 2, we can see that there is a good overall agreement between our derived c(Hβ) values and those reported in the literature, except for some objects of Girard et al. (2007) (red filled circles in the on-line version) and the data of Peña et al. (2001) (green stars in the on-line version) where we found significant differences in the derived c(Hβ) for most of the objects in common between both samples. These differences could be due to difficulties in separating the nebular from the stellar emission in the case of Girard et al. (2007) data, or to problems in the flux calibration in the zones of bluer H I lines in Peña et al. (2001) data.

Table 3 presents the observed and reddening corrected emission line intensities measured in all our PNe. A sample of Table 3 (available on-line only in machine readable format) is shown. The first column presents the adopted laboratory wavelength, λ_0. The second and third columns provide the ion and multiplet number or series for each line. Column 4 lists the observed wavelength, while column 5 shows the heliocentric radial velocity determined for the line. Columns 6, 7, and 8 present the observed and dereddened flux relative to Hβ and the observational 1σ error (in percentage) associated with the line flux. The uncertainties in the flux measurement, the flux calibration, and the error propagation in the reddening coefficient are included in the observational error. We provide notes in the last column.

The identification and adopted laboratory wavelength for the lines were obtained from several previous identifications in the literature (Sharpee et al., 2004; Zhang et al., 2005; García-Rojas et al., 2004; Esteban et al., 2004; Mesa-Delgado et al., 2009; Fang & Liu, 2011, and references therein).

We detected hundreds of lines in each object of our sample. The final set of detected and measured lines amounts to more than 3500 lines. Owing to the high resolution of our spectra, we were able to detect and deblend several faint lines that were partially blended with other features. In some cases, we included faint ORLs belonging to a multiplet with other clear identifications in our spectra. If the lines are brighter than 10% of the principal detected component, we then included them in our list

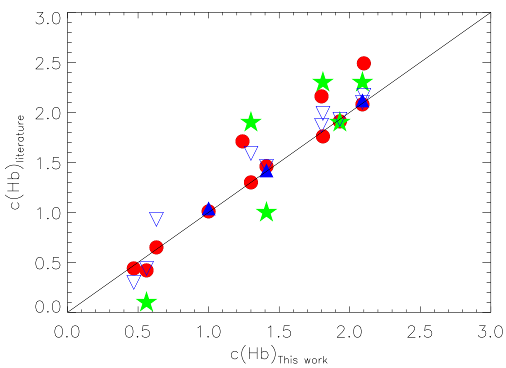

Fig. 2. Comparison between our derived c(Hβ) and those derived in the literature for common objects. Red filled circles: Girard et al. (2007); green filled stars: Peña et al. (2001); blue filled triangles: Górny et al. (2009); blue open inverse triangles: Acker & Neiner (2003). It is clear that there is a good overall agreement, except for some data (see text).

Table 3. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications. (An example. The full version of this table is on-line)

				Cn 1-5				
λ_o(Å)	Ion	Mult.	λ_{obs}(Å)	V_{rad} (km s^{-1})	F(λ)/F(Hβ	I(λ)/I(Hβ	err (%)	notes
3447.59	He I	7	3447.24	-30.45	0.286	0.441	16	
3478.97	He I	43	3478.76	-18.09	0.169	0.257	23	
3487.73	He I	42	3487.44	-24.93	0.106	0.161	33	
3512.51	He I	38	3512.17	-29.03	0.225	0.338	18	
3530.50	He I	36	3530.15	-29.73	0.202	0.302	20	
3554.42	He I	34	3554.05	-31.20	0.232	0.343	18	
3587.28	He I	32	3586.89	-32.61	0.350	0.512	13	
3613.64	He I	6	3613.26	-31.52	0.363	0.525	13	
3634.25	He I	28	3633.85	-32.99	0.484	0.696	11	
3669.47	H I	H25	3669.07	-32.68	0.352	0.500	13	
3671.48	H I	H24	3671.07	-33.47	0.399	0.567	12	
3673.76	H I	H23	3673.34	-34.27	0.452	0.641	11	
3676.37	H I	H22	3675.97	-32.63	0.518	0.733	10	
3679.36	H I	H21	3678.94	-34.24	0.492	0.696	11	
3682.81	H I	H20	3682.48	-26.87	0.636	0.898	9	
3686.83	H I	H19	3686.46	-30.10	0.586	0.827	10	
3691.56	H I	H18	3691.17	-31.69	0.606	0.854	10	
3694.22	Ne II	1	3693.80	-34.08	0.124	0.175	29	
3697.15	H I	H17	3696.75	-32.43	0.745	1.047	9	
3703.86	H I	H16	3703.47	-31.58	0.914	1.279	8	
3705.04	He I	25	3704.63	-33.19	0.740	1.036	9	
3711.97	H I	H15	3711.60	-29.88	1.063	1.485	7	
3721.83	[S III]	2F	3721.42	-33.04	2.386	3.321	6	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3725.62	-32.98	51.615	71.752	6	
3728.82	[O II]	1F	3728.37	-36.18	25.956	36.053	6	
3734.37	H I	H13	3733.97	-32.13	1.610	2.233	7	
3750.15	H I	H12	3749.72	-34.37	2.195	3.029	6	
3770.63	H I	H11	3770.22	-32.59	2.675	3.669	6	
3797.63	[S III]	2F	3797.48	-11.83	3.834	5.217	6	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.24	-29.05	1.317	1.781	7	
3835.39	H I	H9	3834.97	-32.83	5.738	7.725	6	
3862.59	Si II	1	3861.97	-48.14	0.061	0.082	:	
3868.75	[Ne III]	1F	3868.33	-32.54	71.411	95.248	6	
3871.82	He I	60	3871.35	-36.39	0.086	0.115	39	
3888.65	He I	2	3888.42	-17.73	17.195	22.809	6	
3889.05	H I	H8	*	*	*	*	*	

and labelled them as blended (e.g., lines of multiplet 2 of O II blended with other features).

Most of the lines detected in our spectra are permitted lines of H I, He I, and He II but there also are many heavy element permitted lines, such as C I, C II, C III, N I, N II, N III, O I, O II, O III, Ne I, Ne II, Si I, Si II, S II, S III, Cl I, and Mg II. Several of these lines are excited mainly by recombination and could be useful for abundance determinations (e.g., some multiplets of O I, O II, C II, C III, N II, Ne II, and Mg II). The analysis and discussion about these lines will be presented in Paper II.

We also detected several forbidden and semi-forbidden lines from ions such as [N I], [N II], [O I], [O II], [O III], [Ne III], [Ne IV], [Ne V], Mg I], [P II], [S I], [S II], [S III], [Cl II], [Cl III], [Cl IV], [Ar III], [Ar IV], [Ar V], [K IV], [Ca II], [Cr II], [Cr III], [Cr IV], [Mn IV], [Mn V], [Fe II], [Fe III], [Fe IV], [Ni II], [Ni III], [Ni IV], [Se II], [Kr III], [Kr IV], and [Xe III]. The abundance analysis of several of these ions will be presented in Paper II.

In Fig. 3 (available only on-line), we show the complete spectra of our objects, from 3350 Å to 9400 Å. The flux scale is such that I(Hβ)=100.0.

4. Plasma diagnostic: temperatures and densities

The large wavelength range covered by our spectra allows us to obtain a large number of diagnostic line ratios to determine the physical conditions (electron temperature, T_e, and density, n_e) in the plasma. The task TEMDEN of the package NEBULAR (Shaw & Dufour, 1995) in IRAF was used to determine T_e and n_e. In our version of TEMDEN, the atomic parameters (transition probabilities and collisional strengths) were updated. The atomic data were taken from Table 6 of García-Rojas et al. (2009) with the exception of the collisional strengths of [S II] lines that were updated to those computed by Tayal & Zatsarinny (2010) .

In this section we describe in detail the procedures and line ratios used to determine the plasma physical properties. In the following analysis, we include the data for PB 8 and NGC 2867 by García-Rojas et al. (2009) for completeness.

4.1. Plasma diagnostics from CELs

Electron densities were inferred from the [S ii] λ6730/λ6717, [O ii] λ3726/λ3729, [Cl iii] λ5517/λ5537, and [Ar iv] λ4740/λ4711 line ratios and, for some objects, from a set of [Fe iii] lines (see discussion about this diagnostic in Sect.5.1).

In general, we considered a three-ionization-zone scheme. First, we assumed a T_e=10000 K and computed the densities. These densities were then used to derive T_e from different diagnostic ratios. We adopted the averaged density, weighted by the errors, for the objects with a good agreement among the different density diagnostics, within the uncertainties; in the cases with large differences among the [S ii], [O ii], [Cl iii], and [Ar iv] nebular density diagnostics, we adopted n_e([Cl iii]) as representative of the low-medium ionization zones (see Sect. 5). For three objects (Cn 1-5, He 2-86, and M 1-61), we adopted n_e([Ar iv]) as representative of the highest ionization zone.

For the low ionization zone of each object, the representative T_e was computed from the line ratios [S ii] (λλ6716+31)/(λλ4069+76), [O ii] (λλ3726+29)/(λλ7320+30), and [N ii] (λλ6548+83)/(λ5755). For the higher ionization zone, we computed T_e from [O iii] (λ4959+λ5007)/(λ4363), [S iii] (λλ9069+530)/(λ6312), and [Ar iii] (λλ7136+751)/(λ5192) line ratios. The [Ar iv] (λλ4711+40)/(λλ7170+263) line ratio was used to compute T_e([Ar iv]), which is representative of the highest ionization zones in the nebulae. These temperatures were used to compute densities and we then iterated the process until convergence.

4.1.1. The effect of recombination on some diagnostic line ratios

To obtain T_e([O ii]), it is necessary to subtract the contribution to [O ii] λλ7320+7330 by recombination. Liu et al. (2000) found that this contribution can be fitted in the range $0.5 \leq T_e/10^4 \leq 1.0$ by

$$\frac{I_R(7320+7330)}{I(\mathrm{H}\beta)} = 9.36 \times (T_4)^{0.44} \times \frac{\mathrm{O}^{++}}{\mathrm{H}^+}, \quad (1)$$

where $T_4 = T_e/10^4$. The importance of this contribution is relative. For instance, for PB 8, by assuming the values derived for O^{++}/H^+ from ORLs and using this equation, García-Rojas et al. (2009) estimated a contribution to the observed line intensities of approximately 59% by recombination. This yielded a T_e([O ii])=7050 K, which was 4350 K lower than those derived without taking into account this contribution. For the objects in this work, we computed the recombination contribution to the [O ii] lines by adopting the abundance derived from multiplet 1 O ii ORLs. For all of these objects, the correction of T_e([O ii]) was lower than 2000 K with a median of about 500 K.

Liu et al. (2000) found that the contribution to the intensity of the λ5755 [N ii] line by recombination can also be estimated from

$$\frac{I_R(5755)}{I(\mathrm{H}\beta)} = 3.19 \times (T_4)^{0.30} \times \frac{\mathrm{N}^{++}}{\mathrm{H}^+}, \quad (2)$$

in the range $0.5 \leq T_4 \leq 2.0$. We used this expression to calculate the recombination contribution to λ5755. We derived the N^{++}/H^+ abundance, to a first approximation, by assuming that $N^{++}/H^+ = O^{++}/H^+ \times N^+/O^+$ where O^{++}/H^+ is the value derived from recombination lines and N^+/O^+ is the fraction derived from CELs. In all the objects of our sample, the correction for T_e([N ii]) was smaller than 1500 K, with a median of about 550 K. The objects with the largest corrections are Hb 4 and M 3-15, whose temperature decreased by 1300 K and 1500 K, respectively. On the other hand, M 1-25, M 1-30, and M 1-32 are almost unaffected and are corrected by only about 50−150 K.

In several objects of our sample, we detected bright He ii lines. Taking into account the similarity between the ionization potentials of He^{++} and O^{3+}, we expected to find a significant amount of oxygen in the form of O^{3+}, so we had to take into account the contribution of recombination to the auroral [O iii] λ4363 line, which we estimated using equation 3 of Liu et al. (2000)

$$\frac{I_R(4363)}{I(\mathrm{H}\beta)} = 12.4 \times (T_4)^{0.79} \times \frac{\mathrm{O}^{3+}}{\mathrm{H}^+}. \quad (3)$$

We were unable to compute directly the O^{3+} abundance from either CELs or ORLs, but we can estimate it from helium ionic abundances using $O^{3+}/H^+ = [(He/He^+)^{2/3} - 1] \times (O^+/H^+ + O^{++}/H^+)$ (Kingsburgh & Barlow, 1994). With this expression, we found that the contribution of recombination to the [O iii] λ4363 line is smaller than ∼3% for the most ionized objects in our sample, which has negligible effects on the determination of T_e([O iii]).

The temperatures and densities derived from the various diagnostic line ratios and their respective 1σ errors, for each object in our sample, are presented in Table 4.

4.2. Plasma diagnostics from ORLs and continua

4.2.1. Electron temperatures from Paschen discontinuity

Electron temperature can be derived from the ratio of the Balmer or Paschen discontinuities to the H i lines belonging to the Balmer or Paschen series, respectively. The high resolution of our spectra allows us to measure the continuum flux in zones very close to the discontinuities. In principle, this technique would allow us to establish whether other continuum contributions apart from pure nebular processes affect the observed spectrum. However, we have to handle continuum measurements in the H i discontinuities with care, because in most of our spectra the central star was included in the slit, and [WC] CS show in their spectra prominently wide emission lines that can affect the continuum. Balmer discontinuities are indeed strongly affected by intense wide stellar He i emission lines, hence are unsuitable for computing temperatures. In the objects where this effect was negligible, the signal-to-noise ratio was too low to derive T_e with any precision. In the Paschen discontinuity, the effect is smaller, but non-negligible. In Fig. 4, we show the spectral region near the Paschen limit for all our objets. The presence of strong He i λ8155.5 and λ8203.9 stellar emission lines, very close to the Paschen discontinuity, is quite clear in all of them. We attempted to compute T_e from the Paschen discontinuity paying special attention to the zones where continuum flux determinations were reliable and we then made a linear fit to the blue and red continua to compute the Paschen jump ($I_c(Pac)$) at λ8204. This fit is overplotted in Fig. 4. Only for Cn 1-5 was it impossible to fit the red continuum owing to the presence of some quite strong wide stellar features.

The Paschen continuum temperature was derived by fitting the relation between $I_c(Pac)/I(Pn)$ and T_e for $10 \leq n \leq 16$. The

Table 4. Plasma diagnostics.

Parameter	Line ratio	Cn1-5	Hb4	He2-86	M1-25	M1-30	M1-32	M1-61
n_e (cm^{-3})	[O ii]	3450± 930	4900± 1770	7430± 3420	6650± 2940	2950± 800	5370± 2180	16040:
	[S ii]	3780± 1400	5760:	15450:	7740:	5180± 2770	8350:	20810:
	[O ii]$_{na}$[c]	—	12300:[d]	25100± 2600	13150± 1320	7150± 700	19780± 2600	28050± 3750
	[S ii]$_{na}$[e]	3775± 350	7700± 1100	18000± 1750	8900± 850	7250± 275	9180± 1120	20400± 2000
	[Cl iii]	4320± 900	7360± 1480	23280± 4360	15100± 2600	8100± 1400	14800± 3300	22200± 4500
	[Fe iii]	13100± 6150	—	30950± 6500	16500± 11900	—	16700± 3350	94100± 8000
	[Ar iv]	10050± 5700	7400± 1300	35810± 5990	—	—	—	33590± 8070
T_e (K)	[N ii][b]	8650± 230	8600± 400	9300± 400	7720± 250	6560± 160	8350± 360	11800± 600
	[O ii][c]	—	12950:[d]	9700± 600	7300± 300	6300± 200	9700± 730	14350± 1880
	[S ii][e]	8380± 460	10000± 1200	7630± 500	5750± 250	6230± 250	6300± 370	10730± 1160
	[O iii]	8780± 160	9950± 240	8420± 150	7800± 150	6600± 150	9430± 220	9170± 180
	[S iii]	8900± 310	9350± 750	9000± 500	7900± 360	6270± 200	8270± 540	9900± 620
	[Ar iii]	7830± 350	8240± 530	8950± 300	—	6310± 240	7960± 640	8690± 360
	[Ar iv]	—	13200± 1050	7700± 400	—	—	—	8110± 690
	He i[f]	7800± 140	7850± 220	7660± 140	7140± 140	5830± 110	7230± 250	8530± 170
	He i[g]	5800± 550	7250± 1750	6850± 900	6400± 800	5700± 650	7300± 1050	7750± 1050
	Paschen decrement	—	12450^{+5700}_{-3700}	7560^{+3050}_{-2060}	7750^{+3100}_{-2050}	5800^{+2150}_{-1300}	8000^{+3200}_{-2100}	9800^{+4150}_{-2700}
Parameter	Line ratio	M3-15	NGC5189	NGC6369	PC14	Pe1-1	PB8[a]	NGC2867[a]
n_e (cm^{-3})	[O ii]	7470:	900± 180	3020± 720	3050± 760	13160± 10880	2650± 750	2675± 680
	[S ii]	5660:	950± 240	3550± 1130	3080± 980	14000:	2450± 1000	3000± 1000
	[O ii]$_{na}$[c]	—	1950± 260	5680± 520	4050± 400	29000± 2800	4950± 300	—
	[S ii]$_{na}$[e]	7000± 1850	1550± 200	—	3550± 350	17900± 1700	—	—
	[Cl iii]	10250± 1730	1320± 520	4640± 1240	3850± 870	31360± 7800	2400± 1800	4750± 1150
	[Fe iii]	—	—	—	8700:	—	—	—
	[Ar iv]	7680± 4350	1290± 680	5000± 1240	4700± 1060	40950:	<6850	3900± 1000
T_e (K)	[N ii][b]	9500± 450	9050± 300	13380± 630	9800± 330	10100± 450	8900± 500	11750± 400
	[O ii][c]	—	11350± 600	18500:[d]	10400± 470	9640± 550	7050± 400	—
	[S ii][e]	8100± 1400	11100± 800	—	9800± 650	6700±350	—	—
	[O iii]	8350± 230	11600± 280	10650± 230	9300± 180	9980± 220	6900± 150	11725± 300
	[S iii]	8630± 600	10720± 600	10370± 480	9000± 350	9620± 540	—	—
	[Ar iii]	—	10100± 370	9100± 750	8750± 530	9170± 430	—	11100± 700
	[Ar iv]	—	17000± 1300	13560± 1440	12700± 1700	—	—	—
	He i[f]	7320± 224	9200± 200	9880± 230	8420± 170	9000± 200	6250± 150	10600± 400
	He i[g]	7400± 1300	8450± 1700	8300± 950	6600± 950	8550± 1050	5850± 750	7450± 1000
	Paschen decrement	9800^{+4150}_{-2800}	9200^{+3600}_{-2300}	11350^{+5000}_{-3200}	8500^{+3250}_{-2050}	10300^{+4500}_{-2950}	5100^{+1300}_{-900}	8950^{+2900}_{-1900}

[a] Data from García-Rojas et al. (2009).
[b] Corrected for recombination contribution to [N ii] λ5755 line (see text).
[c] Corrected for recombination contribution to [O ii] $\lambda\lambda$7320+30 lines (see text).
[d] [O ii] $\lambda\lambda$7320+30 lines affected by telluric emission lines.
[e] [S ii] $\lambda\Lambda$4068.60, 4076.35 lines corrected for the contributions of O ii $\lambda\lambda$4069.62+4069.86 lines and/or C iii λ4067.94 line and/or O ii λ4075.86, respectively.
[f] T_e(He i) derived using the method developed by Peimbert et al. (2002).
[g] T_e(He i) derived using the method of Zhang et al. (2005).

emissivities as a function of the electron temperature for the nebular continuum and the H i Paschen lines were taken from Brown & Mathews (1970) and Storey & Hummer (1995), respectively. The finally adopted value of $T_e(Pac)$ is the average of those obtained using the different H i lines, neglecting those affected by atmospheric features. Errors were computed considering the H i line uncertainties and an error of ∼15% in the Paschen discontinuity determination, and propagating the error by means of an extinction correction; finally, we added quadratically the dispersion in the values obtained from different continuum-to-line ratios. Table 4 shows the T_e values derived from the H i Paschen decrement. Although T_e(Paschen decrement) are in relatively good agreement with T_e from other diagnostics, the errors are quite large.

4.2.2. Electron temperatures from helium lines

The He i recombination lines can be used as a diagnostic of electron temperature. Two approaches have been proposed for deriving T_e from these lines. In the first one, Peimbert et al. (2002) claimed that in the presence of temperature fluctuations in the ionized gas, the temperature in the zone where He i is present is a function of the temperatures in the O^+ and O^{++} zones and of the temperature fluctuation parameter, t^2. These authors pro-

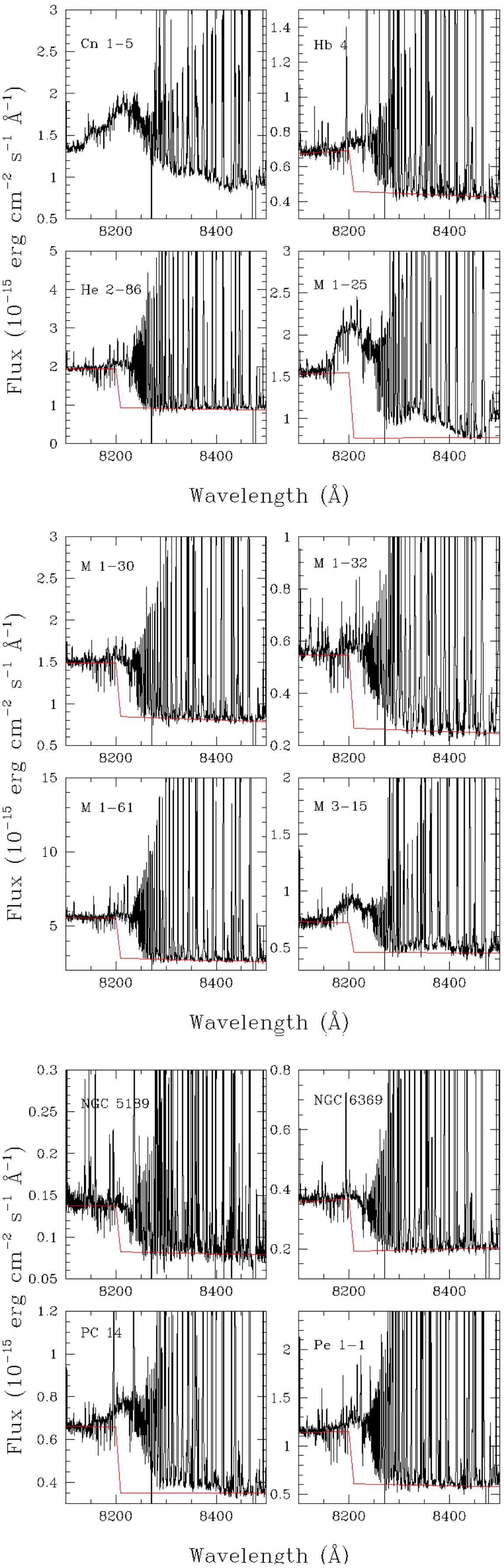

Fig. 4. Section of the echelle spectra showing the Paschen discontinuity in all the objects of our sample. In several objects, we can clearly see the wide stellar emission line that contaminates the spectrum in the blue part of the discontinuity

posed a maximum likelihood method to obtain simultaneously the n_e(He I), T_e(He I), He$^+$/H$^+$ ratio, and the optical depth of the He I λ3889 line. In a different approach, Zhang et al. (2005) used the analytic expressions of the emissivity of He I lines given by Benjamin et al. (1999) to compute the temperature-dependent He I singlet λ7281/λ6678 line ratio. A matter of concern about this method is that there might be a departure from case B to case A for the He I singlet lines by means of the destruction of He I Lyman photons by the photoionization of neutral hydrogen and/or the absorption by dust grains (Liu et al., 2001; Fang & Liu, 2011). Unfortunately, only tailored photoionization modelling constrained by multiwavelength data could quantitatively compute this effect.

In Table 4, we show $T_{\rm e}$(He I) for our objects, derived from the two methods. For the $T_{\rm e}$(He I) computed using the Peimbert et al. (2002) method, we assumed a temperature fluctuations parameter, t^2, given by the ADF(O^{++}) (see Paper II for more details about t^2 determinations) and a minimum of 11 He I lines were used. In Fig. 5, we show the comparison between T_e(H I) and T_e(He I) derived using both methods: the open circles correspond to values using the Zhang et al. (2005) method, and the black ones are the values derived with the Peimbert et al. (2002) procedure. In this figure, we have overplotted lines representing equality (t^2 = 0, solid line) and representing different values of t^2 (dashed lines). It is observed that, for our objects, the T_e(He I) derived from many lines (Peimbert et al. method) are in general higher (by up to 2-3 thousand degrees) than the values derived from Zhang et al. method. We decided to adopt the measurements obtained using the Peimbert et al. (2002) method, which, being based on the observation of several lines, more tightly constrains the temperature. It is not clear in this figure that the behaviour of our [WC]PNe corresponds to objects with a moderate t^2. Most of the objects, in particular the hotter ones, have a T_e(H I) that is higher than T_e(He I), in some cases by up to several thousand degrees. Similar results were obtained by Zhang et al. (2005) for their PN sample, which they interpreted as evidence of H-deficient knots in the plasma. However, our large uncertainties, mainly in the derived T_e(H I) for the hotter objects, cannot rule out an overall agreement with the predictions of the temperature fluctuations paradigm. We note that in our work, it is particularly difficult to properly determine T_e from H I discontinuities, owing to the wide emission stellar features that are clearly present in the continuum, thus causing large uncertainties.

4.2.3. Electron temperatures and densities from O II and N II recombination lines

The intensities of the ORLs, originating from states with different orbital angular momentum, have different dependences on $T_{\rm e}$. Thus, by comparing the intensity of an O II 3d − 4f transition to that of an O II 3s − 3p transition, it is possible to compute the electron temperature (Tsamis et al., 2004; Wesson et al., 2003). However, this method has its difficulties: first, the dependence of the intensity ratio on the temperature is very weak, so extremely high quality spectra are required to measure accurately these faint lines; second, the relative intensities of the O II lines can be affected by departures from the local thermodynamic equilibrium (LTE) in the fundamental recombination level of the O^{++} ion, ^3P. Tsamis et al. (2004) argued that the intensity ratio of the λ4089.29 O II 3d − 4f transition and the λ4649.14 O II 3p − 3s transition (of multiplet 1) was adequate to derive $T_{\rm e}$ because these lines originate from states of high total angular momentum, ^{3}P$_2$, and therefore must be affected in a

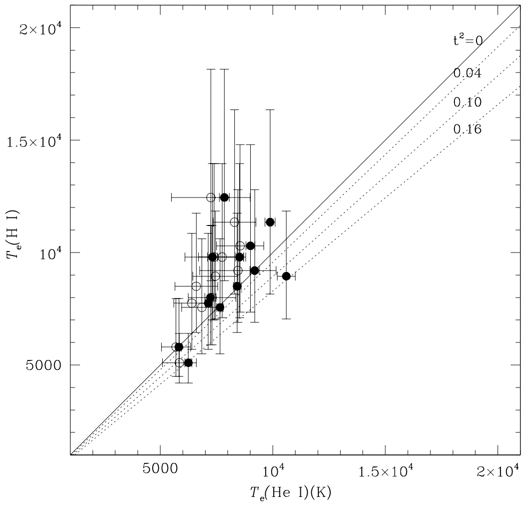

Fig. 5. T_e(He I) *vs.* T_e(H I) diagram. Two methods for deriving T_e(He I) have been used. One follows the method of Zhang et al. (2005), based on the line ratio λ7281/λ6678 (open circles). The other follows the Peimbert et al. (2002) procedure and computes T_e(He I) based on several He Ilines (black circles). Solid line represents equality (t^2=0), and dotted lines show the variation in T_e(H I) as a function of T_e(He I) considering different t^2 values.

similar way by this effect. Moreover, high densities (which is the case for most of our objects) also minimize this effect, which is negligible for $n_e > 10^4$ cm^{-3}.

The temperature-sensitive ratio $I(\lambda4089.29)/I(4649.14)$ was measured for the first time by Wesson et al. (2003) for Abell 30, to determine the T_e of the plasma in which O II recombination lines arise. These authors found very low T_e in two H-deficient knots in this PN. This method was later applied by several authors to other PNe, with similar results (e.g., Tsamis et al., 2004; Liu et al., 2004; Wesson et al., 2005). These results are consistent with a scenario in which there is a cold H-deficient component of the gas emitting the bulk of the O II lines and a "normal" gas component that emits the bulk of the CELs. Independently of the origin of this cold H-deficient component which, to this day, has not been resolved, this scenario provides an explanation to the abundance discrepancy. However, García-Rojas & Esteban (2007) measured this ratio in three H II regions with moderate ADFs, and did not find any evidence of this cold component. Our sample of [WC]PNe also have moderate values of the ADF, similar to the values found in H II regions (see Paper II). We checked the $I(\lambda4089.29)/I(4649.14)$ ratio for all our objects where the very faint O II λ4089.29 line was detected. In Table 5, we present the values of the T_e obtained from O II ORLs for our objects. These results are discussed later.

Recently, Fang et al. (2011) computed new effective recombination coefficients for the N II recombination spectrum, including radiative and dielectronic recombination. These authors found a set of recombination coefficients that allows us to construct density and temperature diagnostics based on the different dependences of the emissivities of different transitions on T_e and n_e. On the basis of their method, we computed electron temperature and density simultaneously using the *loci* of the recombination line ratios λ5679/λ5666 versus (*vs.*) λ5679/λ4041 of N II. The results are presented in Table 5. However, prior to discussing them, we note that several authors (Grandi, 1976; Escalante & Morisset, 2005) have claimed that resonance fluorescence coming from both the absorption of continuum or line photons, is necessary to reproduce the observed intensities of multiplet 3 N II lines. In particular, Grandi (1976) found that the resonance fluorescence of the $4s\ ^3P^0$ term by the recombination line He I $1s^2\ ^1S -^1 s8p\ ^1P^0$ was the dominant excitation mechanism, over starlight and recombination, for several multiplets of N II (including N II multiplet 3, i.e., λ5666 and λ5679 lines). Escalante & Morisset (2005) found that, in the Orion nebula, recombination contributed a minor part of the observed intensities of lines from $3p$ and $3d$ levels connected to the ground state (e.g. lines of multiplet 3), but that it was the dominant mechanism producing the intensity of lines coming from $4f$ levels (e.g. N II λ4041 line). These results suggest that we have to be careful when dealing with temperatures and abundances from N II lines, especially in low ionization PNe, where the potential effects of fluorescence on these lines would be stronger[2].

In Table 5, we show the physical conditions obtained from O II and N II permitted lines for the objects of our sample. In this table, objects are ordered from higher to lower ionization degree, i.e., from low to high potential influence of fluorescence in the N II lines. Owing to the large uncertainties in the faint O II λ4089 and N II λ4041 line fluxes of most objects, it makes no sense to calculate the single T_e and n_e values obtained from the measured line ratios, because they are several times beyond the validity range of the computed diagnostics. Instead, we show the upper or lower limits given by the error boxes in the diagrams and, additionally, we show in brackets the values obtained without considering the uncertainties. However, for some objects, we can compute T_e(O II) with the corresponding uncertainties. The values obtained from O II and N II diagnostics seem to show that the uncertainties in the measurement of the faint O II λ4089 and N II λ4041 lines dominate over any other effect, real or not, so it is really hard to conclude anything about the origin of the emission of O II and N II permitted lines. In addition, we did not find any systematic trend to very low temperatures similar to that found in other objects (Wesson et al., 2003, 2005). To illustrate the quality of these diagnostics, in Figure 6 we present O II λ4089 and N II λ4041 lines in the four PNe with the highest signal-to-noise ratios.

5. Discussion

The correct knowledge of chemical abundances in PNe is essential to constrain the different models of post-AGB evolution. The most accurate evaluation of these chemical abundances has several steps in which we have to make the right decisions to avoid errors that would lead us to incorrect conclusions. Adopting a correct set of plasma conditions for each ion is one of those fundamental steps that we discuss. In a forthcoming paper (Paper

[2] The recombination contribution to N II lines comes from the capture of a free electron to an excited level of N^{++} followed by a radiative transition, and dominates when the ionization degree is high, while the fluorescence contribution comes from the excitation of N^+ by fluorescence photons followed by a radiative transition, and could be very important in relatively low ionization PNe.

Table 5. Physical conditions derived from O II and N II recombination lines[a].

Object	T_e(O II) (K)	T_e(N II) (K)	n_e(N II) (cm^{-3})	log((
NGC 6369	—	—	—	
M 3-15	—	—	—	
PC 14	2900^{+7000}_{-2000}	< 6300 [2500]	>100 [1300]	
M 1-61	>5000 [> 10000]	> 3200[b]	>600[b]	
He 2-86	6200^{+4000}_{-2700}	> 7900 [11200]	>2000 [6300]	
Hb 4	—	> 4000[b]	>2000[b]	
Cn 1-5	$8500^{+>2000}_{-6700}$	> 1500 [12000]	<6500 [1600]	(
Pe 1-1	$10000^{+>2000}_{-8000}$	—	—	(
M 1-25	>5500 [> 10000]	>5000[b]	>600[b]	(
NGC 5189	—	<15800 [7100]	<4000 [650]	(
M 1-30	>6000 [> 10000]	>15800[b]	>1000[b]	–
M 1-32	—	—	—	–

[a] The T_e and n_e values shown in the table are upper or lower limits given by the error boxes in the diagrams. Additionally, we show in brackets the values obtained without considering the uncertainties.
[b] Line ratios (without errors) are out of range

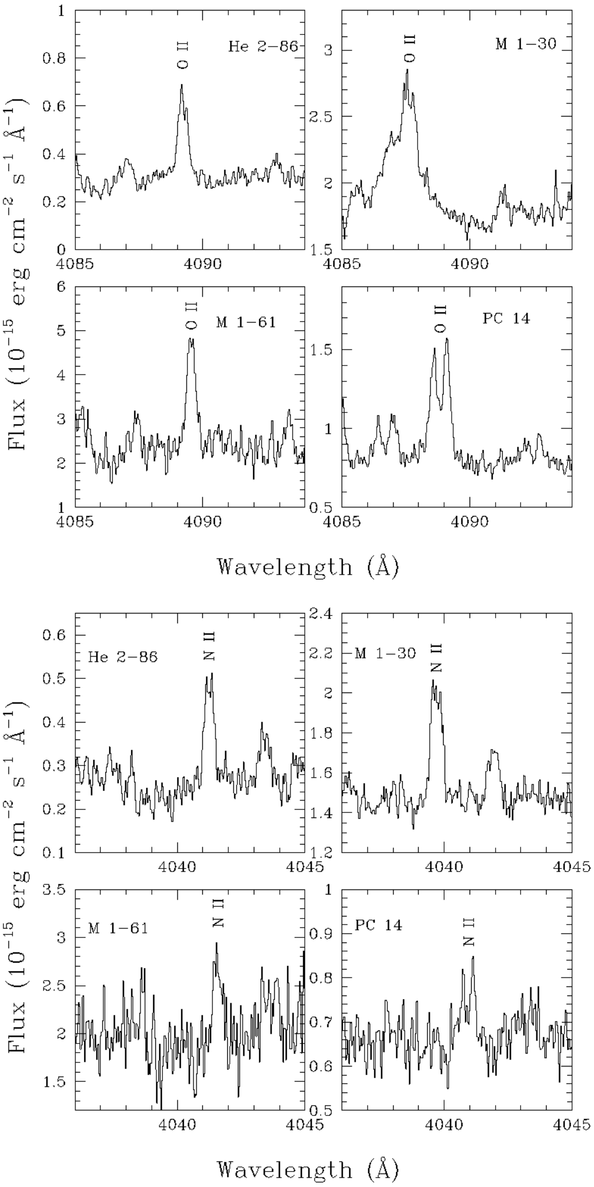

Fig. 6. Part of the spectrum of four objects in which the faint O II λ4089 (upper four panels) and N II λ4041 (lower four panels) lines were most reliably measured.

II), we will focus on whether ORLs or CELs are more reliable options for computing abundances and on the issue of ionization correction factors.

To obtain an overall picture of the physical conditions, we have constructed $T_e - n_e$ diagnostic plots for all our objects, making use of the software PYNEBULAR (Luridiana et al., 2011), an update of the IRAF package NEBULAR, rewritten in *Python*. These plots are shown in Fig. 7 where all the available diagnostic ratios for T_e and n_e, in each object, have been included. We note in these diagrams that in general, a good average solution for $T_e - n_e$ can be found for most of the objects. However, in several cases there are significant differences among the values of T_e and n_e derived from different diagnostic ions, which reflects the density and temperature structure inside the nebulae. We examine these differences in the following sections, to derive the most appropriate set of plasma conditions for the different nebular zones.

5.1. The densities

We derived densities from several diagnostic ratios of [S II], [O II], [Cl III], [Ar IV], and [Fe III]. Fig. 9 shows the behaviour of n_e([O II]) (blue triangles), n_e([S II]) (black circles), and n_e([Ar IV]) (red stars) *vs.* n_e([Cl III]). A correlation is observed in all the cases. For n_e([S II]) *vs.* n_e([Cl III]), the slope (in logarithm) is 0.93±0.05, and for n_e([O II]) the slope is about 0.69±0.05. For n_e([Ar IV]), the slope is 1.17±0.06. We find, in general, that n_e([Ar IV]) > n_e([Cl III]) > n_e([S II]) > n_e([O II]). However, the trend is not present in the objects Cn 1-5, Hb 4, NGC 5189, NGC 6369, and PC 14, for which we can adopt a density as the weighted average of all the computed density diagnostics. For the other objects, these density differences can be explained from two points of view. On the one hand, it is possible that a real and strong density stratification exists in these objects that has to be taken into account to properly compute the physical conditions and chemical abundances. On the other hand, we know that at densities higher than the critical density of the departure level, collisional de-excitation dominates over radiative de-excitation, suppressing part of the emission flux of the line; if this effect occurs for both lines of the density diagnostic, then the density derived would probably be lower than the real value. In the case of the [O II] λ3726/λ3729 ratio, the critical density is ~3500 cm^{-3} and for the [S II] λ6717/λ6731 ratio, it is about 3000 cm^{-3}, hence, in the presence of high density clumps in the the low ionization zone, these ratios would underestimate the real density. However, the [Cl III] λ5517/λ5537 and [Ar IV] λ4711/λ4740 line ratios are free of these effects owing to the high critical densities of the departure levels for, at least, one of the lines (> 4×10^4 cm^{-3}).

To decide which density should be adopted, other alternatives can be used. First, we could use [O II]$_{na}$ and [S II]$_{na}$ nebular to auroral line ratios, which in our density range are also density sensitive (see Fig. 7). However, these ratios should be treated with caution because they can be affected by telluric emisson lines in the case of [O II] $\lambda\lambda$ 7320+30 lines, or might be blended

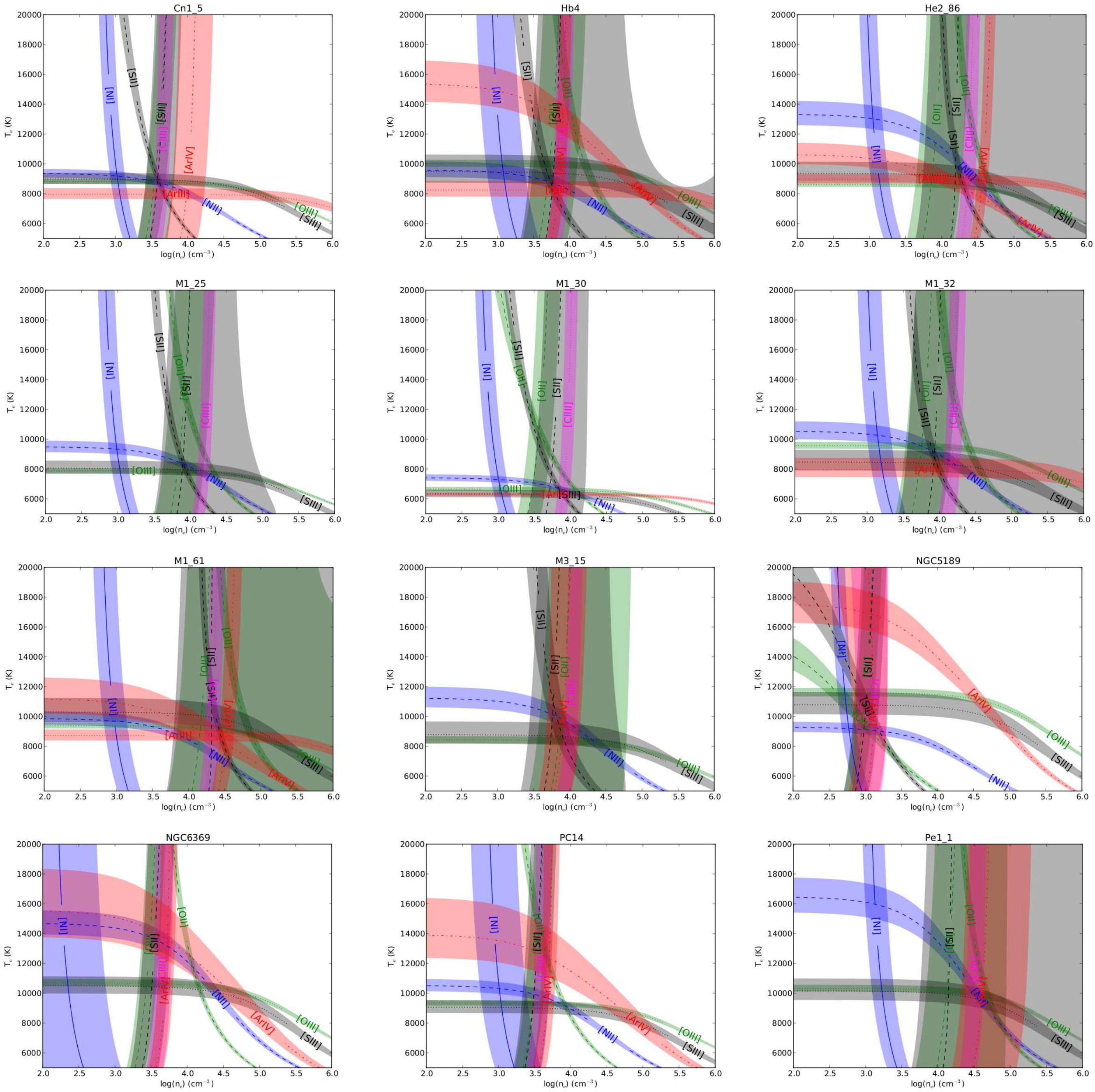

Fig. 7. $T_e - n_e$ diagnostic plots. Colors correspond to species: Grey for S, blue for N, green for O, magenta for Cl, and red for Ar. Different lines indicate ions: solid for neutral ions ([N I]), dashed for once ionized ions ([N II], [S II] and [S II]), dotted for two ionized ions ([O III], [S III], [Ar III], and [Cl III]), and dotted-dashed for three times ionized ions ([Ar IV]).

with other emission lines, in the case of [S II] $\lambda\lambda$4068+76 lines (see note [e] on Table 4). In Table 4, we show the densities obtained from the [O II]$_{na}$ and [S II]$_{na}$ ratios, which were computed by assuming that T_e([N II]) is representative of the low ionization zone. The values obtained are much larger than those obtained from the nebular ratios and are, in general, consistent with the values derived from the [Cl III] λ5517/λ5537 ratio. As said before, this suggests that the nebular [O II] and [S II] diagnostics are insensitive to any high density clumps in the nebula.

Second, we measured several [Fe III] lines in our spectra, which are very useful because their ratios provide very robust density diagnostics over a wider range in electron density (Keenan et al., 2001). We derived electron densities from the analysis of [Fe III] lines detected in several of our objects (Cn 1-5, He 2-86, M 1-25, M 1-32, M 1-61, and PC 14). In most of them, we observed at least four emission lines of the 2F and 3F multiplets, namely [Fe III] $\lambda\lambda$4658, 4701, 4734, and 4881. The density values of [Fe III], n_e([Fe III]), which are presented in Table 4, were calculated by computing the minimum dispersion between the observed and theoretical ratios of the [Fe III] lines with respect to the bright [Fe III] λ4658 line, considering the observational errors. The theoretical emissivites were calcu-

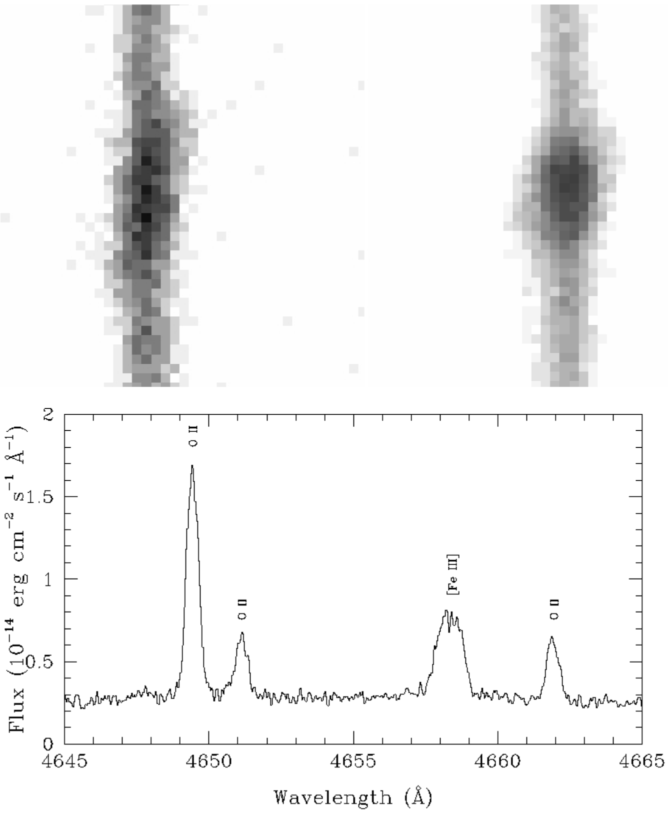

Fig. 8. Upper panel: Portion of the 2D echellogram showing [Fe III] λ5270 (left) and [Cl III] λ5517 lines for M1-61. The grey scale is the same for both lines. It is clear that the [Fe III] emission is more extended that [Cl III] emission. Lower panel: portion of the 1D extracted spectra showing the [Fe III] λ4658 line, compared with multiplet 1 O II ORLs. The FWHM of the [Fe III] line is clearly larger.

lated by solving a 34-level model atom that uses the collision strengths of Zhang (1996), the transition probabilities of Quinet (1996), combined with the probabilities of some UV transitions estimated by Johansson et al. (2000), and adopting T_e([N II]) as the temperature of the Fe^{++} zone. The n_e([Fe III]) values determined from this analysis are representative of the low-medium ionization zone, though their values seems to be more consistent with those determined from high density indicators such as [Cl III] and [Ar IV] line ratios. However, there is a clear exception to this rule: M 1-61, which has an extremely high n_e([Fe III]) of about 94000 cm^{-3}. We tested this value by computing the density after discarding various lines, but we reached similar values in all the cases. It is not the scope of this paper to investigate the origin of this discrepancy; however, after inspecting of the 2D echellograms (Fig. 8 upper panel) and the 1D spectra (Fig. 8 lower panel), one can easily see that the [Fe III] line structure is completely different than that of other CELs or ORLs, which indicates that [Fe III] emission originates from a different place in the PN than the other lines in the low and medium ionization zones. Hence, n_e([Fe III]) is no longer representative of the low-medium ionization zone of this nebula. Two [Fe III] lines were also detected in M 1-30 and Pe 1-1, but could not be used to perform this analysis.

Therefore, in agreement with the above discussion, for each object we adopted the densities that are summarized in Table 6.

Table 6. Adopted electron densities.

Object	n_e(low-medium) (cm^{-3})	n_e (high) (cm^{-3})
Cn 1-5	4000±600	10050±5700
Hb 4	6250±1050	6250±1050
He 2-86	23300±4350	35810±5990
M 1-25	15100±2600	15100±2600
M 1-30	8000±1000	8000±1000
M 1-32	15000±3300	15000±3300
M 1-61	22200±4500	35590±8070
M 3-15	8800±1400	8800±1400
NGC 5189	960±140	960±140
NGC 6369	3700±500	3700±500
PC 14	3550±450	3350±450
Pe 1-1	31100±7800	31100±7800

In Fig. 10, we present the behaviour of the adopted low-medium electron density *vs.* the [WC] spectral classification of the central star. This diagram has been constructed several times in the literature and it shows that [WC]-early stars are surrounded by lower density nebulae. Most of the [WC]-late nebulae have, in contrast, a quite high density. It can be concluded that [WC]-early PNe are more evolved objects than [WC]-late PNe, which appear younger from the point of view of the nebulae and the central star as well. This diagram and this conclusion have been used to propose that there is an evolutionary sequence from [WC]-late PNe to [WC]-early PNe (Acker & Neiner, 2003). However, this sequence has been questioned from the point of view of the chemical abundances calculated for the central stars, for which it is deduced that the mean C abundance in [WC]-early stars is a factor of two lower than the C abundance in [WC]-late stars, while an evolutionary sequence would predict the opposite. (Koesterke, 2001; Hamann et al., 2005). In Paper II, we will discuss this point further.

5.2. The temperatures

Given that the [O II] $\lambda\lambda$7320+30 and [S II] $\lambda\lambda$4068+76 lines are affected by telluric emission and blends with other lines, and that these ratios are also density sensitive, especially at the densities of most of the objects analysed here, we assumed that only T_e([N II]) is representative of the low ionization zone.

In Fig. 11, we compare the temperatures obtained from the high ionization diagnostic ratios T_e([O III]), T_e([S III]), and T_e([Ar III]). In this figure, the correlation between the [O III] and [S III] temperatures has a slope of 0.96±0.03, which is very close the unity, and a Spearman rank correlation coefficient (SRCC) of r=0.84. In Fig. 11, we can also see that the [Ar III] diagnostic ratios provide somewhat lower temperatures than [O III] ones. The slope is 0.75±0.02 and the SRCC is r=0.77. Given the similarity between these temperatures, we assumed T_e([O III]) is representative of the high ionization zone.

In general, temperatures derived from [O III] and [N II] diagnostics are similar, except in some cases where T_e([N II]) is higher than T_e([O III]) by as much as 3000 K. Only one object has a T_e([O III]) that is higher than T_e([N II]) by about 2000 K. In Fig. 12, we compare both temperatures, finding that they are only weakly correlated, with a slope of 0.69, but a SRCC of r=0.61. This weak correlation is mainly due to the cases mentioned before.

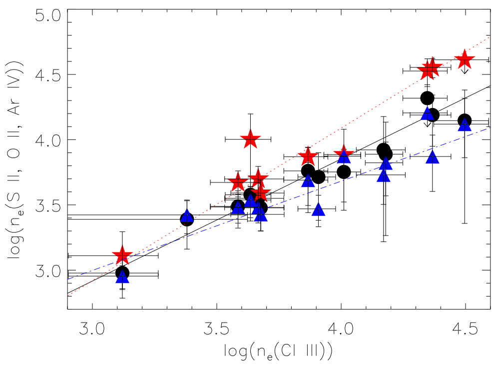

Fig. 9. Electron densities derived from [S ii] λλ6717/6730 (black filled circles), [O ii] λλ3726/3729 (blue triangles), and [Ar iv] λλ4711/4740 (red stars) compared to the one derived from [Cl iii] λλ5517/5537.There is a clear correlation between all quantities. The trend n_e([Ar iv]) > n_e([Cl iii]) > n_e([S ii]) > n_e([O ii]) is clear. Solid line represents the equality. Pointed, solid, and dashed lines are the fits to the n_e([Ar iv]), n_e([S ii]), and n_e([O ii]) *vs.* n_e([Cl iii]) data points, respectively.

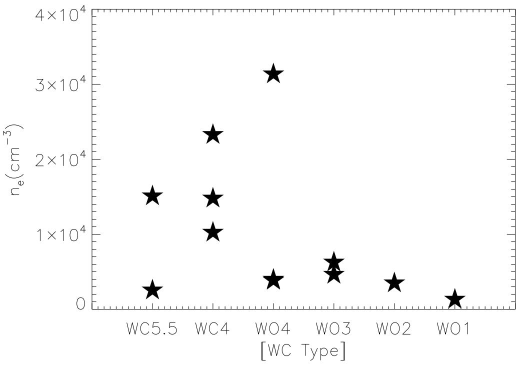

Fig. 10. n_e as a function of the [WC] type of the central star.

To analyse in greater depth the behaviour between the temperatures in the high and low ionization zones, we present, in Fig. 13, the electron temperature ratio T_e([O iii])/T_e([N ii]) *vs.* the ionization degree, represented by O^{++}/O^{+} for our sample (filled black triangles). In general, we find two regimes in this figure: one zone in the lower ionization regime, where T_e([O iii])/T_e([N ii]) is about one, and a second zone where O^{++}/O^{+} is larger than 10 and T_e([O iii])/T_e([N ii]) drops. In this zone, we find objects for which T_e([N ii]) is higher than T_e([O iii]). To verify that this effect (already described for the sample analysed by Peña et al., 2001) is not due to biases introduced by the incompleteness of our particular sample of [WC]PNe, we overplotted in Fig. 13 the data for [WR]PNe by Peña et al. (2001), and the data for bulge PNe by Górny et al. (2004). The trend is clear for all the samples.

This behaviour of T_e([N ii]) being higher than T_e([O iii]) is often found in photoionized nebulae, and is due to radiation hardening, i. e. the lower absorption probability of more energetic photons, which causes these photons to have longer mean free paths and to remain unabsorbed until the edge of the Strömgren sphere. Peña et al. (2001) found, from simple photoionization models at metallicities around solar, that the behaviour predicted by the models is mild, dependent on T_*, not as extreme as the one found here, and, in adition, not dependent on the excitation of the PNe. Peña et al. (2001) proposed as a possible origin of this behaviour a strong inhomogeneous structure, or additional heating by shocks and/or turbulence. Hence, to properly constrain the problem, we calculated a more complete grid of photoionization models.

5.3. Photoionization modelling

A grid of photoionization models was computed using Cloudy c10.00 code (Ferland et al., 1998). The grid covers the parameter space [lower value, higher value, steps] of T_{eff} (kK) = [50, 150, 10], *log* (O/H) = [-3.5, -3.0, 0.25], *log* (R_{in}) (cm) = [15.5, 18, 0.5], *log* (H-density) (cm-3) = [2.5, 4.5, 0.25], and *log* ($L/L_{\odot}$) = [2.5, 3.5, 0.5]. A total of about 5000 models were then run, using atmosphere models from Rauch (2003) for the ionizing spectral energy distribution, constant density shells, and metal abundances following the O/H ratio. The models are radiation bounded and dust-free. The mean values of the ionic fractions and temperatures were obtained by integrating these variables over the volume of the nebula. The results of the models are presented in Figure 14, with the observations superimposed as square symbols. The color code is related to the O/H abundance and is the same for the models and the observations. For the objects, the O/H abundance is that computed for the adopted physical conditions in each object and will be presented and discussed in Paper II.

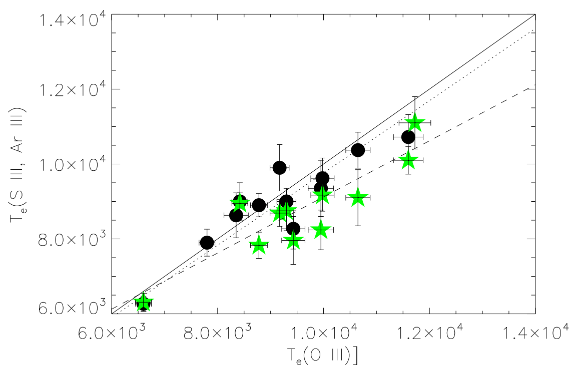

Fig. 11. Comparison between high ionization T_e diagnostics. Black dots: T_e([S III]); green stars: T_e([Ar III]). A very good correlation T_e([O III]) vs. T_e([S III]) is found. Solid line represent an equality.

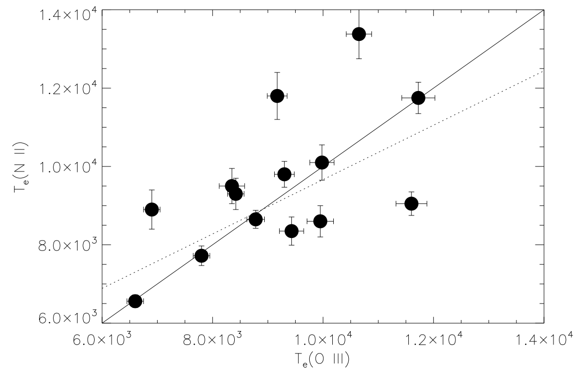

Fig. 12. Comparison between T_e([O III]) and T_e([N II]). Solid line represent equality. Pointed line is the fit to the data.

The models, which are radiation-bounded (R), do not reach values larger than 10 for O^{++}/O^{+} and do not reproduce the trend of the observed values.

We then computed matter-bounded models (M), where the geometrical size of the nebula is set to 70% of the Strömgren size for which, theoretically, we can successfully reach any high O^{++}/O^{+} value, as the size of the O^{+} region can be reduced to values close to 0. Real nebulae may be a combination of matter- and radiation-bounded components. They can thus reach higher values of O^{++}/O^{+} than the pure R nebulae shown in Fig. 14. However, for any realistic combination of M and R models, no changes in the values of $T_e(O^{++})/T_e(N^{+})$ are expected relative to the R models, as the O^{++} temperature is the same in both models and the N^{+} temperature is the one from the R models (N^{+} is negligible in the M models). It is interesting to notice that the smallest values for $T_e(O^{++})/T_e(N^{+})$ are obtained with high metallicity models (*log* (O/H) ~ 9.0), but the observed nebulae are not so metal-rich. We note however, that the models are relatively simple, and that, for example, for each model the density is constant within the nebula and all metal abundances follow that of oxygen. We have to bear in mind that real objects are more complex but our simple approximation seems to succesfully reproduce the observed behaviour.

6. Conclusions

We have presented deep high-resolution spectrophotometric data of 12 PNe with [WC] central star, obtained at LCO with the 6.5-m Magellan telescope and the spectrograph MIKE. Data were reduced, wavelength- and flux-calibrated and dereddened. Hundreds of lines were detected and identified for each object, and their fluxes were measured. These [WR]PNe, together with the three objects analysed by García-Rojas et al. (2009) represent the most extensive sample of this type of PNe analysed so far, at such high resolution. The spectra were exposed deep enough to detect, with a signal-to-noise ratio higher than ~3, the weak ORLs of O II, C II, and other species.

From our deep spectra, which cover a wide wavelength range (from 3350 Å to 9400 Å), numerous diagnostic line ratios for T_e and n_e were determined, from CELs and ORLs as well. In addition, H discontinuities (H Paschen discontinuity in particular) were measured for this purpose. All known recombinations effects that could perturb the CEL diagnostic ratios were careful removed. In addition, the possible mechanisms perturbing ORLs, such as fluorescence, departures from LTE and others, were considered.

Our main aim in this paper is to determine the optimal physical conditions in the nebulae, for the accurate calculation of ionic abundances. We have performed a careful analysis of all our available T_e and n_e and their errors to ascertain these conditions.

The conditions derived from CEL diagnostic ratios allow us to conclude the following:

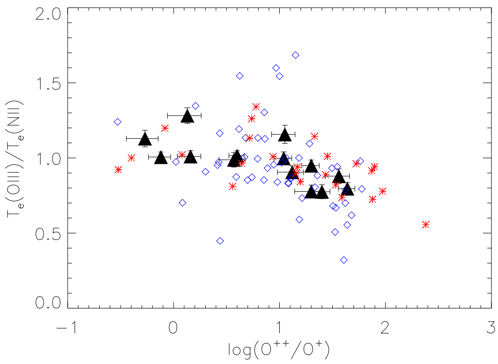

Fig. 13. T_e([O III])/T_e([N II]) vs.O^{++}/O^{+}. Black triangles: our data; red asterisks: Peña et al. (2001); blue open diamonds: Górny et al. (2004) data for bulge PNe

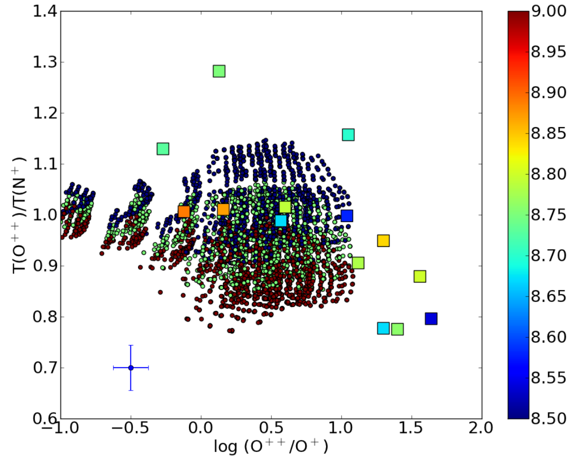

Fig. 14. Photoionization models computed to reproduce the observed T_e([O III])/T_e([N II]) *vs.* O^{++}/O^{+} behaviour. Models (circles) and observational data (squares) are colored according to the O/H value. At the lower left, we show the typical error bars for the observational data.

- The CEL diagnostic ratios usually used to determine n_e, [S II]λ6730/λ6717, and [O II]λ3726/λ3729 seem to underestimate the true nebular densities owing to their low critical densities. This occurs particularly for the densest objects of our sample. Therefore, for these objects, we decided to use the density derived from the [Cl III]λ5517/λ5537 line ratio as a representative value of the whole nebula, which agrees with density determinations using [Fe III] lines and the densities computed from the highly density-sensitive [O II]$_{na}$ and [S II]$_{na}$ line ratios.
- Temperature-sensitive CEL ratios were corrected for the effects of recombination. In some cases, these effects can severely affect (up to several thousand degrees) the T_e determinations. Finally, we adopted a three-temperature scheme for the nebulae: T_e([Ar IV]) is used to represent the highest ionization zone, when available, T_e([O III]) is used to represent the high ionization zone, and T_e([N II]) represent the low-ionization zone.

These physical conditions are used in Paper II to determine ionic abundances from CEL lines.

A careful analysis to determine the physical conditions from ORL diagnostic lines was also performed, with the following results:

- Electron temperatures were derived from the Paschen discontinuity relative to several Paschen recombination lines. Although the derived values of T_e agree with T_e obtained from other mechanisms, the errors are quite large because of the stellar emission lines near the Paschen jump. We also derived T_e from several He lines by considering two different approaches: that of Peimbert et al. (2005) who consider several He I lines and a t^2 parameter, and that of Zhang et al. (2005), based on the ratio of two He I lines. In both cases, we found that T_e(He I) appears to be lower than T_e(H I), although the effect is smaller when a t^2 value is considered. However, the errors are so large (for H I in particular) that no conclusive results can be extracted.
- Electron temperatures were also computed from O II and N II recombination lines, as proposed in several papers in the literature (Wesson et al., 2003, 2005; Fang & Liu, 2011). However, different authors have indicated that some effects, such as fluorescence and departures from LTE, could be perturbing these lines. We conclude that, despite our deep high-resolution data, the uncertainties in the measurements of these faint lines dominate over any other effect and we cannot conclude anything about the origin of these recombination lines.

Other phenomena such as the behaviour of density as a function of the [WC] spectral type and the electron temperatures as a function of the nebular ionization degree have been investigated. We have confirmed that PNe around [WC]-early stars are evolved nebulae, while those around [WC]-late stars are young, a result already reported in the literature. We have analysed the behaviour of the temperatures found by Peña et al. (2001) of an unusually small T_e([O III])/T_e([N II]) when O^{++}/O^{+} is larger than 10. An ample grid of photoionization models was computed with this aim. We have found that models could reproduce this behaviour (shown in Fig. 14) if a combination of matter-bounded and radiation-bounded models are considered, but for the lowest $T_e(O^{++})/T_e(N^{+})$ ratio, a too high metallicity seem required.

The second part of this work, including ADF calculations and ionic and total abundances for the nebulae, will be presented elsewhere (García-Rojas et al., Paper II, in preparation).

Acknowledgements. This work received financial support from the Ministerio de Educación y Ciencia (MEC) Español, under project AYA2007-63030; from

CONACYT-México under grant #43121 and from DGAPA-UNAM, México under grants IN118405, IN112708 and IN105511. JGR acknowledges people and staff of Instituto de Astronomía at UNAM, where part of this work were done. CM received financial support for his Sabbatical at the IAC from the Spanish MEC. The authors want to thank Mónica Rodríguez, Grazyna Stasińska, Antonio Peimbert, Manuel Peimbert and César Esteban for very fruitful discussions.

References

Acker, A. & Neiner, C. 2003, A&A, 403, 659
Allen, C., Carigi, L., & Peimbert, M. 1998, ApJ, 494, 247
Benjamin, R. A., Skillman, E. D., & Smits, D. P. 1999, ApJ, 514, 307
Brown, R. L. & Mathews, W. G. 1970, ApJ, 160, 939
DePew, K., Parker, Q. A., Miszalski, B., et al. 2011, MNRAS
Escalante, V. & Morisset, C. 2005, MNRAS, 361, 813
Esteban, C., Peimbert, M., García-Rojas, J., et al. 2004, MNRAS, 355, 229
Fang, X. & Liu, X.-W. 2011, MNRAS, 415, 181
Fang, X., Storey, P. J., & Liu, X.-W. 2011, A&A, 530, A18+
Ferland, G. J., Korista, K. T., Verner, D. A., et al. 1998, PASP, 110, 761
García-Rojas, J. & Esteban, C. 2007, ApJ, 670, 457
García-Rojas, J., Esteban, C., Peimbert, M., et al. 2004, ApJS, 153, 501
García-Rojas, J., Peña, M., & Peimbert, A. 2009, A&A, 496, 139
Girard, P., Köppen, J., & Acker, A. 2007, A&A, 463, 265
Górny, S. K., Chiappini, C., Stasińska, G., & Cuisinier, F. 2009, A&A, 500, 1089
Górny, S. K., Stasińska, G., Escudero, A. V., & Costa, R. D. D. 2004, A&A, 427, 231
Grandi, S. A. 1976, ApJ, 206, 658
Hamann, W.-R., Todt, H., & Gräfener, G. 2005, in Planetary Nebulae as Astronomical Tools. American Institute of Physics Conference Series, ed. R. Szczerba, G. Stasińska, & S. K. Gorny, Vol. 804, 153
Johansson, S., Zethson, T., Hartman, H., et al. 2000, A&A, 361, 977
Keenan, F. P., Aller, L. H., Ryans, R. S. I., & Hyung, S. 2001, Proceedings of the National Academy of Science, 98, 9476
Kingsburgh, R. L. & Barlow, M. J. 1994, MNRAS, 271, 257
Koesterke, L. 2001, Ap&SS, 275, 41
Koesterke, L. & Hamann, W.-R. 1997, in IAU Symp. 180: Planetary Nebulae, ed. H. J. Habing & H. J. G. L. M. Lamers, Vol. 180, 114
Leuenhagen, U., Hamann, W.-R., & Jeffery, C. S. 1996, A&A, 312, 167
Liu, X.-W., Barlow, M. J., Zhang, Y., Bastin, R. J., & Storey, P. J. 2006, MNRAS, 368, 1959
Liu, X.-W., Luo, S.-G., Barlow, M. J., Danziger, I. J., & Storey, P. J. 2001, MNRAS, 327, 141
Liu, X.-W., Storey, P. J., Barlow, M. J., et al. 2000, MNRAS, 312, 585
Liu, Y., Liu, X.-W., Luo, S.-G., & Barlow, M. J. 2004, MNRAS, 353, 1231
Luridiana, V., Shaw, R. A., & Morisset, C. 2011, in IAU Symp. 283, Planetary Nebulae: An Eye to the Future (Cambridge University Press), ed. A. Manchado & L. Stanghellini
Mesa-Delgado, A., Esteban, C., García-Rojas, J., et al. 2009, MNRAS, 395, 855
Oke, J. B. 1990, AJ, 99, 1621
Peña, M., Stasińska, G., & Medina, S. 2001, A&A, 367, 983
Peimbert, A., Peimbert, M., & Luridiana, V. 2002, ApJ, 565, 668
Peimbert, A., Peimbert, M., & Ruiz, M. T. 2005, ApJ, 634, 1056
Quinet, P. 1996, A&AS, 116, 573
Rauch, T. 2003, A&A, 403, 709
Seaton, M. J. 1979, MNRAS, 187, 73P
Sharpee, B., Baldwin, J. A., & Williams, R. 2004, ApJ, 615, 323
Shaw, R. A. & Dufour, R. J. 1995, PASP, 107, 896
Storey, P. J. & Hummer, D. G. 1995, MNRAS, 272, 41
Tayal, S. S. & Zatsarinny, O. 2010, ApJS, 188, 32
Todt, H., Peña, M., Hamann, W.-R., & Gräfener, G. 2010, A&A, 515, A83+
Tsamis, Y. G., Barlow, M. J., Liu, X.-W., Storey, P. J., & Danziger, I. J. 2004, MNRAS, 353, 953
Tylenda, R., Acker, A., & Stenholm, B. 1993, A&AS, 102, 595
Tylenda, R. & Stasińska, G. 1994, A&A, 288, 897
Werner, K. & Herwig, F. 2006, PASP, 118, 183
Wesson, R., Liu, X.-W., & Barlow, M. J. 2003, MNRAS, 340, 253
Wesson, R., Liu, X.-W., & Barlow, M. J. 2005, MNRAS, 362, 424
Zhang, C. Y. & Kwok, S. 1993, ApJS, 88, 137
Zhang, H. 1996, A&AS, 119, 523
Zhang, Y., Liu, X.-W., Liu, Y., & Rubin, R. H. 2005, MNRAS, 358, 457

Table 7. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			Cn 1-5					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3447.59	He I	7	3447.24	-30.45	0.286	0.441	16	
3478.97	He I	43	3478.76	-18.09	0.169	0.257	23	
3487.73	He I	42	3487.44	-24.93	0.106	0.161	33	
3512.51	He I	38	3512.17	-29.03	0.225	0.338	18	
3530.50	He I	36	3530.15	-29.73	0.202	0.302	20	
3554.42	He I	34	3554.05	-31.20	0.232	0.343	18	
3587.28	He I	32	3586.89	-32.61	0.350	0.512	13	
3613.64	He I	6	3613.26	-31.52	0.363	0.525	13	
3634.25	He I	28	3633.85	-32.99	0.484	0.696	11	
3669.47	H I	H25	3669.07	-32.68	0.352	0.500	13	
3671.48	H I	H24	3671.07	-33.47	0.399	0.567	12	
3673.76	H I	H23	3673.34	-34.27	0.452	0.641	11	
3676.37	H I	H22	3675.97	-32.63	0.518	0.733	10	
3679.36	H I	H21	3678.94	-34.24	0.492	0.696	11	
3682.81	H I	H20	3682.48	-26.87	0.636	0.898	9	
3686.83	H I	H19	3686.46	-30.10	0.586	0.827	10	
3691.56	H I	H18	3691.17	-31.69	0.606	0.854	10	
3694.22	Ne II	1	3693.80	-34.08	0.124	0.175	29	
3697.15	H I	H17	3696.75	-32.43	0.745	1.047	9	
3703.86	H I	H16	3703.47	-31.58	0.914	1.279	8	
3705.04	He I	25	3704.63	-33.19	0.740	1.036	9	
3711.97	H I	H15	3711.60	-29.88	1.063	1.485	7	
3721.83	[S III]	2F	3721.42	-33.04	2.386	3.321	6	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3725.62	-32.98	51.615	71.752	6	
3728.82	[O II]	1F	3728.37	-36.18	25.956	36.053	6	
3734.37	H I	H13	3733.97	-32.13	1.610	2.233	7	
3750.15	H I	H12	3749.72	-34.37	2.195	3.029	6	
3770.63	H I	H11	3770.22	-32.59	2.675	3.669	6	
3797.63	[S III]	2F	3797.48	-11.83	3.834	5.217	6	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.24	-29.05	1.317	1.781	7	
3835.39	H I	H9	3834.97	-32.83	5.738	7.725	6	
3862.59	Si II	1	3861.97	-48.14	0.061	0.082	:	
3868.75	[Ne III]	1F	3868.33	-32.54	71.411	95.248	6	
3871.82	He I	60	3871.35	-36.39	0.086	0.115	39	
3888.65	He I	2	3888.42	-17.73	17.195	22.809	6	
3889.05	H I	H8	*	*	*	*	*	
3918.98	C II	4	3918.52	-35.19	0.050	0.066	:	
3920.68	C II	4	3920.32	-27.52	0.096	0.126	36	
3926.53	He I	58	3926.13	-30.55	0.155	0.203	24	
3964.73	He I	5	3964.31	-31.76	0.780	1.014	8	
3967.46	[Ne III]	1F	3967.02	-33.25	22.439	29.139	6	
3970.07	H I	H7	3969.64	-32.49	12.197	15.827	6	
3994.98	N II	12	3994.62	-27.01	0.046	0.059	:	
4009.26	He I	55	4008.78	-35.89	0.233	0.299	18	
4023.98	He I	54	4023.55	-32.03	0.046	0.058	:	
4026.21	He I	18	4025.78	-32.02	2.665	3.402	6	
4041.31	N II	39	4040.99	-23.75	0.060	0.076	:	
4068.60	[S II]	1F	4068.17	-31.70	4.400	5.546	6	
4069.62	O II	10	*	*	*	*	*	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4071.77	-27.97	0.170	0.214	23	
4075.86	O II	10	4075.88	-34.59	1.688	2.122	6	
4076.35	[S II]	1F	*	*	*	*	*	
4078.84	O II	10	4078.52	-23.53	0.039	0.049	:	
4089.29	O II	48	4088.85	-32.26	0.067	0.084	:	
4097.22	O II	20	4096.90	-23.44	0.490	0.612	10	

Table 7. continued.

			Cn 1-5					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4097.26	O II	48	*	*	*	*	*	
4101.74	H I	H6	4101.30	-32.19	20.362	25.407	5	
4104.99	O II	20	*	*	*	*	*	
4110.79	O II	20	4110.33	-33.55	0.032	0.040	:	
4119.22	O II	20	4120.42	-29.10	0.264	0.328	16	
4120.82	He I	16	*	*	*	*	*	
4132.80	O II	19	4132.32	-34.82	0.064	0.079	:	
4143.76	He I	53	4143.32	-31.83	0.387	0.477	12	
4153.30	O II	19	4152.87	-31.02	0.077	0.095	:	
4156.53	O II	19	4156.03	-36.07	0.051	0.063	:	
4168.97	He I	52	4168.69	-20.16	0.062	0.076	:	
4185.45	O II	36	4185.07	-27.25	0.046	0.056	:	
4189.79	O II	36	4189.30	-35.08	0.047	0.057	:	
4219.76	Ne II	52	4219.39	-26.26	0.026	0.031	:	
4236.91	N II	48	4236.50	-29.02	0.050	0.060	:	
4237.05	N II	48	*	*	*	*	*	
4241.78	N II	48	4241.37	-28.96	0.048	0.058	:	
4243.97	[Fe II]	21F	4243.54	-30.39	0.034	0.041	:	
4253.90	O II	109	4253.42	-33.83	0.041	0.049	:	
4253.91	O II	109	*	*	*	*	*	
4267.15	C II	6	4266.71	-30.91	1.162	1.395	7	
4275.55	O II	67	4275.75	14.04	0.084	0.101	:	
4276.75	O II	67	*	*	*	*	*	
4276.83	[Fe II]	21F	*	*	*	*	*	
4287.39	[Fe II]	7F	4287.47	5.60	0.077	0.092	:	d
4294.78	S II	49	4294.47	-31.39	0.028	0.034	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4303.33	-19.49	0.047	0.057	:	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4316.72	-29.16	0.043	0.051	:	
4319.63	O II	2	4319.10	-36.77	0.030	0.036	:	
4340.47	H I	H5	4340.01	-31.81	40.806	48.200	5	
4345.55	O II	65	4345.13	-29.68	0.073	0.087	:	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4348.98	-31.03	0.087	0.103	39	
4363.21	[O III]	2F	4362.72	-33.65	3.060	3.592	6	
4366.89	O II	2	4366.48	-28.16	0.061	0.072	:	
4387.93	He I	51	4387.48	-30.76	0.752	0.876	8	
4391.94	Ne II	55e	4391.52	-28.67	0.047	0.054	:	
4409.30	Ne II	55e	4408.81	-33.30	0.041	0.048	:	
4416.97	O II	5	4416.49	-32.58	0.046	0.053	:	
4437.55	He I	50	4437.17	-25.67	0.075	0.085	:	
4465.41	O II	94	4465.17	-16.13	0.021	0.024	:	
4471.47	He I	14	4471.02	-30.19	6.308	7.140	5	
4491.23	O II	86a	4490.96	-18.03	0.032	0.036	:	
4530.41	N II	58b	4529.84	-37.74	0.028	0.031	:	
4562.60	Mg I]	1	4562.10	-32.86	0.085	0.093	:	
4571.10	Mg I]	1	4570.61	-32.16	0.287	0.314	15	
4590.97	O II	15	4590.39	-37.88	0.045	0.049	:	
4595.95	O II	15	4595.68	-17.61	0.042	0.046	:	
4596.18	O II	15	*	*	*	*	*	
4601.48	N II	5	4601.06	-27.36	0.077	0.084	:	
4607.13	[Fe III]	3F	4606.69	-28.63	0.101	0.109	35	
4607.16	N II	5	*	*	*	*	*	
4621.39	N II	5	4621.05	-22.08	0.048	0.051	:	
4630.54	N II	5	4630.12	-27.19	0.157	0.168	24	
4634.14	N III	2	4633.76	-24.61	0.282	0.302	15	
4638.86	O II	1	4638.37	-31.65	0.067	0.071	:	
4640.64	N III	2	4640.40	-15.52	0.428	0.458	11	

Table 7. continued.

			Cn 1-5					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4649.13	O II	1	4648.62	-32.88	0.295	0.315	15	
4650.84	O II	1	4650.41	-27.70	0.055	0.059	:	
4658.05	[Fe III]	3F	4657.72	-21.21	1.046	1.114	7	
4661.63	O II	1	4661.13	-32.16	0.136	0.144	27	
4676.24	O II	1	4675.67	-36.57	0.119	0.126	30	
4701.62	[Fe III]	3F	4701.13	-31.26	0.354	0.372	13	
4711.37	[Ar IV]	1F	4710.79	-36.92	0.185	0.193	21	
4713.14	He I	12	4712.69	-28.64	0.731	0.766	8	
4733.93	[Fe III]	3F	4733.39	-34.20	0.156	0.162	24	
4740.17	[Ar IV]	1F	4739.75	-26.56	0.308	0.320	14	
4754.69	[Fe III]	3F	4754.35	-21.43	0.234	0.242	17	
4769.43	[Fe III]	3F	4769.00	-27.04	0.117	0.120	31	
4777.68	[Fe III]	3F	4777.26	-26.38	0.071	0.073	:	
4814.55	[Fe II]	20F	4814.10	-28.00	0.029	0.029	:	
4861.33	H I	H4	4860.84	-30.24	100.000	100.000	5	
4881.00	[Fe III]	2F	4880.56	-27.02	0.546	0.543	10	
4921.93	He I	48	4921.45	-29.24	1.838	1.804	6	
4924.53	O II	28	4924.13	-24.35	0.049	0.048	:	
4931.32	[O III]	1F	4930.77	-33.43	0.077	0.076	:	
4958.91	[O III]	1F	4958.38	-32.06	291.917	283.291	5	
4987.20	[Fe III]	2F	4986.86	-20.46	0.122	0.117	30	
4987.38	N II	24	*	*	*	*	*	
4994.37	N II	24	4993.87	-30.02	0.090	0.086	38	
5001.13	N II	19	5000.90	-13.79	0.123	0.118	29	
5001.47	N II	19	*	*	*	*	*	
5006.84	[O III]	1F	5006.34	-29.94	892.977	854.452	5	
5015.68	He I	4	5015.18	-29.89	3.031	2.893	9	
5041.03	Si II	5	5040.68	-20.79	0.240	0.227	9	
5045.10	N II	4	5044.56	-32.09	0.115	0.109	15	
5047.74	He I	47	5047.25	-29.12	0.296	0.280	8	
5055.98	Si II	5	5055.54	-26.09	0.134	0.126	14	
5121.82	C II	12	5121.26	-32.79	0.060	0.055	25	
5158.81	[Fe II]	19F	5158.31	-29.06	0.252	0.231	9	
5191.82	[Ar III]	3F	5191.17	-37.53	0.124	0.113	14	
5197.90	[N I]	1F	5197.34	-32.31	1.726	1.570	5	
5200.26	[N I]	1F	5199.69	-32.85	1.217	1.106	6	
5261.61	[Fe II]	19F	5260.83	-44.44	0.062	0.056	24	
5270.40	[Fe III]	1F	5270.01	-22.19	0.765	0.682	6	
5342.38	C II	17.06	5341.64	-41.52	0.113	0.099	15	
5363.65	[Ni IV]	4F-2G	5363.23	-23.47	0.045	0.039	31	
5412.00	[Fe III]	1F	5411.58	-23.26	0.095	0.082	17	
5495.82	[Fe II]	17F	5495.11	-38.73	0.080	0.067	20	
5495.98	N II	29	*	*	*	*	*	
5517.71	[Cl III]	1F	5517.21	-27.17	1.207	1.009	6	
5537.88	[Cl III]	1F	5537.30	-31.41	1.480	1.230	6	
5551.95	N II	63	5551.22	-39.42	0.055	0.046	26	
5577.34	[O I]	3F	5576.84	-26.88	0.767	0.631	6	c
5666.64	N II	3	5666.08	-29.63	0.161	0.129	12	
5676.02	N II	3	5675.48	-28.53	0.063	0.050	24	
5679.56	N II	3	5679.02	-28.51	0.272	0.217	9	
5686.21	N II	3	5685.90	-16.35	0.054	0.043	27	
5710.76	N II	3	5710.18	-30.43	0.046	0.037	30	
5754.64	[N II]	3F	5754.02	-32.31	5.273	4.122	6	
5875.64	He I	11	5875.08	-28.58	29.166	22.070	6	
5906.15	Si I	—	5905.70	-22.83	0.060	0.045	25	
5931.78	N II	28	5931.17	-30.83	0.033	0.024	:	
5941.65	N II	28	5940.95	-35.31	0.047	0.035	30	
6000.20	[Ni III]	2F	5999.74	-22.98	0.026	0.019	:	
6151.43	C II	16.04	6150.70	-35.58	0.082	0.058	20	

Table 7. continued.

			Cn 1-5					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
6300.30	[O I]	1F	6299.63	-31.88	11.320	7.839	6	
6312.10	[S III]	3F	6311.47	-29.92	3.675	2.539	6	
6347.11	Si II	2	6346.50	-28.81	0.141	0.097	14	
6363.78	[O I]	1F	6363.09	-32.51	3.780	2.586	6	
6371.36	Si II	2	6370.75	-28.70	0.126	0.086	15	
6461.95	C II	17.04	6461.19	-35.27	0.152	0.102	13	e
6527.10	[N II]	1F	6526.61	-22.52	0.107	0.071	16	
6533.99	[Ni III]	2F	6532.67	-60.59	0.104	0.069	17	c
6548.03	[N II]	1F	6547.39	-29.29	174.733	115.480	6	
6562.82	H I	H3	6562.09	-33.35	439.743	289.867	6	
6578.05	C II	2	6577.32	-33.27	0.928	0.610	7	
6583.41	[N II]	1F	6582.68	-33.25	539.538	354.365	6	
6678.15	He I	46	6677.50	-29.18	8.888	5.744	6	
6716.47	[S II]	2F	6715.75	-32.15	23.058	14.811	6	
6730.85	[S II]	2F	6730.13	-32.08	40.597	26.017	6	
6895.10	O II	4F-4D	6894.37	-31.74	0.053	0.033	28	
6906.44	O II	4F-4D	6906.08	-15.62	0.027	0.017	:	
6915.20	[Cr IV]	4F-2G	6915.14	-2.60	0.029	0.018	:	
7001.92	O I	21	7001.38	-23.12	0.045	0.028	31	
7002.23	O I	21	*	*	*	*	*	
7065.28	He I	10	7064.56	-30.54	9.910	6.046	7	
7135.78	[Ar III]	1F	7135.11	-28.15	53.816	32.521	7	
7155.16	[Fe II]	14F	7154.37	-33.11	0.388	0.234	9	
7160.61	He I	1/10	7159.91	-29.30	0.065	0.039	24	
7172.00	[Fe II]	14F	7171.05	-39.72	0.095	0.057	18	
7231.34	C II	3	7230.57	-31.93	0.585	0.349	8	
7236.42	C II	3	7235.81	-25.27	1.188	0.708	7	
7254.15	O I	20	7254.04	-4.54	0.063	0.037	24	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7280.65	-28.83	1.519	0.900	7	
7298.05	He I	1/9	7297.24	-33.26	0.066	0.039	23	
7318.92	[O II]	2F	7317.70	-49.97	1.112	0.656	7	
7318.92	[O II]	2F	7320.16	50.79	3.959	2.334	7	
7319.99	[O II]	2F	*	*	*	*	*	
7319.99	[O II]	2F	7321.35	55.68	3.145	1.854	7	
7329.66	[O II]	2F	7328.34	-54.01	1.835	1.080	7	
7329.66	[O II]	2F	7330.83	47.84	3.258	1.918	7	
7330.73	[O II]	2F	*	*	*	*	*	
7330.73	[O II]	2F	7331.99	51.53	1.767	1.040	7	
7377.83	[Ni II]	2F	7377.02	-32.92	0.477	0.279	8	
7388.16	[Fe II]	14F	7387.39	-31.25	0.060	0.035	25	
—	?	—	7401.07	—	0.218	0.127	11	c
7411.61	[Ni II]	2F	7411.06	-22.24	0.034	0.020	39	
7452.54	[Fe II]	14F	7451.72	-32.98	0.125	0.073	15	
7468.31	N I	3	7467.56	-30.11	0.022	0.013	:	
7499.85	He I	1/8	7499.15	-27.99	0.091	0.052	19	
—	?	—	7508.28	—	0.051	0.029	29	
7519.49	C II	16.08	7519.02	-18.75	0.022	0.013	:	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7529.90	-25.49	0.103	0.059	17	
7751.10	[Ar III]	2F	7750.38	-27.86	13.859	7.755	7	c
7771.93	O I	1	7771.17	-29.33	0.047	0.026	30	
7774.17	O I	1	7774.73	21.60	0.043	0.024	32	c
7775.39	O I	1	*	*	*	*	*	
7816.13	He I	1/7	7815.34	-30.31	0.134	0.074	15	
7876.03	[P II]	1D-1S	7875.00	-39.20	0.047	0.026	30	
7889.90	[Ni III]	1F	7889.21	-26.22	0.117	0.065	16	
8045.63	[Cl IV]	1F	8045.00	-23.47	0.164	0.089	13	

Table 7. continued.

			Cn 1-5					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8203.85	He I	4/14	8203.08	-28.12	0.032	0.017	:	
8216.34	N I	2	8215.31	-37.60	0.040	0.021	34	
8223.14	N I	2	8222.11	-37.53	0.033	0.018	:	
8276.31	H I	P32	8275.50	-29.33	0.178	0.094	13	
8281.12	H I	P31	8280.67	-16.30	0.328	0.173	10	c
8286.43	H I	P30	8285.69	-26.75	0.244	0.129	11	c
8292.31	H I	P29	8291.46	-30.72	0.220	0.116	11	c
8298.83	H I	P28	8298.19	-23.11	0.473	0.249	9	
8306.11	H I	P27	8305.42	-24.92	0.223	0.118	11	
8314.26	H I	P26	8313.51	-27.05	0.261	0.137	11	
8323.42	H I	P25	8322.63	-28.46	0.298	0.156	10	
8333.78	H I	P24	8333.03	-26.98	0.362	0.190	10	
8345.55	H I	P23	8344.00	-55.68	0.969	0.507	8	c
8359.00	H I	P22	8358.18	-29.42	0.409	0.214	9	
8361.67	He I	1/6	8360.92	-26.89	0.249	0.130	11	
8374.48	H I	P21	8373.74	-26.50	0.473	0.247	9	
8392.40	H I	P20	8391.59	-28.96	0.511	0.265	9	
8413.32	H I	P19	8412.49	-29.58	0.545	0.282	9	
8437.96	H I	P18	8437.13	-29.49	0.599	0.308	9	
8446.25	O I	4	8445.48	-27.32	0.367	0.188	10	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8467.25	H I	P17	8466.40	-30.08	0.699	0.357	9	
8480.90	[Cl III]	3F	8480.23	-23.68	0.020	0.010	:	
8486.27	He I	6/16	8485.75	-18.35	0.053	0.027	28	
8502.48	H I	P16	8501.64	-29.65	0.930	0.472	8	
8528.99	He I	6/15	8528.39	-21.11	0.066	0.033	24	
8545.38	H I	P15	8544.58	-28.06	1.077	0.542	8	
8578.70	[Cl II]	1F	8577.85	-29.73	1.069	0.534	8	
8598.39	H I	P14	8597.54	-29.63	1.358	0.676	8	
8616.95	[Fe II]	4H-2I	8615.98	-33.74	0.606	0.300	9	
8665.02	H I	P13	8664.12	-31.12	1.779	0.873	8	
8727.13	[C I]	3F	8726.11	-35.03	0.269	0.130	11	
8733.43	He I	6/12	8732.77	-22.66	0.099	0.048	18	
8750.47	H I	P12	8749.66	-27.74	2.111	1.018	8	
8845.38	He I	6/11	8844.62	-25.75	0.147	0.069	14	
8862.79	H I	P11	8861.89	-30.46	2.777	1.311	8	
8891.91	[Fe II]	13F	8891.16	-25.29	0.178	0.084	13	
8996.99	He I	6/10	8996.27	-24.02	0.223	0.103	12	
9014.91	H I	P10	9014.02	-29.62	3.976	1.832	9	
9063.29	He I	4/8	9062.51	-25.81	0.212	0.097	12	
9068.60	[S III]	1F	9068.09	-16.85	107.815	49.308	9	
9123.60	[Cl II]	1F	9122.57	-33.83	0.352	0.160	10	

[a] Where F is the unreddened flux in units of 100.00 = 9.724×10^{-13}.

[b] Where I is the reddened corrected flux, with c(Hβ)=0.56±0.05, in units of 100.00 = 3.531×10^{-12}.

[c] Affected by telluric emission.

[d] Blended with an unknown line.

[e] Affected by charge transfer.

[f] Affected by atmospheric absorption bands.

Table 8. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			Hb 4					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3340.77	O III	3	3340.03	-66.42	0.965	4.541	14	
3428.65	O III	15	3427.81	-73.45	0.268	1.115	19	
3444.07	O III	15	3443.31	-66.17	2.730	11.128	12	
3669.47	H I	H25	3668.65	-67.01	0.186	0.578	22	
3671.48	H I	H24	3670.82	-53.89	0.157	0.488	24	
3673.76	H I	H23	3673.05	-57.95	0.216	0.667	20	
3676.37	H I	H22	3675.62	-61.17	0.206	0.634	21	
3679.36	H I	H21	3678.58	-63.57	0.256	0.786	18	
3682.81	H I	H20	3682.07	-60.25	0.301	0.922	17	
3686.83	H I	H19	3686.07	-61.81	0.417	1.271	14	
3691.56	H I	H18	3690.81	-60.92	0.263	0.796	18	
3697.15	H I	H17	3696.34	-65.68	0.306	0.922	16	
3703.86	H I	H16	3703.04	-66.39	0.360	1.078	15	
3705.04	He I	25	3704.18	-69.61	0.172	0.511	23	
3711.97	H I	H15	3711.17	-64.63	0.474	1.395	13	
3721.93	H I	H14	3721.05	-70.89	0.967	2.820	11	
3726.03	[O II]	1F	3725.38	-52.32	5.933	17.224	10	
3728.82	[O II]	1F	3728.15	-53.89	2.740	7.933	10	
3734.37	H I	H13	3733.57	-64.24	0.738	2.125	12	
3750.15	H I	H12	3749.35	-63.95	0.845	2.396	11	
3754.69	O III	2	3753.88	-64.69	0.147	0.415	25	
3759.87	O III	2	3759.07	-63.81	0.788	2.213	11	
3770.63	H I	H11	3769.83	-63.60	1.126	3.130	10	
3797.63	[S III]	2F	3797.09	-42.62	1.709	4.629	10	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3818.83	-61.24	0.411	1.091	14	
3835.39	H I	H9	3834.57	-64.09	2.360	6.176	9	
3868.75	[Ne III]	1F	3867.96	-61.23	41.080	104.331	9	
3888.65	He I	2	3888.11	-41.62	5.475	13.661	9	
3889.05	H I	H8	*	*	*	*	*	
3964.73	He I	5	3963.89	-63.54	0.322	0.751	15	
3967.46	[Ne III]	1F	3966.64	-61.98	13.857	32.279	8	
3970.07	H I	H7	3969.25	-61.94	5.751	13.364	8	
4009.26	He I	55	4008.45	-60.58	0.075	0.169	:	
4026.21	He I	18	4025.33	-65.53	1.068	2.355	9	
4041.31	N II	39	4040.41	-66.79	0.019	0.041	:	
4068.60	[S II]	1F	4067.87	-53.80	1.025	2.167	9	
4069.62	O II	10	4068.94	-50.11	0.194	0.409	20	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4071.27	-64.79	0.136	0.288	26	
4075.86	O II	10	4075.43	-67.69	0.549	1.152	11	
4076.35	[S II]	1F	*	*	*	*	*	
4097.22	O II	20	4096.44	-57.10	1.006	2.069	9	
4097.26	O II	48	*	*	*	*	*	
4097.33	N III	1	*	*	*	*	*	
4100.04	He II	4.12	4099.19	-62.17	0.153	0.314	24	
4101.74	H I	H6	4100.88	-62.90	11.839	24.244	8	
4103.43	N III	1	4102.48	-69.44	0.481	0.983	12	
4119.22	O II	20	4118.27	-69.17	0.065	0.131	:	
4120.82	He I	16	4119.92	-65.48	0.135	0.271	26	
4143.76	He I	53	4142.91	-61.48	0.156	0.307	23	
4153.30	O II	19	4152.43	-62.78	0.026	0.051	:	
4156.53	O II	19	4155.50	-74.29	0.053	0.103	:	
4169.22	O II	19	4168.31	-65.46	0.053	0.102	:	
4185.45	O II	36	4184.51	-67.38	0.022	0.042	:	
4186.90	C III	18	4185.93	-69.45	0.042	0.080	:	
4189.79	O II	36	4188.88	-65.14	0.027	0.051	:	
4195.76	N III	6	4194.72	-74.30	0.034	0.064	:	

Table 8. continued.

			Hb 4					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^{a}$	$I(\lambda)/I(H\beta)^{b}$	Err(%)	not
4199.83	He II	4.11	4199.03	-57.14	0.280	0.528	16	
4241.78	N II	48	4241.00	-55.12	0.030	0.055	:	
4267.15	C II	6	4266.24	-63.92	0.418	0.756	12	
4275.55	O II	67	4274.53	-71.54	0.043	0.078	:	
4276.75	O II	67	*	*	*	*	*	
4294.78	S II	49	4293.79	-69.10	0.036	0.064	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4302.89	-50.14	0.043	0.075	:	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4316.19	-66.00	0.043	0.076	:	
4338.67	He II	4.10	4337.72	-65.64	0.340	0.583	14	
4340.47	H I	H5	4339.54	-64.26	28.905	49.572	7	
4345.55	O II	65	4344.72	-57.95	0.027	0.046	:	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4348.57	-59.31	0.104	0.178	31	
4363.21	[O III]	2F	4362.29	-63.22	4.393	7.381	7	
4366.89	O II	2	4365.93	-65.92	0.095	0.160	33	
4379.11	N III	18	4378.22	-60.92	0.316	0.523	14	
4387.93	He I	51	4387.04	-60.83	0.418	0.686	12	
4391.94	Ne II	55e	4391.08	-58.71	0.049	0.080	:	
4409.30	Ne II	55e	4408.76	-36.72	0.017	0.028	:	
4414.85	O III	46a	4413.94	-61.82	0.061	0.097	:	
4414.90	O II	5	*	*	*	*	*	
4416.97	O II	5	4416.02	-64.51	0.060	0.095	:	
4437.55	He I	50	4436.69	-58.10	0.060	0.094	:	
4471.47	He I	14	4470.58	-59.69	3.280	4.903	6	
4478.09	[Mn IV]	5D-3P	4477.13	-64.28	0.019	0.028	:	
4481.21	Mg II	4	4480.48	-48.84	0.034	0.050	:	
4510.92	N III	3	4509.98	-62.48	0.134	0.191	26	
4514.85	N III	3	4513.81	-69.08	0.033	0.047	:	
4541.59	He II	4.9	4540.61	-64.70	0.576	0.795	10	
4571.10	Mg I]	1	4570.20	-59.03	0.133	0.178	26	
4590.97	O II	15	4589.91	-69.24	0.046	0.060	:	
4595.95	O II	15	4595.23	-46.99	0.044	0.058	:	
4596.18	O II	15	*	*	*	*	*	
4607.16	N II	5	4606.34	-53.39	0.024	0.030	:	
4609.44	O II	92a	4608.44	-65.05	0.064	0.082	:	
4630.54	N II	5	4629.52	-66.05	0.063	0.080	:	
4634.14	N III	2	4633.15	-64.07	1.215	1.528	7	
4638.86	O II	1	4637.81	-67.86	0.095	0.119	33	
4640.64	N III	2	4639.61	-66.57	2.229	2.786	6	
4641.81	O II	1	4640.75	-68.48	0.639	0.798	9	
4641.85	N III	2	*	*	*	*	*	
4647.42	C III	1	4646.46	-61.94	0.178	0.221	21	
4649.13	O II	1	4648.16	-62.54	0.589	0.730	9	
4650.25	C III	1	4649.71	-34.82	0.334	0.413	13	
4650.84	O II	1	*	*	*	*	*	
4651.47	C III	1	4650.85	-39.97	0.033	0.040	:	
4658.05	[Fe III]	3F	4657.38	-43.12	0.069	0.084	:	
4661.63	O II	1	4660.66	-62.38	0.152	0.186	23	
4676.24	O II	1	4675.18	-67.98	0.096	0.116	33	
4685.68	He II	3.4	4684.73	-60.81	20.797	24.857	5	
4711.37	[Ar IV]	1F	4710.33	-66.19	2.517	2.933	6	
4713.14	He I	12	4712.20	-59.80	0.559	0.650	10	
4740.17	[Ar IV]	1F	4739.20	-61.34	3.632	4.114	5	
4859.32	He II	4.8	4858.26	-65.41	1.235	1.240	7	
4861.33	H I	H4	4860.30	-63.55	100.000	100.000	5	
4958.91	[O III]	1F	4958.06	-51.40	408.734	371.496	5	
5006.84	[O III]	1F	5006.00	-50.30	1284.716	1115.544	5	

Table 8. continued.

			Hb 4					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
5015.68	He I	4	5014.68	-59.78	2.301	1.982	9	
5041.03	Si II	5	5040.02	-60.06	0.330	0.278	14	
5047.74	He I	47	5046.71	-61.20	0.238	0.200	12	
5055.98	Si II	5	5055.04	-55.74	0.170	0.141	15	
5191.82	[Ar III]	3F	5190.65	-67.57	0.131	0.097	17	
5197.90	[N I]	1F	5197.14	-43.83	0.258	0.190	11	
5200.26	[N I]	1F	5199.47	-45.52	0.174	0.128	15	
5220.06	[Fe II]	19F	5383.17	0.00	0.181	0.114	:	
5342.38	C II	17.06	5341.53	-47.71	0.042	0.027	39	
5411.52	He II	4.7	5410.39	-62.61	3.331	2.049	6	
5517.71	[Cl III]	1F	5516.58	-61.40	1.004	0.564	8	
5537.88	[Cl III]	1F	5536.71	-63.35	1.544	0.852	7	
5666.64	N II	3	5665.45	-62.97	0.130	0.064	18	
5675.46	N II	3	5674.89	-30.10	0.060	0.029	30	
5679.56	N II	3	5678.35	-63.88	0.282	0.137	12	
5686.21	N II	3	5685.00	-63.81	0.048	0.023	35	
5691.98	[Mn V]	4F-2G	5690.89	-57.41	0.049	0.023	35	
5701.82	[Mn V]	4F-2G	5700.70	-58.88	0.119	0.056	19	
5710.76	N II	3	5709.52	-65.10	0.046	0.022	36	
5754.64	[N II]	3F	5753.57	-55.77	3.028	1.368	8	
5861.00	[Mn V]	4F-2G	5860.18	-41.94	0.163	0.067	16	
5875.64	He I	11	5874.45	-60.73	36.100	14.686	9	
5885.40	[Mn V]	4F-2G	5884.52	-44.83	0.124	0.050	19	
5913.24	He II	5.26	5911.98	-63.91	0.090	0.035	23	
5931.83	He II	5.25	5930.60	-62.18	0.071	0.028	27	
5952.93	He II	5.24	5951.51	-71.55	0.108	0.041	21	
5957.57	Si II	4	5956.64	-46.79	0.106	0.041	21	
5977.03	He II	5.23	5975.84	-59.70	0.113	0.043	20	
5990.10	[Mn V]	4F-4P	5989.39	-35.54	0.080	0.030	25	
6004.73	He II	5.22	6003.69	-51.93	0.185	0.068	16	
6024.40	[Mn V]	4F-4P	6023.42	-48.77	0.102	0.037	22	
6036.70	He II	5.21	6035.46	-61.60	0.220	0.080	15	
6074.10	He II	5.20	6073.04	-52.33	0.170	0.060	17	
6083.30	[Mn V]	4F-4P	6082.37	-45.82	0.115	0.040	20	
6101.83	[K IV]	1F	6100.42	-69.30	0.580	0.201	11	
6118.20	He II	5.19	6117.04	-56.86	0.145	0.050	18	
6151.43	C II	16.04	6150.04	-67.76	0.073	0.025	27	
6157.60	[Mn V]	4F-4P	6156.10	-73.05	0.114	0.038	21	
6166.00	[Mn V]	4F-4P	6164.48	-73.92	0.095	0.032	23	
6170.60	He II	5.18	6169.36	-60.27	0.195	0.065	16	
6219.10	[Mn V]	4F-4P	6217.54	-75.22	0.087	0.028	24	
6233.80	He II	5.17	6232.50	-62.52	0.275	0.088	14	
6300.30	[O I]	1F	6299.22	-51.38	9.171	2.800	10	
6312.10	[S III]	3F	6310.78	-62.72	7.521	2.279	11	
6343.60	[Mn V]	4F-4P	6342.32	-60.52	0.167	0.050	17	
6347.11	Si II	2	6345.74	-64.71	0.349	0.104	13	
6363.78	[O I]	1F	6362.68	-51.81	3.305	0.969	11	
6371.36	Si II	2	6369.99	-64.46	0.526	0.154	12	
6393.60	[Mn V]	4F-4P	6392.41	-55.81	0.232	0.067	15	
6406.30	He II	5.15	6405.08	-57.09	0.446	0.127	13	
6435.10	[Ar V]	2P-1D	6433.66	-67.10	0.160	0.045	18	
6461.95	C II	17.04	6460.46	-69.15	0.288	0.080	15	
6527.10	[N II]	1F	6525.78	-60.65	0.574	0.152	13	
6527.11	He II	5.14	*	*	*	*	*	
6548.03	[N II]	1F	6547.16	-39.82	102.085	26.793	11	
6560.00	He II	4.6	6558.61	-63.54	10.175	2.653	12	
6562.82	H I	H3	6561.62	-54.81	1072.284	279.108	12	
6578.05	C II	2	6576.81	-56.51	0.899	0.232	12	
6583.41	[N II]	1F	6582.54	-39.63	313.079	80.530	12	

Table 8. continued.

			Hb 4					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
6678.15	He I	46	6676.77	-61.96	15.611	3.813	12	
6683.20	He II	5.13	6681.78	-63.73	0.703	0.171	13	
6716.47	[S II]	2F	6715.31	-51.79	13.761	3.294	12	
6730.85	[S II]	2F	6729.65	-53.47	26.336	6.258	12	
6795.00	[K IV]	1F	6793.53	-64.88	0.187	0.043	18	
6890.88	He II	5.12	6889.45	-62.21	0.756	0.166	14	
7005.67	[Ar V]	3P-1D	7004.19	-63.35	0.520	0.108	14	
7065.28	He I	10	7063.78	-63.66	28.552	5.789	13	
7135.78	[Ar III]	1F	7134.33	-60.92	119.025	23.391	14	
7170.62	[Ar IV]	2F	7169.12	-62.73	0.586	0.113	15	
7177.50	He II	5.11	7176.00	-62.67	1.505	0.290	14	
7231.34	C II	3	7229.73	-66.76	0.547	0.103	15	
7236.42	C II	3	7235.21	-50.13	1.395	0.262	14	
7262.76	[Ar IV]	2F	7261.37	-57.37	0.526	0.098	15	
7281.35	He I	45	7279.85	-61.77	3.937	0.726	14	c
7318.92	[O II]	2F	7318.50	-17.20	17.557	3.186	14	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7328.82	-34.37	15.061	2.721	14	
7330.73	[O II]	2F	*	*	*	*	*	
7499.85	He I	1/8	7498.29	-62.37	0.257	0.043	18	
7530.54	[Cl IV]	1F	7528.83	-68.09	2.293	0.382	15	
7592.74	He II	5.10	7591.15	-62.81	2.437	0.396	15	
7751.10	[Ar III]	2F	7749.57	-59.20	37.383	5.729	15	
7816.13	He I	1/7	7814.56	-60.22	0.456	0.068	17	
—	?	—	8016.95	—	0.225	0.032	19	
8045.63	[Cl IV]	1F	8043.98	-61.49	6.393	0.893	16	
8116.30	He I	4/16	8114.90	-51.72	0.082	0.011	28	
8196.48	C III	43	8194.92	-57.09	0.824	0.109	17	
—	?	—	8225.74	—	0.146	0.019	22	
8236.77	He II	5.9	8235.07	-61.86	5.464	0.711	17	
—	?	—	8242.39	—	0.214	0.028	20	
8255.02	H I	P38	8253.31	-62.11	0.290	0.037	19	
8257.85	H I	P37	8255.93	-69.72	0.295	0.038	19	
8260.93	H I	P36	8259.28	-59.87	0.496	0.064	18	
8264.28	H I	P35	8262.76	-55.17	0.681	0.088	17	
8267.94	H I	P34	8266.50	-52.24	0.648	0.083	17	
8271.93	H I	P33	8270.22	-61.99	0.577	0.074	18	
8276.31	H I	P32	8274.62	-61.21	0.639	0.082	17	c
8281.12	H I	P31	8279.12	-72.42	0.487	0.062	18	
8286.43	H I	P30	8284.77	-60.07	0.813	0.104	17	
8292.31	H I	P29	8290.60	-61.83	0.921	0.117	17	
8298.83	H I	P28	8296.76	-74.81	1.444	0.183	17	c
8306.11	H I	P27	8304.39	-62.12	1.048	0.132	17	
8314.26	H I	P26	8312.50	-63.47	1.265	0.159	17	
8323.42	H I	P25	8321.68	-62.69	1.355	0.170	17	
8333.78	H I	P24	8332.02	-63.35	1.637	0.204	17	
8342.33	He I	4/12	8340.57	-63.25	0.245	0.030	20	
8345.55	H I	P23	8343.69	-66.81	1.816	0.225	17	c
8359.00	H I	P22	8357.27	-62.08	2.048	0.251	17	
8361.67	He I	1/6	8360.11	-55.93	0.991	0.121	17	
8374.48	H I	P21	8372.76	-61.61	2.335	0.284	17	
8392.40	H I	P20	8390.65	-62.53	2.454	0.295	17	
8413.32	H I	P19	8411.57	-62.37	2.763	0.328	17	
8421.67	He II	6.37	8420.09	-56.26	0.125	0.015	24	
8433.85	[Cl III]	3F	8432.16	-60.07	0.194	0.023	21	
8437.96	H I	P18	8436.20	-62.54	3.275	0.383	17	
8444.34	He I	4/11	8442.43	-67.83	0.159	0.018	23	
8446.25	O I	4	8444.85	-49.71	0.682	0.079	18	
8446.36	O I	4	*	*	*	*	*	

Table 8. continued.

			Hb 4					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8449.42	-56.06	0.098	0.011	27	
8467.25	H I	P17	8465.51	-61.63	5.813	0.667	18	c
8486.27	He I	6/16	8484.42	-65.35	0.185	0.021	22	
8499.00	He II	6.32	8497.71	-45.51	0.168	0.019	22	
8502.48	H I	P16	8500.70	-62.78	4.725	0.530	18	
8518.04	He I	2/8	8517.06	-34.51	0.182	0.020	22	
8528.99	He I	6/15	8527.24	-61.52	0.244	0.027	21	
8531.48	He I	7/15	8530.07	-49.56	0.107	0.012	26	
8545.38	H I	P15	8543.61	-62.09	5.639	0.614	18	
8567.15	He II	6.29	8565.46	-59.17	0.177	0.019	22	
8582.54	He I	3/10	8580.74	-62.88	0.741	0.079	19	
8594.91	He II	6.28	8593.07	-64.19	0.181	0.019	22	
8598.39	H I	P14	8596.63	-61.37	7.097	0.745	18	
8648.10	He I	6/13	8646.19	-66.20	0.198	0.020	22	c
8665.02	H I	P13	8663.26	-60.90	9.320	0.936	18	
8727.13	[C I]	3F	8725.50	-56.00	0.226	0.022	22	
8733.43	He I	6/12	8731.60	-62.83	0.411	0.039	20	
8736.04	He I	7/12	8734.22	-62.48	0.177	0.017	23	
8747.00	He II	6.24	8745.07	-66.15	0.265	0.025	21	
8750.47	H I	P12	8748.64	-62.71	11.091	1.052	19	
8776.60	He I	4/9	8774.91	-57.72	0.524	0.049	20	
8798.90	He II	6.23	8797.10	-61.37	0.329	0.030	21	
8845.38	He I	6/11	8843.55	-62.04	0.519	0.046	20	
8848.05	He I	7/11	8846.21	-62.35	0.242	0.022	22	
8854.11	He I	5/11	8852.52	-53.87	0.075	0.007	31	
8859.10	He II	6.22	8857.24	-62.93	0.247	0.022	22	
8862.79	H I	P11	8860.96	-61.92	15.445	1.368	19	
8996.99	He I	6/10	8995.09	-63.34	0.801	0.066	20	
9011.20	He II	6.20	9009.25	-64.89	0.404	0.033	21	
9014.91	H I	P10	9013.04	-62.20	20.908	1.709	20	
9063.29	He I	4/8	9061.60	-55.93	0.887	0.071	21	
9068.60	[S III]	1F	9067.40	-39.65	486.386	38.843	20	
9108.50	He II	6.19	9106.64	-61.24	0.337	0.027	22	
9123.60	[Cl II]	1F	9121.96	-53.89	0.532	0.042	21	

[a] Where F is the unreddened flux in units of 100.00 = 1.343×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.81±0.14, in units of 100.00 = 8.671×10^{-12}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 9. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3711.97	H I	H15	3711.89	-6.47	0.415	1.451	8	
3721.83	[S III]	2F	3721.76	-5.64	0.910	3.146	8	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3725.94	-7.25	3.726	12.817	8	
3728.82	[O II]	1F	3728.70	-9.66	1.596	5.474	8	
3734.37	H I	H13	3734.28	-7.23	0.662	2.256	8	
3750.15	H I	H12	3750.07	-6.38	0.876	2.933	8	
3770.63	H I	H11	3770.55	-6.35	1.002	3.277	8	
3797.63	[S III]	2F	3797.82	15.01	1.391	4.417	8	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.55	-4.71	0.486	1.508	8	
3833.57	He I	62	3833.44	-10.18	0.025	0.075	22	
3835.39	H I	H9	3835.31	-6.24	2.066	6.301	7	
3856.13	O II	12	3856.13	0.00	0.038	0.113	17	
3862.59	Si II	1	3862.46	-10.10	0.039	0.115	17	
3868.75	[Ne III]	1F	3868.67	-6.21	24.101	70.987	7	
3871.82	He I	60	3871.73	-6.98	0.035	0.102	18	
3888.65	He I	2	3888.86	16.20	4.782	13.800	7	
3889.05	H I	H8	*	*	*	*	*	
3926.53	He I	58	3926.46	-5.35	0.065	0.181	13	
3964.73	He I	5	3964.66	-5.30	0.410	1.096	8	
3967.46	[Ne III]	1F	3967.38	-6.05	8.299	22.111	7	
3970.07	H I	H7	3970.00	-5.29	5.319	14.133	7	
3994.98	N II	12	3994.92	-4.51	0.022	0.058	23	
4009.26	He I	55	4009.19	-5.24	0.097	0.248	11	
4026.21	He I	18	4026.12	-6.69	1.189	2.972	7	
4035.07	O II	68	4035.03	-2.97	0.017	0.042	27	
4041.31	N II	39	4041.24	-5.20	0.034	0.084	18	
—	?	—	4043.44	—	0.022	0.054	23	
4068.60	[S II]	1F	4068.48	-8.85	1.355	3.227	7	
4069.62	O II	10	4069.71	6.62	0.119	0.282	10	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4072.06	-6.61	0.099	0.235	11	
4075.86	O II	10	4076.15	-14.72	0.586	1.382	7	
4076.35	[S II]	1F	*	*	*	*	*	
4078.84	O II	10	4078.78	-4.41	0.021	0.049	24	
4083.90	O II	47	4083.90	0.00	0.020	0.047	25	
4085.11	O II	10	4084.92	-13.96	0.016	0.038	28	
4087.15	O II	48	4087.01	-10.26	0.020	0.046	25	
4089.29	O II	48	4089.21	-5.87	0.062	0.145	13	
4092.93	O II	10	4092.88	-3.67	0.015	0.035	30	
4095.64	O II	48	4095.72	5.86	0.021	0.048	24	
4097.22	O II	20	4097.23	0.71	0.154	0.354	9	
4097.26	O II	48	*	*	*	*	*	
4098.24	O II	62	4098.21	-2.21	0.012	0.027	34	
4101.74	H I	H6	4101.66	-5.85	10.526	24.147	6	
4103.43	N III	1	4103.26	-12.45	0.107	0.245	10	
4104.99	O II	20	4104.85	-10.22	0.027	0.061	20	
4110.79	O II	20	4110.73	-4.38	0.022	0.050	23	
4112.02	O II	47	4111.88	-10.22	0.025	0.057	22	
4119.22	O II	20	4119.17	-3.66	0.052	0.118	14	
4120.82	He I	16	4120.76	-4.37	0.169	0.380	9	
4132.80	O II	19	4132.70	-7.23	0.029	0.065	20	
4143.76	He I	53	4143.67	-6.50	0.206	0.451	8	
4145.90	O II	106	4145.99	6.53	0.022	0.048	23	
4146.08	O II	106	*	*	*	*	*	
4153.30	O II	19	4153.21	-6.49	0.039	0.085	17	
4156.53	O II	19	4156.32	-15.14	0.041	0.088	16	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4168.97	He I	52	4168.93	-2.88	0.047	0.101	15	
4185.45	O II	36	4185.40	-3.60	0.032	0.068	18	
4189.79	O II	36	4189.70	-6.43	0.039	0.083	16	
4219.76	Ne II	52	4219.67	-6.38	0.020	0.041	25	
4236.91	N II	48	4236.88	-2.14	0.024	0.049	22	
4237.05	N II	48	*	*	*	*	*	
4241.78	N II	48	4241.69	-6.35	0.034	0.068	18	
4253.90	O II	109	4253.81	-6.33	0.024	0.048	22	
4253.91	O II	109	*	*	*	*	*	
4267.15	C II	6	4267.08	-4.91	0.369	0.733	7	
4275.55	O II	67	4275.60	3.53	0.054	0.107	14	
4276.75	O II	67	4276.63	-8.42	0.011	0.022	36	
4285.69	O II	78	4285.60	-6.28	0.013	0.025	33	
4287.39	[Fe II]	7F	4287.33	-4.20	0.022	0.043	23	
4288.82	O II	53	4288.61	-14.68	0.017	0.034	27	d
4291.25	O II	55	4291.25	0.00	0.009	0.017	:	
4292.21	O II	78	4292.23	1.40	0.008	0.016	:	
4294.78	S II	49	4294.67	-7.67	0.016	0.030	29	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4303.78	-2.79	0.035	0.067	18	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4317.10	-2.78	0.046	0.087	15	
4319.63	O II	2	4319.55	-5.56	0.044	0.083	15	
4325.76	O II	2	4325.76	0.00	0.012	0.022	35	d
4336.83	O II	2	4336.85	1.38	0.026	0.048	21	
4340.47	H I	H5	4340.38	-6.24	25.656	47.914	6	
4345.55	O II	65	4345.48	-5.52	0.057	0.106	13	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4349.33	-6.90	0.073	0.134	12	
4363.21	[O III]	2F	4363.11	-6.88	1.722	3.140	6	
4366.89	O II	2	4366.79	-6.87	0.043	0.077	16	
4379.11	N III	18	4379.09	-1.37	0.023	0.041	23	
4387.93	He I	51	4387.84	-6.17	0.459	0.813	6	
4391.94	Ne II	55e	4391.90	-2.73	0.029	0.052	19	
4397.86	O II	116	4397.88	1.36	0.011	0.019	36	
4409.30	Ne II	55e	4409.17	-8.83	0.034	0.059	18	
4414.90	O II	5	4414.81	-6.10	0.037	0.063	17	
4416.97	O II	5	4416.75	-14.95	0.048	0.082	14	
4432.45	[Fe II]	6F	4432.65	13.51	0.020	0.033	25	
4437.55	He I	50	4437.47	-5.38	0.051	0.085	14	
4465.41	O II	94	4465.36	-3.38	0.026	0.042	21	
4467.92	O II	94	4467.82	-6.72	0.015	0.023	30	
4469.37	O II	4D-4P	4469.35	-1.34	0.015	0.024	29	
4471.47	He I	14	4471.42	-3.37	4.276	6.806	6	
4481.21	Mg II	4	4481.20	-0.65	0.029	0.046	19	
4491.23	O II	86a	4491.18	-3.32	0.011	0.018	35	
4510.92	N III	3	4510.92	0.00	0.024	0.036	22	
—	?	—	4529.57	—	0.026	0.039	20	
4530.41	N II	58b	4530.33	-5.30	0.029	0.043	19	
—	?	—	4552.54	—	0.027	0.038	20	
4571.10	Mg I]	1	4570.99	-7.21	0.092	0.130	10	
4590.97	O II	15	4590.87	-6.54	0.063	0.087	12	
4595.95	O II	15	4596.10	9.78	0.055	0.075	13	
4596.18	O II	15	*	*	*	*	*	
4601.48	N II	5	4601.36	-7.83	0.027	0.037	20	
4602.13	O II	92b	4601.97	-10.40	0.032	0.044	18	
4607.16	N II	5	4607.05	-7.18	0.055	0.074	13	
4609.44	O II	92a	4609.31	-8.45	0.040	0.054	16	
4610.20	O II	2D-F[2]$_0$	4610.14	-3.91	0.015	0.020	29	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4613.68	O II	92b	4613.73	3.24	0.024	0.032	22	
4613.87	N II	5	*	*	*	*	*	
4621.39	N II	5	4621.30	-5.86	0.040	0.052	16	
4630.54	N II	5	4630.45	-5.82	0.112	0.146	9	
4634.14	N III	2	4634.06	-5.18	0.159	0.208	8	
4638.86	O II	1	4638.75	-7.10	0.098	0.128	10	
4640.64	N III	2	4640.55	-5.84	0.289	0.374	7	
4641.81	O II	1	4641.73	-5.17	0.245	0.316	7	
4641.85	N III	2	*	*	*	*	*	
4643.06	N II	5	4642.99	-4.51	0.043	0.055	15	
4647.42	C III	1	4647.50	5.17	0.017	0.022	27	
4649.13	O II	1	4649.05	-5.16	0.388	0.497	6	
4650.25	C III	1	4650.10	-9.66	0.011	0.015	35	
4650.84	O II	1	4650.75	-5.79	0.108	0.138	9	
4658.05	[Fe III]	3F	4658.05	0.00	0.446	0.565	6	
4661.63	O II	1	4661.53	-6.44	0.111	0.140	9	
4667.01	[Fe III]	3F	4666.95	-3.83	0.025	0.031	21	
4673.73	O II	1	4673.63	-6.42	0.019	0.023	25	
4676.24	O II	1	4676.15	-5.79	0.077	0.096	11	
—	?	—	4694.54	—	0.012	0.014	34	
4696.36	O II	1	4696.24	-7.64	0.013	0.015	32	
4699.22	O II	25	4699.00	-14.05	0.023	0.028	22	
4701.62	[Fe III]	3F	4701.51	-7.04	0.183	0.221	8	
4705.35	O II	25	4705.26	-5.76	0.020	0.023	25	
4711.37	[Ar IV]	1F	4711.27	-6.37	0.246	0.293	7	
4713.14	He I	12	4713.07	-4.47	0.830	0.988	5	
4733.93	[Fe III]	3F	4733.83	-6.34	0.085	0.099	10	
4740.17	[Ar IV]	1F	4740.11	-3.80	0.839	0.968	5	
4754.69	[Fe III]	3F	4754.68	-0.62	0.087	0.098	10	
4769.43	[Fe III]	3F	4769.42	-0.64	0.065	0.072	12	
4777.68	[Fe III]	3F	4777.62	-3.77	0.047	0.052	14	
4779.71	N II	20	4779.65	-3.77	0.021	0.023	24	
4788.13	N II	20	4788.12	-0.61	0.036	0.040	17	
—	?	—	4802.30	—	0.014	0.015	30	
4803.29	N II	20	4803.22	-4.36	0.036	0.039	17	
4843.37	O II	192	4843.20	-10.52	0.021	0.022	23	
4861.33	H I	H4	4861.23	-6.17	100.000	100.000	5	
4881.00	[Fe III]	2F	4880.97	-1.83	0.248	0.243	6	
4902.65	Si II	7.23	4902.58	-4.27	0.030	0.028	19	
4906.81	O II	28	4906.74	-4.27	0.047	0.045	14	
4921.93	He I	48	4921.82	-6.72	1.721	1.604	5	
4924.53	O II	28	4924.42	-6.69	0.058	0.054	13	
4931.32	[O III]	1F	4931.11	-12.76	0.119	0.113	8	
4958.91	[O III]	1F	4958.81	-6.05	302.453	270.340	5	
4987.20	[Fe III]	2F	4987.21	-10.21	0.061	0.053	12	
4987.38	N II	24	*	*	*	*	*	
4994.37	N II	24	4994.28	-5.42	0.042	0.036	16	
5001.13	N II	19	5001.28	8.99	0.195	0.166	7	
5001.47	N II	19	*	*	*	*	*	
5006.84	[O III]	1F	5006.75	-5.38	975.513	827.011	5	
5015.68	He I	4	5015.58	-5.98	3.472	2.916	5	
5041.03	Si II	5	5040.91	-7.11	0.231	0.189	7	
5041.98	O II	23.01	5041.92	-3.57	0.057	0.047	11	
5045.10	N II	4	5044.97	-7.72	0.055	0.045	11	
5047.74	He I	47	5047.64	-5.95	0.275	0.223	6	
5055.98	Si II	5	5055.96	-1.19	0.217	0.175	6	
5121.82	C II	12	5121.80	-1.17	0.041	0.031	12	
5179.52	N I	5D-5F	5179.43	-5.20	0.059	0.042	10	
5191.82	[Ar III]	3F	5191.60	-12.69	0.158	0.112	7	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
5197.90	[N I]	1F	5197.78	-6.93	0.363	0.254	6	
5200.26	[N I]	1F	5200.16	-5.74	0.237	0.166	6	
5261.61	[Fe II]	19F	5261.64	1.72	0.033	0.021	14	
5270.40	[Fe III]	1F	5270.48	4.55	0.542	0.354	6	
5342.38	C II	17.06	5342.29	-5.04	0.069	0.042	10	
5346.02	[Kr IV]	4S-2D	5345.89	-7.28	0.023	0.014	17	
5363.65	[Ni IV]	4F-2G	5363.65	0.00	0.025	0.015	16	
5376.45	[Fe II]	19F	5376.52	3.89	0.032	0.019	14	
5412.00	[Fe III]	1F	5412.21	11.63	0.072	0.041	10	
5517.71	[Cl III]	1F	5517.65	-3.26	0.678	0.347	6	
5530.24	N II	63	5530.20	-2.17	0.038	0.019	13	
5535.36	N II	63	5535.26	-5.42	0.089	0.045	9	
5537.88	[Cl III]	1F	5537.73	-8.12	1.708	0.855	6	
5551.95	N II	63	5551.98	1.61	0.047	0.023	12	d
5666.64	N II	3	5666.53	-5.84	0.289	0.126	7	
5676.02	N II	3	5675.90	-6.34	0.117	0.050	9	
5679.56	N II	3	5679.46	-5.28	0.581	0.250	7	
5686.21	N II	3	5686.11	-5.28	0.077	0.033	10	
5710.76	N II	3	5710.67	-4.72	0.098	0.041	9	
5746.97	[Fe II]	34F	5747.21	12.51	0.060	0.024	11	
5754.64	[N II]	3F	5754.46	-9.39	6.693	2.658	7	
—	?	—	5821.04	—	0.065	0.024	11	
5867.74	[Kr IV]	4S-2D	5867.61	-6.66	0.090	0.032	10	
5875.64	He I	11	5875.56	-4.09	57.154	20.099	7	
5891.60	C II	2D-2P	5891.46	-7.13	0.030	0.010	16	
5927.82	N II	28	5927.72	-5.04	0.062	0.021	11	
5931.78	N II	28	5931.68	-5.03	0.111	0.037	9	
5940.24	N II	28	5940.18	-3.03	0.045	0.015	13	
5941.65	N II	28	5941.57	-4.04	0.185	0.061	8	
5978.93	Si II	4	5978.85	-4.02	0.110	0.035	10	
6000.20	[Ni III]	2F	6000.19	-0.51	0.032	0.010	15	
6046.23	O I	22	6046.22	-0.48	0.099	0.030	10	
6046.44	O I	22	*	*	*	*	*	
6046.49	O I	22	*	*	*	*	*	
6101.83	[K IV]	1F	6101.59	-11.80	0.085	0.025	11	
—	?	—	6125.34	—	0.035	0.010	15	
6151.43	C II	16.04	6151.21	-10.73	0.099	0.028	10	
6300.30	[O I]	1F	6300.15	-7.13	12.439	3.136	8	
6312.10	[S III]	3F	6311.95	-7.12	8.477	2.119	8	
6347.11	Si II	2	6346.99	-5.65	0.525	0.128	9	
6363.78	[O I]	1F	6363.62	-7.52	4.372	1.052	8	
6371.36	Si II	2	6371.26	-4.71	0.484	0.116	9	
6461.95	C II	17.04	6461.72	-10.67	0.296	0.066	9	
6548.03	[N II]	1F	6547.94	-4.11	154.059	32.603	9	
6562.82	H I	H3	6562.67	-6.85	1333.651	279.489	9	
6578.05	C II	2	6577.90	-6.83	1.531	0.318	9	
6583.41	[N II]	1F	6583.30	-5.03	483.706	100.000	9	
6666.89	[Ni II]	8F	6667.01	5.38	0.032	0.006	16	
6678.15	He I	46	6678.04	-4.93	26.054	5.071	9	
6716.47	[S II]	2F	6716.34	-5.82	10.234	1.946	9	
6730.85	[S II]	2F	6730.71	-6.24	21.963	4.141	9	
6734.00	C II	21	6733.88	-5.35	0.070	0.013	12	
6739.80	[Fe IV]	—	6739.79	-0.43	0.035	0.007	16	
6747.50	[Cr IV]	4F-2G	6747.60	4.45	0.080	0.015	12	
6779.93	C II	14	6779.97	1.77	0.058	0.011	13	
6791.48	[Ni II]	8F	6791.35	-5.73	0.028	0.005	17	
6795.00	[K IV]	1F	6794.94	-2.65	0.035	0.006	16	
6910.79	[Ni II]	4F-2D	6910.45	-14.74	0.065	0.011	13	
6915.20	[Cr IV]	4F-2G	6915.41	9.10	0.138	0.023	11	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
6933.89	He I	1/13	6933.84	-2.17	0.067	0.011	13	
—	?	—	6964.75	—	0.087	0.014	12	
7065.28	He I	10	7065.11	-7.21	71.477	11.211	10	
7135.78	[Ar III]	1F	7135.67	-4.62	118.000	17.850	10	
7151.08	O II	2G-2F	7150.97	-4.61	0.056	0.008	14	
7155.16	[Fe II]	14F	7155.18	0.84	0.517	0.077	11	
7160.61	He I	1/10	7160.44	-7.11	0.229	0.034	11	
7170.62	[Ar IV]	2F	7170.49	-5.43	0.143	0.021	12	
7172.00	[Fe II]	14F	7171.81	-7.94	0.225	0.033	11	
7231.34	C II	3	7231.19	-6.21	1.175	0.169	11	
7236.42	C II	3	7236.32	-4.15	2.157	0.310	11	
7237.17	C II	3	7237.15	-0.83	0.425	0.061	11	
7254.15	O I	20	7254.22	2.91	0.453	0.065	11	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7281.21	-5.77	6.816	0.958	11	
7318.92	[O II]	2F	7319.78	35.22	30.519	4.208	11	
7319.99	[O II]	2F	*	*	*	*	*	
7323.89	[Ca II]	1F	7324.03	5.72	0.078	0.011	13	
7329.66	[O II]	2F	7330.05	15.94	25.299	3.471	11	
7330.73	[O II]	2F	*	*	*	*	*	
—	?	—	7340.08	—	0.124	0.017	12	
7377.83	[Ni II]	2F	7377.90	2.84	0.458	0.061	11	
7388.16	[Fe II]	14F	7388.13	-1.23	0.122	0.016	12	
7390.80	[Cr IV]	1F	7390.96	6.50	0.111	0.015	12	
7411.61	[Ni II]	2F	7411.88	10.92	0.068	0.009	14	
7442.30	N I	3	7442.14	-6.43	0.061	0.008	14	
7452.54	[Fe II]	14F	7452.57	1.20	0.202	0.026	12	
7499.85	He I	1/8	7499.73	-4.80	0.527	0.067	11	
7519.49	C II	16.08	7519.79	11.95	0.063	0.008	14	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7530.36	-7.17	1.099	0.137	11	
7751.10	[Ar III]	2F	7750.97	-5.02	66.521	7.542	12	c
7771.93	O I	1	7771.77	-6.18	0.120	0.013	13	
7816.13	He I	1/7	7816.00	-4.98	0.930	0.103	12	
7889.90	[Ni III]	1F	7889.85	-1.89	0.666	0.072	12	
7937.13	He I	4/27	7936.99	-5.27	0.049	0.005	16	
7944.58	He I	4/26	7944.51	-2.65	0.055	0.006	15	
7952.96	He I	4/25	7952.70	-9.79	0.056	0.006	15	
7962.42	He I	4/24	7962.25	-6.40	0.047	0.005	16	
7973.34	He I	4/23	7973.06	-10.52	0.050	0.005	16	
7985.45	He I	4/22	7985.37	-3.01	0.065	0.007	15	
7999.58	He I	4/21	7999.55	-1.13	0.095	0.010	14	
8015.90	He I	4/20	8015.87	-1.11	0.064	0.007	15	
8035.04	He I	4/19	8034.95	-3.35	0.093	0.009	14	
8045.63	[Cl IV]	1F	8045.59	-1.49	3.034	0.309	12	
8057.59	He I	4/18	8057.46	-4.83	0.120	0.012	13	
8084.29	He I	4/17	8084.12	-6.30	0.134	0.013	13	
8094.08	He I	2/10	8093.69	-14.45	0.156	0.016	13	c
8116.30	He I	4/16	8116.24	-2.20	0.141	0.014	13	
8155.66	He I	4/15	8155.43	-8.45	0.177	0.017	13	
8203.85	He I	4/14	8203.72	-4.75	0.216	0.021	13	
8252.40	H I	P39	8252.27	-4.75	0.774	0.072	12	
8255.02	H I	P38	8254.91	-3.97	0.817	0.076	12	
8257.85	H I	P37	8257.75	-3.62	0.861	0.080	12	
8260.93	H I	P36	8260.82	-3.97	1.003	0.093	12	
8264.28	H I	P35	8264.22	-2.20	1.198	0.111	12	
8264.56	He I	4/13	*	*	*	*	*	
8265.71	He I	2/9	8265.58	-4.71	0.207	0.019	13	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
8267.94	H I	P34	8267.82	-4.36	1.038	0.096	12	
8276.31	H I	P32	8276.15	-5.77	1.172	0.108	13	
8281.12	H I	P31	8280.89	-8.34	1.155	0.106	13	
8286.43	H I	P30	8286.25	-6.50	1.550	0.142	13	
8292.31	H I	P29	8292.15	-5.75	1.494	0.136	13	
8300.99	[Ni II]	2F	8298.68	-83.47	2.183	0.198	13	
8306.11	H I	P27	8305.95	-5.78	1.753	0.159	13	
8307.81	He I	6/25	8307.67	-5.04	0.160	0.014	13	
8314.26	H I	P26	8314.11	-5.39	1.968	0.177	13	
8320.50	He I	7/24	8320.34	-5.77	0.044	0.004	17	
8323.42	H I	P25	8323.27	-5.42	2.213	0.198	13	
8329.87	He I	6/23	8329.75	-4.32	0.120	0.011	14	
8333.78	H I	P24	8333.64	-5.06	2.528	0.225	13	
8342.33	He I	4/12	8342.02	-11.16	0.225	0.020	13	
8345.55	H I	P23	8345.40	-5.37	2.769	0.245	13	
8359.00	H I	P22	8358.83	-6.09	3.306	0.289	13	
8361.67	He I	1/6	8361.56	-3.96	2.162	0.189	13	
8374.48	H I	P21	8374.32	-5.73	3.418	0.296	13	
8376.55	He I	6/20	8376.24	-11.08	0.256	0.022	13	
8378.95	He I	7/20	8378.75	-7.16	0.054	0.005	16	
8392.40	H I	P20	8392.26	-5.02	4.013	0.343	13	
8397.41	He I	6/19	8397.28	-4.64	0.197	0.017	13	
8413.32	H I	P19	8413.19	-4.63	4.475	0.377	13	
8421.96	He I	6/18	8421.85	-3.93	0.242	0.020	13	
8424.39	He I	7/18	8424.17	-7.82	0.086	0.007	15	
8433.85	[Cl III]	3F	8433.59	-9.23	0.384	0.032	13	
8437.96	H I	P18	8437.84	-4.27	4.977	0.412	13	
8446.25	O I	4	8446.30	1.77	6.115	0.503	13	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8451.01	0.35	0.279	0.023	13	
8453.61	He I	7/17	8453.42	-6.75	0.110	0.009	14	
8467.25	H I	P17	8467.13	-4.25	5.774	0.467	13	
8480.90	[Cl III]	3F	8480.63	-9.56	0.386	0.031	13	
8486.27	He I	6/16	8486.09	-6.35	0.336	0.027	13	
8488.73	He I	7/16	8488.61	-4.24	0.131	0.010	14	
8499.70	[Cl III]	3F	8499.77	2.45	0.518	0.041	13	
8502.48	H I	P16	8502.32	-5.65	7.035	0.554	13	
8518.04	He I	2/8	8517.89	-5.29	0.150	0.012	14	
8528.99	He I	6/15	8528.87	-4.22	0.429	0.033	13	
8531.48	He I	7/15	8531.45	-1.06	0.154	0.012	14	
8545.38	H I	P15	8545.24	-4.90	8.266	0.630	13	
8578.70	[Cl II]	1F	8578.54	-5.60	3.022	0.224	13	
8582.54	He I	3/10	8582.19	-12.21	1.124	0.083	13	
8584.38	He I	7/14	8584.17	-7.33	0.149	0.011	14	
8598.39	H I	P14	8598.25	-4.87	10.354	0.756	13	
8616.95	[Fe II]	4H-2I	8616.95	0.00	1.061	0.076	14	
8648.10	He I	6/13	8648.12	0.71	0.560	0.039	14	
8665.02	H I	P13	8664.89	-4.49	12.552	0.870	14	
8680.28	N I	1	8680.05	-7.96	0.264	0.018	14	
8683.40	N I	1	8683.28	-4.15	0.150	0.010	15	
8703.25	N I	1	8703.07	-6.19	0.103	0.007	15	
8711.70	N I	1	8711.49	-7.23	0.224	0.015	14	
8718.83	N I	1	8718.57	-8.93	0.069	0.005	16	
8727.13	[C I]	3F	8726.70	-14.76	0.302	0.020	14	
8728.90	N I	1	*	*	*	*	*	
8729.89	He I	10/13	8729.55	-11.67	0.159	0.011	15	
8733.43	He I	6/12	8733.27	-5.50	0.782	0.051	14	
8736.04	He I	7/12	8735.92	-4.12	0.280	0.018	14	

Table 9. continued.

			He 2-86					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8739.97	He I	5/12	8740.09	4.12	0.055	0.004	17	
8747.37	N I	1	8747.02	-12.02	0.158	0.010	15	
8750.47	H I	P12	8750.33	-4.78	15.724	1.021	14	
8776.60	He I	4/9	8776.62	0.70	0.876	0.056	14	
8862.79	H I	P11	8862.65	-4.72	21.843	1.309	14	
8999.40	He I	7/10	8999.47	2.31	0.420	0.023	15	
9014.91	H I	P10	9014.76	-5.00	34.040	1.861	15	
9063.29	He I	4/8	9063.19	-3.29	1.456	0.078	15	
9068.60	[S III]	1F	9068.74	4.65	698.365	37.161	15	
9123.60	[Cl II]	1F	9123.47	-4.27	1.068	0.055	15	
9210.28	He I	6/9	9210.14	-4.58	2.538	0.128	15	
9213.20	He I	7/9	9212.99	-6.83	0.995	0.050	15	
9229.01	H I	P9	9228.88	-4.22	42.285	2.119	15	

[a] Where *F* is the unreddened flux in units of 100.00 = 2.963×10^{-13}.

[b] Where *I* is the reddened corrected flux, with c(Hβ)=2.10±0.10, in units of 100.00 = 3.730×10^{-11}.

[c] Affected by telluric emission.

[d] Blended with an unknown line.

[e] Affected by charge transfer.

[f] Affected by atmospheric absorption bands.

Table 10. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3447.59	He I	7	3447.73	12.16	0.099	0.296	30	
3478.97	He I	43	3479.27	25.85	0.065	0.186	:	
3530.50	He I	36	3530.69	16.13	0.126	0.345	25	
3554.42	He I	34	3554.58	13.51	0.130	0.348	24	
3587.28	He I	32	3587.42	11.69	0.163	0.424	20	
3613.64	He I	6	3613.75	9.13	0.224	0.568	16	
3634.25	He I	28	3634.38	10.71	0.258	0.643	14	
3666.10	H I	H27	3666.26	13.08	0.183	0.444	18	
3667.68	H I	H26	3667.83	12.27	0.198	0.478	17	
3669.47	H I	H25	3669.65	14.70	0.226	0.545	16	
3671.48	H I	H24	3671.65	13.87	0.234	0.565	15	
3673.76	H I	H23	3673.92	13.05	0.273	0.658	14	
3676.37	H I	H22	3676.52	12.22	0.326	0.784	12	
3679.36	H I	H21	3679.53	13.84	0.372	0.890	11	
3682.81	H I	H20	3682.98	13.83	0.379	0.904	11	
3686.83	H I	H19	3687.01	14.63	0.461	1.096	10	
3691.56	H I	H18	3691.69	10.55	0.449	1.064	10	
—	?	—	3693.65	—	0.013	0.030	:	
3694.22	Ne II	1	3694.35	10.56	0.078	0.185	37	
—	?	—	3695.14	—	0.020	0.047	:	
3697.15	H I	H17	3697.30	12.17	0.515	1.214	10	
3703.86	H I	H16	3703.99	10.51	0.582	1.358	9	
3705.04	He I	25	3705.18	11.32	0.421	0.980	11	
3711.97	H I	H15	3712.15	14.53	0.733	1.698	9	
3721.83	[S III]	2F	3722.00	13.69	1.234	2.837	8	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3726.20	13.67	22.584	51.772	7	
3728.82	[O II]	1F	3728.95	10.44	9.712	22.218	7	
3734.37	H I	H13	3734.53	12.84	0.971	2.213	8	
3750.15	H I	H12	3750.30	12.00	1.206	2.715	8	
3770.63	H I	H11	3770.79	12.73	1.530	3.390	8	
3784.89	He I	64	3784.98	7.14	0.041	0.090	:	
3797.63	[S III]	2F	3798.07	34.75	2.075	4.506	7	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.80	14.91	0.740	1.582	8	
3833.57	He I	62	3833.69	9.37	0.034	0.072	:	
3835.39	H I	H9	3835.56	13.30	3.253	6.877	7	
3838.09	He I	61	3838.47	29.67	0.054	0.114	:	
3856.02	Si II	1	3856.17	11.65	0.080	0.166	37	
3862.59	Si II	1	3862.77	13.96	0.052	0.108	:	
3867.49	He I	20	3867.45	-3.10	0.040	0.083	:	
3868.75	[Ne III]	1F	3868.93	13.94	5.034	10.398	7	
3871.82	He I	60	3871.96	10.83	0.055	0.114	:	
3888.65	He I	2	3889.09	33.93	8.073	16.447	7	
3889.05	H I	H8	*	*	*	*	*	
3920.68	C II	4	3920.81	9.95	0.029	0.058	:	
3926.53	He I	58	3926.74	16.03	0.091	0.181	32	
3964.73	He I	5	3964.90	12.85	0.580	1.123	9	
3967.46	[Ne III]	1F	3967.69	17.38	1.111	2.145	7	
3970.07	H I	H7	3970.24	12.83	7.404	14.272	7	
3994.98	N II	12	3995.20	16.51	0.028	0.053	:	
4009.26	He I	55	4009.40	10.46	0.135	0.254	23	
4026.21	He I	18	4026.39	13.40	1.641	3.037	7	
4041.31	N II	39	4041.48	12.60	0.031	0.058	:	
4068.60	[S II]	1F	4068.79	14.00	1.873	3.355	7	
4069.62	O II	10	*	*	*	*	*	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4072.35	14.74	0.088	0.158	33	

Table 10. continued.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4075.86	O II	10	4076.48	9.55	0.745	1.327	8	
4076.35	[S II]	1F	*	*	*	*	*	
4089.29	O II	48	4089.49	14.66	0.037	0.065	:	
4097.22	O II	20	4097.48	19.01	0.070	0.123	:	
4097.26	O II	48	*	*	*	*	*	
4101.74	H I	H6	4101.92	13.13	14.165	24.739	6	
4104.99	O II	20	4105.14	10.95	0.025	0.044	:	
4110.79	O II	20	4110.99	14.60	0.027	0.047	:	
4119.22	O II	20	4119.41	13.82	0.036	0.062	:	
4120.82	He I	16	4121.06	17.48	0.183	0.314	18	
4132.80	O II	19	4133.06	18.88	0.038	0.065	:	
4143.76	He I	53	4143.95	13.78	0.261	0.443	13	
4153.30	O II	19	4153.48	13.00	0.059	0.099	:	
4156.53	O II	19	4156.57	2.89	0.030	0.051	:	
4168.97	He I	52	4169.31	24.44	0.048	0.079	:	
4169.22	O II	19	*	*	*	*	*	
4185.45	O II	36	4185.68	16.47	0.024	0.040	:	
4189.79	O II	36	4190.02	16.45	0.031	0.052	:	
4236.91	N II	48	4237.12	14.86	0.028	0.045	:	
4237.05	N II	48	*	*	*	*	*	
4241.78	N II	48	4241.96	12.73	0.031	0.050	:	
4267.15	C II	6	4267.35	14.06	0.370	0.587	10	
4294.78	S II	49	4295.08	20.96	0.021	0.032	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4304.04	29.96	0.025	0.039	:	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4317.33	13.19	0.046	0.071	:	
4319.63	O II	2	4319.79	11.11	0.028	0.043	:	
4325.76	O II	2	4326.23	32.58	0.028	0.044	:	
4336.83	O II	2	4337.09	17.96	0.021	0.032	:	
4340.47	H I	H5	4340.66	13.12	32.368	49.237	6	
4345.55	O II	65	4345.77	14.48	0.065	0.099	:	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4349.66	15.85	0.062	0.094	:	
4363.21	[O III]	2F	4363.40	13.05	0.844	1.263	7	
4366.89	O II	2	4367.07	12.34	0.048	0.071	:	
4368.19	O I	5	4368.45	17.86	0.020	0.029	:	
4368.25	O I	5	*	*	*	*	*	
4387.93	He I	51	4388.13	13.64	0.583	0.857	8	
4391.94	Ne II	55e	4392.39	30.73	0.006	0.008	:	
—	?	—	4394.43	—	0.017	0.025	:	
4409.30	Ne II	55e	4409.16	-9.50	0.005	0.007	:	
4414.90	O II	5	4415.11	14.26	0.023	0.033	:	
4416.97	O II	5	4417.10	8.82	0.034	0.049	:	
4437.55	He I	50	4437.76	14.18	0.067	0.094	:	
4471.47	He I	14	4471.70	15.42	4.798	6.556	5	
4481.21	Mg II	4	4481.37	10.71	0.024	0.033	:	
4491.23	O II	86a	4491.50	18.02	0.016	0.021	:	
4562.60	Mg I]	1	4562.72	7.89	0.022	0.028	:	
4571.10	Mg I]	1	4571.27	11.14	0.134	0.168	23	
4590.97	O II	15	4591.20	15.02	0.044	0.054	:	
4595.95	O II	15	4596.41	30.00	0.031	0.038	:	
4596.18	O II	15	*	*	*	*	*	
4601.48	N II	5	4601.82	22.14	0.066	0.081	:	
4602.13	O II	92b	*	*	*	*	*	
4607.16	N II	5	4607.35	12.36	0.068	0.083	:	
4609.44	O II	92a	4609.70	16.93	0.023	0.029	:	
4613.68	O II	92b	4613.98	19.48	0.030	0.037	:	
4613.87	N II	5	*	*	*	*	*	

Table 10. continued.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4621.39	N II	5	4621.61	14.25	0.043	0.051	:	
4638.86	O II	1	4639.03	10.98	0.092	0.109	32	
4640.64	N III	2	4640.54	-6.47	0.061	0.073	:	
4641.81	O II	1	4641.90	5.80	0.160	0.190	19	
4641.85	N III	2	*	*	*	*	*	
4649.13	O II	1	4649.34	13.54	0.257	0.304	13	
4650.84	O II	1	4651.21	23.86	0.083	0.098	35	
4658.05	[Fe III]	3F	4658.35	19.33	0.532	0.624	8	
4661.63	O II	1	4661.91	18.02	0.142	0.166	22	
4676.24	O II	1	4676.45	13.46	0.065	0.075	:	
4685.68	He II	3.4	4685.98	19.18	0.042	0.049	:	
4701.62	[Fe III]	3F	4701.81	12.11	0.172	0.195	18	
4713.14	He I	12	4713.39	15.90	0.731	0.822	7	
4733.93	[Fe III]	3F	4734.08	9.49	0.087	0.096	33	
4754.69	[Fe III]	3F	4754.97	17.67	0.085	0.092	34	
4769.43	[Fe III]	3F	4769.70	16.97	0.064	0.068	:	
4777.68	[Fe III]	3F	4777.96	17.56	0.041	0.044	:	
4803.29	N II	20	4803.39	6.25	0.040	0.042	:	
4861.33	H I	H4	4861.54	12.95	100.000	100.000	5	
4881.00	[Fe III]	2F	4881.28	17.18	0.296	0.292	12	
4921.93	He I	48	4922.15	13.38	1.780	1.698	5	
4924.50	[Fe III]	2F	4924.78	17.03	0.046	0.044	:	
4924.53	O II	28	*	*	*	*	*	
4958.91	[O III]	1F	4959.16	15.11	166.674	154.591	5	
4987.20	[Fe III]	2F	4987.58	22.83	0.111	0.100	27	
4987.38	N II	24	*	*	*	*	*	
4994.37	N II	24	4994.59	13.19	0.099	0.089	30	
5001.13	N II	19	5001.61	28.77	0.099	0.089	30	
5001.47	N II	19	*	*	*	*	*	
5006.84	[O III]	1F	5007.11	16.17	518.847	464.435	5	
5015.68	He I	4	5015.91	13.75	3.800	3.380	5	
5041.03	Si II	5	5041.21	10.71	0.159	0.139	23	
5045.10	N II	4	5045.32	13.06	0.084	0.073	33	
5047.74	He I	47	5048.02	16.62	0.251	0.219	14	
5055.98	Si II	5	5056.25	16.01	0.180	0.156	7	
5197.90	[N I]	1F	5198.14	13.86	0.345	0.271	6	
5200.26	[N I]	1F	5200.51	14.41	0.249	0.196	6	
5270.40	[Fe III]	1F	5270.76	20.47	0.480	0.360	6	
5342.38	C II	17.06	5342.63	14.03	0.051	0.036	13	
5412.00	[Fe III]	1F	5412.42	23.26	0.054	0.037	13	
5454.22	N II	29	5454.40	9.88	0.050	0.033	14	
5495.82	[Fe II]	17F	5495.93	6.02	0.075	0.048	11	
5517.71	[Cl III]	1F	5517.94	12.49	0.652	0.416	6	
5535.36	N II	63	5535.65	15.71	0.041	0.026	15	
5537.88	[Cl III]	1F	5538.09	11.37	1.386	0.871	6	
5551.95	N II	63	5552.07	6.46	0.030	0.019	19	
5666.64	N II	3	5666.88	12.68	0.237	0.136	7	
5676.02	N II	3	5676.26	12.66	0.090	0.051	10	
5679.56	N II	3	5679.82	13.71	0.395	0.224	7	
5686.21	N II	3	5686.40	10.01	0.067	0.038	12	
5710.76	N II	3	5710.99	12.10	0.083	0.046	11	
5754.64	[N II]	3F	5754.87	11.98	4.676	2.515	6	
5867.74	[Kr IV]	4S-2D	5868.28	27.56	0.041	0.021	16	
5875.64	He I	11	5875.93	14.80	41.097	20.376	7	
5931.78	N II	28	5932.16	19.22	0.057	0.027	13	
5941.65	N II	28	5941.96	15.64	0.070	0.033	12	
5957.57	Si II	4	5958.39	41.27	0.120	0.056	9	
5958.39	O I	23	*	*	*	*	*	
5958.58	O I	23	*	*	*	*	*	

Table 10. continued.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
5978.93	Si II	4	5979.23	15.03	0.085	0.040	11	
6046.23	O I	22	6046.63	19.83	0.052	0.023	14	
6046.44	O I	22	*	*	*	*	*	
6046.49	O I	22	*	*	*	*	*	
—	?	—	6143.50	—	0.035	0.015	18	
6151.43	C II	16.04	6151.59	7.78	0.056	0.024	14	
6167.75	N II	$3F_0$-3D	6168.10	17.02	0.035	0.015	18	
6173.31	N II	$3F_0$-3D	6173.69	18.45	0.035	0.015	18	
6300.30	[O I]	1F	6300.59	13.80	5.323	2.111	8	
6312.10	[S III]	3F	6312.36	12.34	4.908	1.935	8	
6347.11	Si II	2	6347.37	12.29	0.349	0.135	8	
6363.78	[O I]	1F	6364.06	13.20	1.813	0.697	8	
6371.36	Si II	2	6371.63	12.70	0.258	0.099	9	
6402.25	Ne I	1	6402.47	10.31	0.105	0.040	11	
6461.95	C II	17.04	6462.13	8.34	0.169	0.062	10	
6482.05	N II	$1P_0$-1P	6482.24	8.81	0.069	0.025	13	
6527.10	[N II]	1F	6527.51	18.82	0.108	0.039	11	
6548.03	[N II]	1F	6548.36	15.11	199.829	70.448	8	
6562.82	H I	H3	6563.10	12.80	821.775	287.812	8	
6578.05	C II	2	6578.33	12.77	0.897	0.312	9	
6583.41	[N II]	1F	6583.75	15.47	586.500	203.544	8	
6678.15	He I	46	6678.46	13.92	15.685	5.227	9	
6716.47	[S II]	2F	6716.76	12.92	14.863	4.877	9	
6730.85	[S II]	2F	6731.14	12.92	29.780	9.715	9	
7065.28	He I	10	7065.58	12.74	26.700	7.698	9	
7135.78	[Ar III]	1F	7136.10	13.46	91.626	25.782	10	
7155.16	[Fe II]	14F	7155.51	14.65	0.328	0.092	10	
7160.61	He I	1/10	7160.94	13.82	0.113	0.032	12	
7172.00	[Fe II]	14F	7172.09	3.76	0.093	0.026	12	d
7231.34	C II	3	7231.64	12.45	0.612	0.167	10	
7236.42	C II	3	7236.86	18.22	1.248	0.339	10	
7254.15	O I	20	7254.75	24.80	0.226	0.061	11	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7281.69	13.99	3.431	0.919	10	
7291.47	[Ca II]	1F	7291.72	10.28	0.076	0.020	13	
7298.05	He I	1/9	7298.37	13.16	0.156	0.042	11	
7318.92	[O II]	2F	7320.24	54.07	23.242	6.146	10	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7330.55	36.38	18.985	5.003	10	
7330.73	[O II]	2F	*	*	*	*	*	
7377.83	[Ni II]	2F	7378.19	14.62	0.296	0.077	10	
7388.16	[Fe II]	14F	7388.36	8.10	0.068	0.018	14	
7411.61	[Ni II]	2F	7412.29	27.51	0.035	0.009	19	
7442.30	N I	3	7442.68	15.32	0.059	0.015	15	
7452.54	[Fe II]	14F	7452.89	14.08	0.115	0.029	12	
7468.31	N I	3	7468.69	15.25	0.085	0.021	13	
7499.85	He I	1/8	7500.20	13.99	0.222	0.055	11	
7504.96	O II	2G-G$[5]_0$	7505.40	17.57	0.044	0.011	17	
7519.49	C II	16.08	7520.45	38.27	0.036	0.009	19	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7530.81	10.75	0.046	0.011	17	
7751.10	[Ar III]	2F	7751.47	14.31	26.071	6.044	11	
7771.93	O I	1	7773.66	66.72	0.291	0.067	11	c
7774.17	O I	1	*	*	*	*	*	
7775.39	O I	1	*	*	*	*	*	
7816.13	He I	1/7	7816.49	13.82	0.357	0.081	11	
8000.08	[Cr II]	1F	8000.23	5.62	0.049	0.011	17	
8015.90	He I	4/20	8016.38	17.95	0.030	0.007	21	

Table 10. continued.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8035.04	He I	4/19	8035.53	18.27	0.042	0.009	18	
8045.63	[Cl IV]	1F	8046.06	16.03	0.029	0.006	21	
8057.59	He I	4/18	8057.97	14.15	0.051	0.011	16	
8084.29	He I	4/17	8084.60	11.50	0.059	0.013	16	
8116.30	He I	4/16	8116.86	20.69	0.061	0.013	15	
8155.66	He I	4/15	8156.19	19.47	0.083	0.017	14	
8188.01	N I	2	8188.37	13.19	0.067	0.014	15	
8203.85	He I	4/14	8204.24	14.27	0.096	0.020	14	
8216.34	N I	2	8216.46	4.38	0.100	0.020	13	
8223.14	N I	2	8223.28	5.13	0.077	0.016	14	
8276.31	H I	P32	8276.68	13.41	0.476	0.096	12	
8281.12	H I	P31	8281.54	15.20	0.626	0.126	12	c
8286.43	H I	P30	8286.74	11.23	0.598	0.120	12	c
8292.31	H I	P29	8292.68	13.38	0.645	0.129	12	
8298.83	H I	P28	8299.16	11.92	0.897	0.179	12	c
8306.11	H I	P27	8306.54	15.51	0.750	0.149	12	
8314.26	H I	P26	8314.65	14.08	0.837	0.166	12	
8323.42	H I	P25	8323.81	14.03	0.953	0.189	12	
8333.78	H I	P24	8334.18	14.37	1.067	0.210	12	
8345.55	H I	P23	8345.99	15.82	1.063	0.208	12	
8359.00	H I	P22	8359.37	13.27	1.362	0.265	12	
8361.67	He I	1/6	8362.09	15.05	0.693	0.135	12	
8374.48	H I	P21	8374.86	13.60	1.459	0.282	12	
8392.40	H I	P20	8392.78	13.57	1.608	0.309	12	
8397.41	He I	6/19	8397.82	14.64	0.096	0.018	14	
8413.32	H I	P19	8413.70	13.54	1.774	0.337	12	
8421.96	He I	6/18	8422.38	14.95	0.083	0.016	14	
8433.85	[Cl III]	3F	8434.22	13.16	0.068	0.013	15	
8437.96	H I	P18	8438.34	13.50	2.031	0.381	12	
8446.25	O I	4	8446.81	19.86	1.934	0.361	12	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8467.25	H I	P17	8467.64	13.80	2.402	0.444	12	
8480.90	[Cl III]	3F	8481.19	10.25	0.104	0.019	14	
8486.27	He I	6/16	8486.67	14.14	0.112	0.020	14	
8502.48	H I	P16	8502.87	13.74	2.886	0.524	12	
8518.04	He I	2/8	8518.41	13.03	0.096	0.017	14	
8528.99	He I	6/15	8529.41	14.76	0.179	0.032	13	
8531.48	He I	7/15	8532.05	20.00	0.058	0.010	16	
8545.38	H I	P15	8545.78	14.05	3.483	0.618	12	
8578.70	[Cl II]	1F	8579.11	14.33	1.921	0.335	12	
8582.54	He I	3/10	8582.86	11.19	0.604	0.105	12	
8598.39	H I	P14	8598.79	13.96	4.160	0.718	12	
8616.95	[Fe II]	4H-2I	8617.31	12.50	0.686	0.117	12	
8648.10	He I	6/13	8648.86	26.37	0.281	0.047	13	c
8665.02	H I	P13	8665.41	13.51	5.300	0.883	12	
8711.70	N I	1	8711.93	7.90	0.069	0.011	16	
8718.83	N I	1	8719.11	9.64	0.022	0.004	26	
8727.13	[C I]	3F	8727.60	16.14	0.099	0.016	15	
8729.89	He I	10/13	8729.97	2.75	0.058	0.009	17	
8733.43	He I	6/12	8733.84	14.08	0.327	0.053	13	
8736.04	He I	7/12	8736.49	15.45	0.104	0.017	15	
8750.47	H I	P12	8750.88	14.05	6.356	1.014	13	
8776.60	He I	4/9	8777.69	37.26	0.857	0.135	13	c
8845.38	He I	6/11	8845.80	14.23	0.446	0.068	13	
8848.05	He I	7/11	8848.45	13.57	0.164	0.025	14	
8854.11	He I	5/11	8854.46	11.84	0.098	0.015	15	
8862.79	H I	P11	8863.20	13.87	8.840	1.336	13	
8891.91	[Fe II]	13F	8892.31	13.47	0.219	0.033	14	

Table 10. continued.

			M 1-25					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
8930.97	He I	10/11	8931.07	3.38	0.074	0.011	16	
8996.99	He I	6/10	8997.38	12.98	0.632	0.090	14	
9014.91	H I	P10	9015.31	13.28	11.877	1.687	13	
9051.95	[Fe II]	13F	9052.24	9.61	0.166	0.023	14	
9063.29	He I	4/8	9063.83	17.86	0.647	0.090	14	
9068.60	[S III]	1F	9069.38	25.79	361.977	50.503	14	
9085.13	He I	10/10	9085.73	19.82	0.084	0.012	16	
9123.60	[Cl II]	1F	9124.04	14.47	0.551	0.076	14	

[a] Where F is the unreddened flux in units of 100.00 = 5.008×10^{-13}.
[b] Where I is the reddened corrected flux, with C(Hβ)=1.41±0.09, in units of 100.00 = 1.287×10^{-11}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 11. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3703.86	H I	H16	3702.37	-120.65	0.725	1.329	7	
3705.04	He I	25	3703.53	-122.23	0.553	1.013	8	
3711.97	H I	H15	3710.48	-120.39	0.827	1.502	7	
3712.74	O II	3	3711.46	-103.39	0.066	0.119	19	
3721.83	[S III]	2F	3720.41	-114.44	1.233	2.228	7	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3724.54	-119.93	21.560	38.868	7	
3728.82	[O II]	1F	3727.29	-123.06	10.913	19.643	7	
3734.37	H I	H13	3732.88	-119.68	1.261	2.263	7	
3750.15	H I	H12	3748.64	-120.76	1.593	2.835	7	
3770.63	H I	H11	3769.12	-120.09	1.863	3.278	7	
3784.89	He I	64	3783.37	-120.43	0.027	0.048	37	
3797.63	[S III]	2F	3796.38	-98.71	2.569	4.457	7	
3797.90	H I	H10	*	*	*	*	*	
3805.74	He I	63	3804.21	-120.57	0.024	0.041	:	
3819.61	He I	22	3818.10	-118.56	0.939	1.612	7	
3829.77	Ne II	39	3828.25	-119.03	0.032	0.054	33	
3831.66	S II	—	3830.11	-121.31	0.025	0.043	:	
3833.57	He I	62	3832.02	-121.27	0.048	0.082	24	
3835.39	H I	H9	3833.85	-120.41	3.762	6.404	7	
3838.09	He I	61	3836.84	-97.67	0.102	0.173	14	
3842.18	N II	20	3840.67	-117.87	0.019	0.032	:	
3855.10	N II	20	3853.52	-122.93	0.025	0.043	39	
3856.02	Si II	1	3854.54	-115.11	0.131	0.221	12	
3856.13	O II	12	*	*	*	*	*	
3862.59	Si II	1	3860.98	-125.02	0.050	0.085	23	
3867.49	He I	20	3865.96	-118.65	0.061	0.103	20	
3868.75	[Ne III]	1F	3867.22	-118.61	3.417	5.720	7	
3871.82	He I	60	3870.21	-124.72	0.081	0.135	17	
3882.19	O II	12	3880.67	-117.43	0.029	0.049	35	
3888.65	He I	2	3887.33	-101.79	10.325	17.117	6	
3889.05	H I	H8	*	*	*	*	*	
3918.98	C II	4	3917.40	-120.92	0.062	0.101	20	
3920.68	C II	4	3919.09	-121.62	0.100	0.163	14	
3926.53	He I	58	3924.98	-118.39	0.108	0.175	14	
3964.73	He I	5	3963.15	-119.52	0.862	1.378	7	
3967.46	[Ne III]	1F	3965.86	-120.94	0.930	1.484	7	
3970.07	H I	H7	3968.63	-108.79	4.268	6.803	6	
3994.98	N II	12	3993.44	-115.61	0.052	0.082	23	
4009.26	He I	55	4007.67	-118.95	0.174	0.271	10	
4023.98	He I	54	4022.39	-118.51	0.019	0.030	:	
4026.08	N II	40	4024.60	-110.24	2.141	3.315	6	
4026.21	He I	18	*	*	*	*	*	
4035.07	O II	68	4033.53	-114.46	0.026	0.040	39	
4041.31	N II	39	4039.69	-120.23	0.055	0.085	22	
4043.60	O I	1P-1D	4041.95	-122.39	0.027	0.041	38	
4068.60	[S II]	1F	4066.98	-119.42	1.132	1.713	6	
4069.62	O II	10	4068.19	-105.39	0.135	0.204	12	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4070.54	-118.57	0.118	0.178	13	
4072.71	Si II	2D-2P	4071.41	-95.73	0.012	0.019	:	
4075.86	O II	10	4074.61	-91.97	0.502	0.756	7	
4076.35	[S II]	1F	*	*	*	*	*	
4078.84	O II	10	4077.21	-119.86	0.029	0.044	35	
4083.90	O II	47	4082.22	-123.37	0.026	0.039	38	
4085.11	O II	10	4083.43	-123.35	0.025	0.038	39	
4087.15	O II	48	4085.57	-115.93	0.025	0.038	39	
4089.29	O II	48	4087.64	-121.02	0.052	0.079	22	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4097.22	O II	20	4095.66	-114.21	0.078	0.117	17	
4097.26	O II	48	*	*	*	*	*	
4101.74	H I	H6	4100.09	-120.67	16.868	25.074	6	
4104.99	O II	20	4103.30	-123.50	0.036	0.054	30	
4110.79	O II	20	4109.15	-119.66	0.053	0.078	22	
4119.22	O II	20	4117.58	-119.41	0.040	0.059	27	
4120.82	He I	16	4119.15	-121.54	0.200	0.295	9	
4121.46	O II	19	4119.85	-117.15	0.046	0.067	25	
—	?	—	4130.10	—	0.049	0.071	24	
4132.80	O II	19	4131.15	-119.73	0.065	0.095	19	
4143.76	He I	53	4142.11	-119.41	0.334	0.486	8	
4153.30	O II	19	4151.65	-119.14	0.082	0.118	16	
4156.53	O II	19	4154.77	-126.98	0.050	0.072	23	
4168.97	He I	52	4167.42	-111.52	0.068	0.098	18	
4176.16	N II	—	4174.54	-116.35	0.033	0.047	32	
4185.45	O II	36	4183.82	-116.82	0.032	0.046	33	
4189.79	O II	36	4188.11	-120.27	0.035	0.049	31	
4236.91	N II	48	4235.28	-115.40	0.050	0.070	23	
4237.05	N II	48	*	*	*	*	*	
4241.78	N II	48	4240.08	-120.18	0.057	0.080	21	
4253.90	O II	109	4252.26	-115.63	0.030	0.042	34	
4253.91	O II	109	*	*	*	*	*	
4267.15	C II	6	4265.46	-118.78	0.709	0.983	6	
4275.55	O II	67	4273.86	-118.54	0.039	0.054	28	
4282.96	O II	67	4281.34	-113.45	0.008	0.011	:	
4291.25	O II	55	4289.50	-122.31	0.010	0.013	:	
4292.21	O II	78	4290.60	-112.48	0.016	0.022	:	
4294.78	S II	49	4293.08	-128.48	0.020	0.028	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4302.12	-103.81	0.035	0.048	31	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4315.42	-119.50	0.059	0.080	21	
4319.63	O II	2	4317.88	-121.50	0.036	0.048	30	
4325.76	O II	2	4324.04	-119.23	0.021	0.029	:	
4336.83	O II	2	4335.13	-117.58	0.026	0.035	38	
4340.47	H I	H5	4338.72	-120.92	36.184	48.765	6	
4345.55	O II	65	4343.82	-120.10	0.093	0.125	15	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4347.69	-120.00	0.086	0.115	16	
4363.21	[O III]	2F	4361.46	-120.29	0.159	0.212	10	
4366.89	O II	2	4365.14	-120.19	0.084	0.112	16	
4387.93	He I	51	4386.18	-119.61	0.712	0.936	6	
4391.94	Ne II	55e	4390.23	-116.77	0.027	0.035	37	
4409.30	Ne II	55e	4407.46	-125.14	0.020	0.026	:	
4414.90	O II	5	4413.16	-118.18	0.041	0.053	27	
4416.97	O II	5	4415.22	-118.82	0.042	0.054	27	
4432.45	[Fe II]	6F	4430.98	-99.47	0.040	0.051	27	
4437.55	He I	50	4435.80	-118.27	0.085	0.109	16	
4471.47	He I	14	4469.72	-117.38	5.988	7.481	5	
4481.21	Mg II	4	4479.49	-115.09	0.023	0.029	:	
4491.23	O II	86a	4489.45	-118.85	0.024	0.030	:	
4507.31	[S I]	3P-1S	4505.75	-103.80	0.019	0.023	:	
4530.41	N II	58b	4528.62	-118.50	0.038	0.045	29	
4552.52	N II	—	4550.65	-123.20	0.022	0.026	:	
4571.10	Mg I]	1	4569.26	-120.75	0.056	0.066	21	
4590.97	O II	15	4589.15	-118.91	0.047	0.055	24	
4594.60	O I	1F-1D$_0$	4592.85	-114.23	0.006	0.007	:	
4595.95	O II	15	4594.34	-105.08	0.029	0.033	35	
4596.18	O II	15	*	*	*	*	*	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4601.48	N II	5	4599.64	-119.92	0.100	0.116	14	
—	?	—	4604.41	—	0.038	0.044	28	
4607.16	N II	5	4605.29	-121.74	0.116	0.133	13	
4609.44	O II	92a	4607.64	-117.10	0.039	0.045	28	
4610.20	O II	2D-F[2]$_0$	4608.39	-117.75	0.020	0.023	:	
4613.68	O II	92b	4612.02	-107.91	0.087	0.099	15	
4613.87	N II	5	*	*	*	*	*	
—	?	—	4618.55	—	0.031	0.035	34	
4621.39	N II	5	4619.54	-120.06	0.131	0.150	12	
4630.54	N II	5	4628.69	-119.83	0.311	0.354	7	
4634.14	N III	2	4632.31	-118.44	0.036	0.041	30	
4638.86	O II	1	4636.98	-121.54	0.101	0.114	14	
4640.64	N III	2	4638.79	-119.57	0.059	0.067	20	
4641.81	O II	1	4639.96	-119.54	0.196	0.221	9	
4641.85	N III	2	*	*	*	*	*	
4643.06	N II	5	4641.25	-116.92	0.142	0.161	11	
4649.13	O II	1	4647.28	-119.35	0.294	0.331	7	
4650.84	O II	1	4649.00	-118.64	0.106	0.119	13	
4658.05	[Fe III]	3F	4656.23	-117.17	0.236	0.264	8	
4661.63	O II	1	4659.78	-119.03	0.114	0.128	13	
4673.73	O II	1	4671.91	-116.78	0.021	0.023	:	
4676.24	O II	1	4674.38	-119.31	0.073	0.080	17	
4699.22	O II	25	4697.36	-118.73	0.012	0.013	:	
4701.62	[Fe III]	3F	4699.66	-125.03	0.035	0.038	30	
4713.14	He I	12	4711.28	-118.38	0.732	0.797	6	
4740.17	[Ar IV]	1F	4738.29	-118.94	0.018	0.020	:	
4752.96	O II	94	4751.18	-112.30	0.012	0.013	:	
4754.69	[Fe III]	3F	4752.87	-114.79	0.024	0.025	:	
—	?	—	4754.59	—	0.019	0.020	:	
4769.43	[Fe III]	3F	4767.50	-121.37	0.023	0.024	:	
4772.06	[Fe II]	4F	4770.22	-115.63	0.026	0.027	38	
4779.71	N II	20	4777.77	-121.73	0.040	0.042	27	
4788.13	N II	20	4786.17	-122.77	0.047	0.049	24	
4802.70	C II	17.08	4800.50	-137.40	0.036	0.037	30	
4803.29	N II	20	4801.34	-121.77	0.102	0.105	14	
4815.51	S II	9	4813.64	-116.44	0.024	0.025	:	
4861.33	H I	H4	4859.38	-120.31	100.000	100.000	5	
4881.00	[Fe III]	2F	4879.09	-117.37	0.063	0.062	19	
4890.86	O II	28	4888.94	-117.73	0.049	0.049	23	
4921.93	He I	48	4919.96	-120.05	1.818	1.760	11	
4958.91	[O III]	1F	4956.94	-119.16	59.365	56.348	5	
4987.20	[Fe III]	2F	4985.38	-109.46	0.076	0.071	24	
4987.38	N II	24	*	*	*	*	*	
4994.37	N II	24	4992.35	-121.30	0.171	0.154	10	
5001.13	N II	19	4999.35	-106.73	0.233	0.216	10	
5001.47	N II	19	*	*	*	*	*	
5002.70	N II	4	5000.66	-122.30	0.054	0.050	22	
5006.84	[O III]	1F	5004.85	-119.19	183.189	169.541	5	
5010.62	N II	4	5008.64	-118.51	0.086	0.080	15	
5015.68	He I	4	5013.67	-120.20	3.520	3.243	5	
5032.13	C II	2P-2D	5030.02	-125.75	0.064	0.059	38	
5035.94	C II	2P-2D	5033.81	-126.85	0.044	0.040	34	
5041.03	Si II	5	5038.99	-121.34	0.106	0.096	16	
5045.10	N II	4	5043.10	-118.89	0.117	0.106	16	
5047.74	He I	47	5045.72	-120.02	0.227	0.185	13	
5055.98	Si II	5	5054.01	-116.87	0.200	0.180	6	
5121.82	C II	12	5119.77	-120.03	0.036	0.031	14	
5179.52	N I	5D-5F	5177.42	-121.60	0.033	0.028	14	
5191.82	[Ar III]	3F	5189.61	-127.66	0.033	0.028	15	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(\mathrm{H}\beta)$[a]	$I(\lambda)/I(\mathrm{H}\beta)$[b]	Err(%)	not
5197.90	[N I]	1F	5195.86	-117.71	0.334	0.282	6	
5200.26	[N I]	1F	5198.21	-118.22	0.250	0.211	6	
5270.40	[Fe III]	1F	5268.43	-112.08	0.085	0.070	9	
5342.38	C II	17.06	5340.31	-116.19	0.069	0.055	10	
5452.07	N II	29	5449.88	-120.47	0.019	0.014	21	
5453.81	S II	6	5451.91	-104.47	0.059	0.045	10	
5461.70	N II	3P-3D$_0$	5460.28	-77.99	0.049	0.037	12	
5462.58	N II	29	*	*	*	*	*	
5463.53	N II	3P-3D$_0$	5461.42	-115.82	0.031	0.023	15	
5478.09	N II	29	5475.82	-124.28	0.022	0.016	19	
5480.05	N II	29	5477.84	-120.95	0.040	0.030	13	
5495.98	N II	29	5493.47	-136.96	0.060	0.044	10	
5517.71	[Cl III]	1F	5515.48	-121.21	0.488	0.355	6	
5530.24	N II	63	5527.96	-123.66	0.030	0.022	16	
5535.36	N II	63	5533.18	-118.10	0.069	0.050	10	
5537.88	[Cl III]	1F	5535.63	-121.85	0.803	0.578	6	
—	?	—	5637.85	—	0.029	0.020	16	
5666.64	N II	3	5664.36	-120.69	0.328	0.222	6	
5675.46	N II	3	5673.76	-89.84	0.144	0.097	8	
5679.56	N II	3	5677.30	-119.35	0.540	0.362	6	
5686.21	N II	3	5683.96	-118.67	0.099	0.066	9	
5710.76	N II	3	5708.51	-118.16	0.108	0.071	8	
5746.97	[Fe II]	34F	5744.99	-103.32	0.028	0.018	16	
5754.64	[N II]	3F	5752.32	-120.93	2.493	1.608	6	
5875.64	He I	11	5873.32	-118.44	34.543	21.027	6	
5927.82	N II	28	5925.41	-121.92	0.089	0.053	9	
5931.78	N II	28	5929.44	-118.30	0.132	0.079	8	
5940.24	N II	28	5937.89	-118.65	0.054	0.032	12	
5941.65	N II	28	5939.32	-117.61	0.182	0.108	8	
5952.39	N II	28	5950.02	-119.42	0.051	0.030	12	
5957.57	Si II	4	5955.43	-107.71	0.040	0.023	14	
5978.93	Si II	4	5976.65	-114.38	0.070	0.041	10	
6046.23	O I	22	6044.08	-106.64	0.035	0.020	15	
6046.44	O I	22	*	*	*	*	*	
6046.49	O I	22	*	*	*	*	*	
6143.28	Ne II	2G-2[4]$_0$	6140.72	-124.96	0.026	0.014	18	
6151.43	C II	16.04	6148.88	-124.34	0.064	0.035	11	
6167.75	N II	3F$_0$-3D	6165.41	-113.77	0.035	0.019	15	
6170.16	N II	3F$_0$-3D	6167.73	-118.12	0.022	0.012	19	
6173.31	N II	3F$_0$-3D	6170.89	-117.56	0.037	0.020	14	
6259.48	C II	2P$_0$-2D	6257.11	-113.56	0.028	0.015	17	
6300.30	[O I]	1F	6297.85	-116.61	2.355	1.223	7	
6312.10	[S III]	3F	6309.57	-120.22	1.398	0.723	7	
6347.11	Si II	2	6344.58	-119.54	0.275	0.141	8	
6363.78	[O I]	1F	6361.31	-116.39	0.805	0.409	8	
6371.36	Si II	2	6368.85	-118.14	0.149	0.076	9	
6402.25	Ne I	1	6399.70	-119.44	0.094	0.047	10	
6461.95	C II	17.04	6459.27	-124.39	0.216	0.106	8	
6482.05	N II	1P$_0$-1P	6479.50	-117.97	0.071	0.034	11	
6527.10	[N II]	1F	6524.65	-112.58	0.096	0.046	10	
6548.03	[N II]	1F	6545.46	-117.70	185.935	88.847	8	
6562.82	H I	H3	6560.18	-120.63	621.637	295.659	8	
6578.05	C II	2	6575.44	-118.99	1.199	0.568	8	
6583.41	[N II]	1F	6580.81	-118.45	573.716	271.103	8	
6606.03	Cl I	2[1]$_0$-2S	6603.32	-123.03	0.293	0.137	8	
6678.15	He I	46	6675.51	-118.57	12.220	5.611	8	
6716.47	[S II]	2F	6713.80	-119.24	8.609	3.909	8	
6730.85	[S II]	2F	6728.18	-118.97	16.399	7.416	8	
6933.89	He I	1/13	6931.24	-114.61	0.029	0.012	17	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
7002.23	O I	21	6999.41	-120.78	0.040	0.017	15	
7032.00	Cl I	$1[2]_0$-2P	7029.33	-113.87	0.170	0.071	10	
—	?	—	7050.68	—	0.081	0.034	11	
7062.26	He I	1/11	7059.54	-115.50	0.067	0.028	12	
7065.28	He I	10	7062.46	-119.70	17.867	7.401	9	
7135.78	[Ar III]	1F	7132.95	-118.93	46.335	18.866	9	
7155.16	[Fe II]	14F	7152.62	-106.46	0.065	0.026	12	
7160.61	He I	1/10	7157.74	-120.19	0.078	0.032	11	
7231.34	C II	3	7228.45	-119.84	0.720	0.286	9	
7236.42	C II	3	7233.64	-115.21	1.405	0.558	9	
7254.15	O I	20	7251.54	-107.90	0.101	0.040	11	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7278.48	-118.22	2.229	0.876	9	
7298.05	He I	1/9	7295.13	-119.99	0.100	0.039	11	
7318.92	[O II]	2F	7317.01	-78.26	5.718	2.228	9	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7327.32	-95.75	4.617	1.794	9	
7330.73	[O II]	2F	*	*	*	*	*	
7499.85	He I	1/8	7496.87	-119.17	0.150	0.056	10	
7504.96	O II	2G-G$[5]_0$	7502.06	-115.88	0.024	0.009	20	
7508.89	C II	16.08	7506.77	-84.64	0.016	0.006	24	
7519.49	C II	16.08	7517.01	-98.93	0.042	0.016	15	
7519.86	C II	16.08	*	*	*	*	*	
7530.57	C II	16.08	7527.46	-123.85	0.015	0.006	26	
7751.10	[Ar III]	2F	7748.04	-118.40	12.145	4.310	10	
7771.93	O I	1	7768.87	-118.08	0.208	0.074	10	
7774.17	O I	1	7771.16	-116.11	0.170	0.060	11	
7775.39	O I	1	7772.42	-114.56	0.088	0.031	12	
7816.13	He I	1/7	7813.05	-118.18	0.240	0.084	10	
7889.90	[Ni III]	1F	7886.95	-112.12	0.030	0.010	18	
—	?	—	7899.35	—	0.062	0.021	13	
8035.04	He I	4/19	8031.96	-114.96	0.028	0.009	18	
8094.08	He I	2/10	8090.37	-137.47	0.022	0.007	21	
8116.30	He I	4/16	8113.16	-116.01	0.041	0.014	15	
8155.66	He I	4/15	8152.15	-129.09	0.044	0.015	15	
8184.85	N I	2	8181.28	-130.83	0.019	0.006	22	
8203.85	He I	4/14	8200.62	-118.06	0.057	0.019	14	
8257.85	H I	P37	8254.61	-117.64	0.257	0.083	11	
8260.93	H I	P36	8257.71	-116.89	0.248	0.080	11	
8264.28	H I	P35	8261.11	-115.04	0.382	0.123	11	
8264.56	He I	4/13	*	*	*	*	*	
8265.71	He I	2/9	8262.54	-115.02	0.088	0.028	12	
8267.94	H I	P34	8264.69	-117.89	0.305	0.098	11	
8271.93	H I	P33	8268.65	-118.90	0.329	0.106	11	
8276.31	H I	P32	8273.07	-117.38	0.324	0.104	11	
8281.12	H I	P31	8277.97	-114.09	0.377	0.121	11	
8286.43	H I	P30	8283.16	-118.33	0.365	0.117	11	
8298.83	H I	P28	8295.55	-118.55	0.457	0.146	11	
8306.11	H I	P27	8302.81	-119.18	0.479	0.153	11	
8314.26	H I	P26	8310.95	-119.38	0.568	0.181	11	
8323.42	H I	P25	8320.13	-118.55	0.569	0.180	11	
8329.87	He I	6/23	8326.63	-116.66	0.029	0.009	18	
8333.78	H I	P24	8330.50	-118.05	0.641	0.203	11	
8342.33	He I	4/12	8339.25	-110.73	0.134	0.042	12	
8343.27	He I	6/22	*	*	*	*	*	
8345.55	H I	P23	8342.32	-116.06	0.738	0.233	11	
8359.00	H I	P22	8355.69	-118.74	0.813	0.255	11	
8361.67	He I	1/6	8358.42	-116.57	0.464	0.145	11	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
8374.48	H I	P21	8371.17	-118.56	0.834	0.261	11	
8376.55	He I	6/20	8373.83	-97.37	0.106	0.033	12	
8392.40	H I	P20	8389.09	-118.31	0.917	0.285	11	
8397.41	He I	6/19	8394.16	-116.07	0.040	0.012	16	
8399.82	He I	7/19	8396.47	-119.63	0.024	0.007	20	
8413.32	H I	P19	8410.01	-118.01	1.072	0.331	11	
8421.96	He I	6/18	8418.68	-116.81	0.057	0.017	14	
8424.39	He I	7/18	8421.22	-112.85	0.031	0.009	18	
8437.96	H I	P18	8434.64	-118.01	1.250	0.382	11	
8444.34	He I	4/11	8441.17	-112.58	0.137	0.042	12	
8446.25	O I	4	8443.54	-96.22	0.544	0.166	11	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8447.86	-111.42	0.083	0.025	13	
8453.61	He I	7/17	8450.19	-121.33	0.044	0.013	15	
8467.25	H I	P17	8463.93	-117.61	1.413	0.427	11	
8486.27	He I	6/16	8482.91	-118.72	0.090	0.027	13	
8488.73	He I	7/16	8485.38	-118.38	0.039	0.012	16	
—	?	—	8491.94	—	0.026	0.008	19	
8499.70	[Cl III]	3F	8496.46	-114.33	0.033	0.010	17	
8502.48	H I	P16	8499.12	-118.53	1.666	0.497	11	
8518.04	He I	2/8	8514.68	-118.31	0.081	0.024	13	
8528.99	He I	6/15	8525.64	-117.82	0.125	0.037	12	
8531.48	He I	7/15	8528.34	-110.40	0.049	0.014	15	
8545.38	H I	P15	8542.01	-118.28	2.124	0.624	11	
8578.70	[Cl II]	1F	8575.38	-116.08	1.166	0.339	11	
8581.89	He I	6/14	8578.93	-103.44	0.329	0.095	11	
8584.38	He I	7/14	8581.13	-113.54	0.040	0.012	16	
8598.39	H I	P14	8595.00	-118.23	2.491	0.718	11	
8648.10	He I	6/13	8644.88	-111.66	0.172	0.049	12	c
8649.88	He I	7/13	8647.76	-73.50	0.030	0.008	18	
8665.02	H I	P13	8661.60	-118.37	3.197	0.899	11	
8727.13	[C I]	3F	8723.70	-117.86	0.072	0.020	14	
8728.90	N I	1	8726.36	-87.26	0.028	0.008	19	
8733.43	He I	6/12	8729.98	-118.45	0.224	0.061	12	
8736.04	He I	7/12	8732.54	-120.16	0.077	0.021	14	
8750.47	H I	P12	8747.01	-118.59	3.719	1.013	12	
8776.60	He I	4/9	8773.23	-115.13	0.237	0.064	12	
8816.50	He I	10/12	8813.10	-115.67	0.034	0.009	18	
8845.38	He I	6/11	8841.91	-117.64	0.273	0.072	12	
8848.05	He I	7/11	8844.62	-116.25	0.156	0.041	13	
8862.79	H I	P11	8859.30	-118.11	4.966	1.302	12	
8891.91	[Fe II]	13F	8888.45	-116.70	0.057	0.015	15	
8930.97	He I	10/11	8927.22	-125.93	0.055	0.014	15	
8996.99	He I	6/10	8993.40	-119.67	0.387	0.098	12	
8999.40	He I	7/10	8996.17	-107.65	0.166	0.042	13	
9014.91	H I	P10	9011.33	-119.10	6.190	1.553	12	
9063.29	He I	4/8	9059.77	-116.50	0.340	0.084	12	
9068.60	[S III]	1F	9065.38	-106.48	166.326	41.183	12	
9085.13	He I	10/10	9082.14	-98.70	0.040	0.010	17	
9123.60	[Cl II]	1F	9120.16	-113.06	0.291	0.071	13	
9210.28	He I	6/9	9206.70	-116.58	0.540	0.130	13	
9213.20	He I	7/9	9209.60	-117.21	0.230	0.056	13	
9223.55	[Cr II]	a^{4}G-a^{2}D	9220.07	-113.14	0.070	0.017	15	
9229.01	H I	P9	9225.38	-117.96	10.454	2.515	12	
—	?	—	9232.49	—	0.076	0.018	15	
9260.81	O I	8	9256.67	-134.07	0.056	0.014	16	
9260.85	O I	8	*	*	*	*	*	
9260.94	O I	8	*	*	*	*	*	

Table 11. continued.

			M 1-30					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
9262.58	O I	8	9258.99	-116.23	0.127	0.030	14	
9262.67	O I	8	*	*	*	*	*	
9262.83	O I	8	*	*	*	*	*	
9265.93	O I	8	9262.40	-114.23	0.115	0.028	14	
9266.01	O I	8	*	*	*	*	*	
9266.78	O I	8	*	*	*	*	*	
—	?	—	9269.75	—	0.385	0.092	13	
9303.42	He I	10/9	9299.53	-125.39	0.114	0.027	14	

[a] Where F is the unreddened flux in units of 100.00 = 5.204×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.00±0.08, in units of 100.00 = 5.204×10^{-12}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 12. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			M 1-32					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3703.86	H I	H16	3702.77	-88.26	0.452	0.992	13	
3705.04	He I	25	3703.88	-93.90	0.379	0.827	15	
3711.97	H I	H15	3710.89	-87.26	0.624	1.357	12	
3721.83	[S III]	2F	3720.73	-88.64	1.615	3.485	10	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3724.94	-87.73	34.294	73.758	9	
3728.82	[O II]	1F	3727.68	-91.69	15.476	33.221	9	
3734.37	H I	H13	3733.21	-93.17	1.061	2.269	10	
3750.15	H I	H12	3749.03	-89.55	1.256	2.655	10	
3770.63	H I	H11	3769.50	-89.86	1.609	3.355	10	
3797.63	[S III]	2F	3796.77	-67.89	2.175	4.451	9	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3818.48	-88.73	0.682	1.376	11	
3835.39	H I	H9	3834.25	-89.13	3.173	6.332	9	
3868.75	[Ne III]	1F	3867.59	-89.91	5.766	11.264	8	
3888.65	He I	2	3887.67	-75.57	10.329	19.925	8	
3889.05	H I	H8	*	*	*	*	*	
3964.73	He I	5	3963.56	-88.49	0.362	0.667	14	
3967.46	[Ne III]	1F	3966.39	-80.88	2.076	3.811	8	
3970.07	H I	H7	3969.03	-78.56	4.936	9.046	8	
4009.26	He I	55	4007.95	-97.99	0.219	0.391	19	
4026.21	He I	18	4025.02	-88.63	1.628	2.875	8	
4068.60	[S II]	1F	4067.39	-89.20	4.839	8.290	7	
4076.35	[S II]	1F	4075.14	-89.03	1.694	2.887	8	
4101.74	H I	H6	4100.52	-89.21	13.481	22.564	7	
4120.82	He I	16	4119.84	-71.31	0.247	0.408	17	
4132.80	O II	19	4131.50	-94.32	0.072	0.118	:	
4143.76	He I	53	4142.52	-89.72	0.232	0.377	18	
4153.30	O II	19	4152.03	-91.70	0.100	0.161	34	
4156.53	O II	19	4155.48	-75.74	0.046	0.074	:	
4169.22	O II	19	4168.21	-72.66	0.070	0.112	:	
—	?	—	4225.53	—	0.038	0.059	:	
4243.97	[Fe II]	21F	4242.71	-89.05	0.188	0.290	21	
4267.15	C II	6	4265.93	-85.72	1.326	2.028	8	
4275.55	O II	67	4275.51	-86.96	0.101	0.153	:	
4276.75	O II	67	*	*	*	*	*	
4287.39	[Fe II]	7F	4286.27	-78.34	0.113	0.172	31	
4317.14	O II	2	4316.91	-15.97	0.360	0.537	:	g
4319.63	O II	2	*	*	*	*	*	
4325.76	O II	2	4324.78	-67.93	0.100	0.148	34	g
4340.47	H I	H5	4339.18	-89.13	31.152	45.903	6	
4345.56	O II	2	4344.31	-86.26	0.051	0.074	:	
4349.43	O II	2	4348.37	-73.08	0.077	0.113	:	
4359.34	[Fe II]	7F	4358.08	-86.66	0.051	0.075	:	
4363.21	[O III]	2F	4361.93	-87.96	1.638	2.379	7	
4387.93	He I	51	4386.65	-87.50	0.599	0.854	10	
4437.55	He I	50	4436.35	-81.07	0.074	0.102	:	
4471.47	He I	14	4470.18	-86.52	4.809	6.422	6	
4507.31	[S I]	3P-1S	4506.30	-67.21	0.022	0.029	:	
4530.41	N II	58b	4529.38	-68.19	0.025	0.032	:	
4562.60	Mg I]	1	4561.25	-88.74	0.077	0.095	:	
4571.10	Mg I]	1	4569.73	-89.89	0.508	0.627	10	
4590.97	O II	15	4589.67	-84.93	0.014	0.017	:	
4595.95	O II	15	4594.92	-67.22	0.030	0.037	:	
4596.18	O II	15	*	*	*	*	*	
4601.48	N II	5	4600.01	-95.82	0.073	0.088	:	
4607.16	N II	5	4605.86	-84.64	0.246	0.296	17	
4613.87	N II	5	4612.52	-87.75	0.045	0.053	:	

Table 12. continued.

			M 1-32					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4621.39	N II	5	4620.00	-90.21	0.076	0.091	:	
4630.54	N II	5	4629.14	-90.66	0.294	0.347	15	
4638.86	O II	1	4639.86	64.61	0.442	0.519	11	
4641.81	O II	1	*	*	*	*	*	
4643.06	N II	5	*	*	*	*	*	
4649.13	O II	1	4648.23	-58.04	0.275	0.320	15	
4650.84	O II	1	*	*	*	*	*	
4658.05	[Fe III]	3F	4656.80	-80.47	3.580	4.150	6	
4661.63	O II	1	4660.17	-93.92	0.049	0.057	:	
4667.01	[Fe III]	3F	4665.72	-82.86	0.117	0.135	30	
4676.24	O II	1	4675.52	-46.18	0.087	0.100	:	
4685.68	He II	3.4	4684.23	-92.81	0.399	0.453	12	
4701.62	[Fe III]	3F	4700.22	-89.29	1.295	1.456	7	
4713.14	He I	12	4711.80	-85.28	0.711	0.793	8	
4733.93	[Fe III]	3F	4732.47	-92.49	0.576	0.632	9	
4740.17	[Ar IV]	1F	4738.95	-77.16	0.077	0.084	:	
4754.69	[Fe III]	3F	4753.41	-80.71	0.856	0.927	8	
4769.43	[Fe III]	3F	4768.16	-79.85	0.459	0.491	11	
4777.68	[Fe III]	3F	4776.38	-81.61	0.295	0.315	15	
4814.55	[Fe II]	20F	4813.17	-85.95	0.145	0.150	25	
4861.33	H I	H4	4859.88	-89.46	100.000	100.000	5	
4881.00	[Fe III]	2F	4879.65	-82.95	2.051	2.025	6	
4905.34	[Fe II]	20F	4904.81	-32.38	0.104	0.101	32	
4921.93	He I	48	4920.49	-87.73	1.812	1.738	6	
4958.91	[O III]	1F	4957.50	-85.28	149.495	139.640	5	
4987.20	[Fe III]	2F	4985.85	-91.98	0.414	0.380	12	
4987.38	N II	24	*	*	*	*	*	
4994.37	N II	24	4992.93	-86.46	0.286	0.260	31	
5006.84	[O III]	1F	5005.44	-83.84	475.613	429.912	5	
5015.68	He I	4	5014.25	-85.51	3.048	2.740	7	
5041.03	Si II	5	5039.70	-79.09	0.258	0.228	16	
5045.10	N II	4	5043.61	-88.58	0.086	0.076	:	
5047.74	He I	47	5046.33	-83.77	0.201	0.177	26	
5055.98	Si II	5	5054.58	-83.03	0.303	0.266	14	
5158.81	[Fe II]	19F	5157.29	-88.36	0.787	0.647	8	
5191.82	[Ar III]	3F	5190.16	-95.87	0.147	0.119	24	
5197.90	[N I]	1F	5196.43	-84.79	1.383	1.110	7	
5200.26	[N I]	1F	5198.78	-85.34	0.875	0.701	8	
5261.61	[Fe II]	19F	5259.88	-98.60	0.402	0.310	12	
5270.40	[Fe III]	1F	5269.11	-73.40	3.236	2.486	6	
5333.65	[Fe II]	19F	5332.10	-87.14	0.153	0.113	24	
5342.38	C II	17.06	5340.89	-83.62	0.210	0.155	19	
5376.45	[Fe II]	19F	5374.77	-93.72	0.106	0.076	32	
5412.00	[Fe III]	1F	5410.74	-69.80	0.432	0.304	11	
5433.13	[Fe II]	18F	5431.63	-82.79	0.058	0.040	:	
5453.81	S II	6	5452.22	-87.42	0.161	0.111	23	
5454.22	N II	29	*	*	*	*	*	
5462.58	N II	29	5461.34	-68.08	0.091	0.062	36	
5495.98	N II	29	5494.06	-104.76	0.152	0.102	24	
5506.87	[Cr III]	2F	5505.26	-87.69	0.119	0.079	29	
5517.71	[Cl III]	1F	5516.18	-83.14	0.832	0.550	9	
5527.34	[Fe II]	17F	5525.72	-87.87	0.245	0.161	17	
5537.88	[Cl III]	1F	5536.26	-87.73	1.737	1.134	7	
5551.96	[Cr III]	2F	5550.31	-89.12	0.204	0.132	19	
5666.64	N II	3	5665.03	-85.22	0.260	0.156	16	
5675.46	N II	3	5674.41	-55.46	0.108	0.064	32	
5679.56	N II	3	5677.93	-86.06	0.391	0.232	13	
5686.21	N II	3	5684.85	-71.71	0.108	0.064	32	
5710.76	N II	3	5709.27	-78.23	0.102	0.059	33	

Table 12. continued.

			M 1-32					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
5714.61	[Cr III]	1F	5713.01	-83.97	0.101	0.059	33	
5754.64	[N II]	3F	5752.97	-87.02	12.253	6.927	8	
5875.64	He I	11	5873.99	-84.21	36.971	19.384	8	
5931.78	N II	28	5930.09	-85.43	0.015	0.008	:	
5941.65	N II	28	5939.81	-92.86	0.045	0.023	:	
5958.39	O I	23	5956.63	-88.59	0.096	0.048	35	
5958.58	O I	23	*	*	*	*	*	
6000.20	[Ni III]	2F	5998.47	-86.46	0.144	0.070	26	
6151.43	C II	16.04	6149.65	-86.79	0.152	0.070	25	
6300.30	[O I]	1F	6298.50	-85.67	18.618	7.943	10	
6312.10	[S III]	3F	6310.31	-85.04	7.509	3.186	10	
6347.11	Si II	2	6345.30	-85.52	0.493	0.206	13	
6363.78	[O I]	1F	6361.96	-85.75	6.345	2.630	10	
6371.36	Si II	2	6369.69	-78.60	0.369	0.153	15	
6401.40	[Ni III]	2F	6400.13	-59.49	0.268	0.109	18	
6461.95	C II	17.04	6460.38	-72.84	0.229	0.091	16	e
6548.03	[N II]	1F	6546.19	-84.26	395.477	151.376	11	
6562.82	H I	H3	6560.91	-87.26	715.871	272.355	11	
6583.41	[N II]	1F	6581.55	-84.74	1230.628	464.267	11	
6678.15	He I	46	6676.25	-85.31	14.986	5.446	11	
6716.47	[S II]	2F	6714.52	-87.07	30.284	10.848	11	
6730.85	[S II]	2F	6728.90	-86.89	61.055	21.756	11	
6826.70	[Kr III]	—	6825.15	-68.10	0.167	0.058	24	e
7001.92	O I	21	7000.16	-75.36	0.096	0.031	36	
7065.28	He I	10	7063.27	-85.30	19.621	6.238	13	
7135.78	[Ar III]	1F	7133.76	-84.89	103.457	32.163	13	
7155.16	[Fe II]	14F	7153.08	-87.18	3.359	1.038	13	
7172.00	[Fe II]	14F	7169.86	-89.49	0.817	0.251	14	
7231.34	C II	3	7233.08	72.13	7.410	2.233	13	
7236.42	C II	3	*	*	*	*	*	
7237.17	C II	3	*	*	*	*	*	
7281.35	He I	45	7279.31	-84.02	3.623	1.076	13	
7291.47	[Ca II]	1F	7289.29	-89.67	1.273	0.377	14	
7318.92	[O II]	2F	7317.82	-45.07	50.055	14.694	13	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7328.15	-61.78	40.816	11.945	13	
7330.73	[O II]	2F	*	*	*	*	*	
7377.83	[Ni II]	2F	7375.74	-84.94	4.269	1.232	13	
7388.16	[Fe II]	14F	7386.19	-79.97	0.649	0.187	15	
7411.61	[Ni II]	2F	7409.66	-78.88	0.311	0.089	19	
7452.54	[Fe II]	14F	7450.39	-86.51	1.146	0.323	14	
7499.85	He I	1/8	7497.74	-84.36	0.189	0.053	24	
7504.96	O II	2G-G[5]$_0$	7502.86	-83.91	0.074	0.020	:	
7519.49	C II	16.08	7517.79	-67.80	0.103	0.028	35	
7519.86	C II	16.08	*	*	*	*	*	
7530.57	C II	16.08	7528.50	-82.42	0.017	0.005	:	
7592.74	He II	5.10	7589.73	-118.90	0.263	0.071	20	
7751.10	[Ar III]	2F	7748.96	-82.80	29.489	7.667	14	
7771.93	O I	1	7769.85	-80.26	0.234	0.061	22	
7774.17	O I	1	7772.02	-82.93	0.157	0.041	27	
7775.39	O I	1	7773.54	-71.35	0.205	0.053	23	c
7816.13	He I	1/7	7813.99	-82.09	0.302	0.077	20	
7876.03	[P II]	1D-1S	7873.48	-97.09	0.291	0.073	20	
7889.90	[Ni III]	1F	7888.01	-71.84	1.688	0.426	15	
—	?	—	7898.25	—	0.094	0.024	37	
8000.08	[Cr II]	1F	7997.67	-90.34	0.344	0.085	19	
8057.59	He I	4/18	8055.47	-78.88	0.035	0.009	:	
8084.29	He I	4/17	8081.98	-85.69	0.038	0.009	:	
8116.30	He I	4/16	8114.13	-80.17	0.036	0.009	:	

Table 12. continued.

			M 1-32					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8125.30	[Cr II]	1F	8123.08	-81.92	0.214	0.051	23	
8188.01	N I	2	8185.72	-83.85	0.071	0.017	:	
8203.85	He I	4/14	8201.65	-80.39	0.052	0.012	:	
8216.34	N I	2	8213.91	-88.68	0.127	0.030	31	
8223.14	N I	2	8220.70	-88.96	0.128	0.030	31	
8306.11	H I	P27	8303.78	-84.12	0.796	0.180	17	
8314.26	H I	P26	8311.83	-87.63	0.738	0.166	17	
8323.42	H I	P25	8321.01	-86.83	0.824	0.185	17	
8333.78	H I	P24	8331.46	-83.49	1.053	0.236	16	
8359.00	H I	P22	8356.64	-84.68	1.093	0.242	16	
8361.67	He I	1/6	8359.27	-86.09	0.588	0.130	18	
8374.48	H I	P21	8372.23	-80.57	1.416	0.312	16	c
8392.40	H I	P20	8390.06	-83.64	1.414	0.309	16	
8413.32	H I	P19	8410.95	-84.48	1.556	0.337	16	
8421.96	He I	6/18	8419.68	-81.19	0.064	0.014	:	
8437.96	H I	P18	8435.56	-85.31	1.847	0.395	16	
8444.34	He I	4/11	8442.36	-70.29	0.246	0.052	22	
8446.25	O I	4	8444.13	-75.27	1.844	0.393	17	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8448.83	-77.00	0.060	0.013	:	
8467.25	H I	P17	8465.27	-70.14	3.418	0.722	16	c
8486.27	He I	6/16	8483.88	-84.44	0.094	0.020	38	
8488.73	He I	7/16	8486.22	-88.70	0.083	0.017	:	
8502.48	H I	P16	8499.66	-99.48	3.461	0.719	17	c
8518.04	He I	2/8	8515.55	-87.67	0.122	0.025	32	
8528.99	He I	6/15	8526.59	-84.40	0.154	0.032	28	
8531.48	He I	7/15	8528.95	-88.94	0.092	0.019	39	
8545.38	H I	P15	8542.97	-84.58	3.280	0.667	17	
8578.70	[Cl II]	1F	8576.46	-78.31	4.541	0.909	17	
8598.39	H I	P14	8596.00	-83.34	4.132	0.819	17	
8616.95	[Fe II]	4H-2I	8614.46	-86.66	6.547	1.286	17	
8665.02	H I	P13	8662.58	-84.42	4.955	0.951	17	
8680.28	N I	1	8677.85	-83.97	0.067	0.013	:	
8728.90	N I	1	8724.66	-145.70	1.977	0.368	18	c
8733.43	He I	6/12	8730.98	-84.10	0.262	0.049	23	
8736.04	He I	7/12	8733.32	-93.36	0.103	0.019	37	
8750.47	H I	P12	8748.00	-84.64	6.215	1.145	18	f
8776.60	He I	4/9	8774.28	-79.25	0.329	0.060	22	
8845.38	He I	6/11	8842.98	-81.34	0.341	0.060	22	
8848.05	He I	7/11	8845.43	-88.80	0.155	0.027	29	
8854.11	He I	5/11	8851.69	-81.96	0.157	0.028	29	
8862.79	H I	P11	8860.31	-83.93	8.808	1.545	18	
8891.91	[Fe II]	13F	8889.29	-88.36	2.559	0.443	18	
8996.99	He I	6/10	8994.82	-72.32	0.812	0.135	19	
9014.91	H I	P10	9012.42	-82.84	10.782	1.785	19	f
9033.50	[Fe II]	13F	9030.41	-102.58	0.770	0.127	20	
9051.95	[Fe II]	13F	9049.45	-82.82	2.783	0.455	19	
9068.60	[S III]	1F	9066.43	-71.75	444.654	72.406	19	
9123.60	[Cl II]	1F	9121.18	-79.54	1.110	0.178	19	
9210.28	He I	6/9	9208.30	-64.48	1.141	0.179	20	
9229.01	H I	P9	9226.30	-88.06	19.148	3.003	19	
9267.56	[Fe II]	13F	9264.42	-101.60	1.239	0.193	20	

[a] Where F is the unreddened flux in units of 100.00 = 2.005×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.30±0.13, in units of 100.00 = 4.001×10^{-12}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.

Table 12. continued.

			M 1-32					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not

[f] Affected by atmospheric absorption bands.
[g] Lines are in the edge of one order and the overlapping is not suitable.

Table 13. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3512.51	He I	38	3512.73	18.77	0.089	0.219	23	
3530.50	He I	36	3530.76	22.08	0.075	0.181	26	
3554.42	He I	34	3554.63	17.71	0.091	0.217	22	
3587.28	He I	32	3587.48	16.71	0.174	0.403	15	
3613.64	He I	6	3613.86	18.27	0.222	0.504	13	
3634.25	He I	28	3634.48	18.97	0.223	0.498	13	
3658.64	H I	H34	3658.83	15.58	0.203	0.445	14	
3659.42	H I	H33	3659.67	20.48	0.111	0.243	19	
3660.28	H I	H32	3660.50	18.02	0.133	0.290	17	
3661.22	H I	H31	3661.44	18.01	0.145	0.316	17	
3662.26	H I	H30	3662.46	16.37	0.169	0.368	15	
3663.40	H I	H29	3663.60	16.38	0.150	0.328	16	
3664.68	H I	H28	3664.91	18.81	0.162	0.352	15	
3666.10	H I	H27	3666.31	17.17	0.168	0.366	15	
3667.68	H I	H26	3667.90	17.98	0.234	0.508	13	
3669.47	H I	H25	3669.68	17.15	0.227	0.494	13	
3671.48	H I	H24	3671.69	17.14	0.227	0.492	13	
3673.76	H I	H23	3673.97	17.13	0.289	0.625	12	
3676.37	H I	H22	3676.58	17.12	0.319	0.689	11	
3679.36	H I	H21	3679.59	18.74	0.358	0.771	11	
3682.81	H I	H20	3683.03	17.91	0.379	0.816	11	
3686.83	H I	H19	3687.05	17.89	0.435	0.932	10	
3691.56	H I	H18	3691.77	17.05	0.508	1.085	10	
3694.22	Ne II	1	3694.47	20.29	0.024	0.051	:	
3697.15	H I	H17	3697.36	17.04	0.559	1.190	9	
—	?	—	3701.41	—	0.020	0.042	:	
3703.86	H I	H16	3704.08	17.80	0.637	1.341	9	
3705.04	He I	25	3705.25	16.99	0.401	0.844	10	
3707.25	O III	14	3707.42	13.74	0.054	0.114	32	
3711.97	H I	H15	3712.19	17.76	0.741	1.551	9	
3721.83	[S III]	2F	3722.05	17.72	1.500	3.121	8	
3726.03	[O II]	1F	3726.25	17.70	8.868	18.397	8	
3728.82	[O II]	1F	3729.01	15.27	3.458	7.161	8	
3734.37	H I	H13	3734.61	19.26	1.104	2.278	8	
3750.15	H I	H12	3750.38	18.38	1.458	2.975	8	
3770.63	H I	H11	3770.86	18.30	1.763	3.549	8	
3797.63	[S III]	2F	3798.13	39.47	2.312	4.575	8	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.85	18.84	0.730	1.424	8	
3835.39	H I	H9	3835.62	17.99	3.433	6.633	7	
3862.59	Si II	1	3862.75	12.41	0.052	0.098	33	
3868.75	[Ne III]	1F	3869.00	19.37	38.219	72.338	7	
3871.82	He I	60	3872.06	18.58	0.054	0.102	32	
3888.65	He I	2	3889.19	41.63	7.067	13.214	7	
3889.05	H I	H8	*	*	*	*	*	
3918.98	C II	4	3919.25	20.65	0.019	0.035	:	
3920.68	C II	4	3920.90	16.82	0.026	0.047	:	
3926.53	He I	58	3926.75	16.79	0.088	0.160	22	
3964.73	He I	5	3964.98	18.90	0.600	1.073	8	
3967.46	[Ne III]	1F	3967.71	18.89	11.842	21.125	7	
3970.07	H I	H7	3970.33	19.63	7.475	13.314	7	
4009.26	He I	55	4009.50	17.94	0.145	0.253	16	
4026.21	He I	18	4026.45	17.87	1.527	2.623	7	
—	?	—	4032.38	—	0.025	0.043	:	
4041.31	N II	39	4041.60	21.51	0.015	0.025	:	
4068.60	[S II]	1F	4068.85	18.42	2.001	3.341	7	
4069.62	O II	10	4070.03	30.19	0.107	0.179	19	
4069.89	O II	10	*	*	*	*	*	

Table 13. continued.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4072.15	O II	10	4072.44	21.35	0.086	0.144	22	
4075.86	O II	10	4076.55	50.74	0.810	1.345	8	
4076.35	[S II]	1F	*	*	*	*	*	
4078.84	O II	10	4078.95	8.07	0.036	0.059	:	
4083.90	O II	47	4084.19	21.29	0.024	0.040	:	
4085.11	O II	10	4085.26	11.00	0.032	0.053	:	
4089.29	O II	48	4089.55	19.06	0.049	0.081	34	
4097.22	O II	20	4097.56	24.86	0.189	0.309	13	
4097.26	O II	48	*	*	*	*	*	
4101.74	H I	H6	4101.99	18.27	14.922	24.368	6	
4103.43	N III	1	4103.57	10.20	0.151	0.247	15	
4104.99	O II	20	4105.15	11.66	0.033	0.055	:	
4110.79	O II	20	4111.12	24.07	0.019	0.031	:	
4119.22	O II	20	4119.47	18.19	0.037	0.059	:	
4120.82	He I	16	4121.12	21.84	0.208	0.335	13	
4132.80	O II	19	4133.01	15.23	0.037	0.060	:	
4143.76	He I	53	4144.01	18.09	0.246	0.391	11	
4145.90	O II	106	4146.28	27.47	0.017	0.027	:	
4146.08	O II	106	*	*	*	*	*	
4153.30	O II	19	4153.56	18.78	0.050	0.080	33	
4156.53	O II	19	4156.64	7.96	0.040	0.064	39	
4168.97	He I	52	4169.30	23.70	0.048	0.076	34	
4185.45	O II	36	4185.76	22.17	0.029	0.045	:	
4189.79	O II	36	4190.03	17.15	0.042	0.065	38	
4253.54	S III	4	4254.09	38.75	0.034	0.051	:	
4253.90	O II	109	*	*	*	*	*	
4267.15	C II	6	4267.43	19.69	0.303	0.454	10	
4275.55	O II	67	4275.82	18.93	0.043	0.064	37	
4276.75	O II	67	*	*	*	*	*	
4285.69	O II	78	4285.93	16.80	0.011	0.016	:	
4287.39	[Fe II]	7F	4288.37	68.51	0.080	0.118	:	
4288.82	O II	53	*	*	*	*	*	
4294.78	S II	49	4295.12	23.75	0.015	0.022	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4304.05	30.64	0.020	0.030	:	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4317.40	18.04	0.041	0.060	38	
4319.63	O II	2	4319.80	11.79	0.032	0.046	:	
4325.76	O II	2	4326.04	19.42	0.019	0.028	:	
4332.71	O II	65	4333.04	22.84	0.014	0.021	:	
4336.83	O II	2	4337.12	20.05	0.021	0.031	:	
4340.47	H I	H5	4340.73	17.94	32.537	47.057	6	
4345.55	O II	65	4345.85	20.72	0.056	0.081	30	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4349.71	19.28	0.068	0.098	26	
4363.21	[O III]	2F	4363.48	18.55	3.306	4.713	6	
4366.89	O II	2	4367.16	18.54	0.048	0.068	34	
4368.19	O I	5	4368.52	22.65	0.052	0.073	32	
4368.25	O I	5	*	*	*	*	*	
4387.93	He I	51	4388.19	17.75	0.533	0.747	8	
4391.94	Ne II	55e	4392.22	19.13	0.014	0.020	:	
—	?	—	4394.26	—	0.015	0.021	:	
4409.30	Ne II	55e	4409.53	15.64	0.019	0.027	:	
4414.85	O III	46a	4415.19	23.08	0.033	0.045	:	
4416.97	O II	5	4417.24	18.33	0.041	0.056	38	
4437.55	He I	50	4437.85	20.29	0.066	0.090	27	
4465.41	O II	94	4465.71	20.13	0.019	0.025	:	
4471.47	He I	14	4471.78	20.75	4.383	5.768	6	
—	?	—	4529.90	—	0.007	0.009	:	

Table 13. continued.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4530.41	N II	58b	4530.55	9.24	0.050	0.062	33	
4571.10	Mg I]	1	4571.39	19.02	0.103	0.126	19	
4590.97	O II	15	4591.26	18.91	0.052	0.063	32	
4595.95	O II	15	4596.48	34.55	0.043	0.051	37	
4596.18	O II	15	*	*	*	*	*	
4607.16	N II	5	4607.27	7.15	0.025	0.030	:	
4609.44	O II	92a	4609.65	13.65	0.023	0.027	:	
4621.39	N II	5	4621.66	17.52	0.021	0.024	:	
4630.54	N II	5	4630.83	18.78	0.049	0.057	34	
4634.14	N III	2	4634.42	18.10	0.147	0.172	15	
4638.86	O II	1	4639.13	17.45	0.073	0.085	25	
4640.64	N III	2	4640.90	16.78	0.251	0.292	11	
4641.81	O II	1	4642.12	20.02	0.201	0.234	12	
4641.85	N III	2	*	*	*	*	*	
4643.06	N II	5	4643.34	18.06	0.021	0.025	:	
4647.42	C III	1	4647.74	20.66	0.017	0.020	:	
4649.13	O II	1	4649.43	19.36	0.303	0.351	10	
4650.84	O II	1	4651.12	18.07	0.092	0.106	21	
4658.05	[Fe III]	3F	4658.33	18.04	0.217	0.249	12	
4661.63	O II	1	4661.91	18.02	0.088	0.101	22	
4676.24	O II	1	4676.54	19.22	0.066	0.075	27	
4699.22	O II	25	4699.38	10.19	0.029	0.032	:	
4701.62	[Fe III]	3F	4701.83	13.39	0.082	0.092	23	
4711.37	[Ar IV]	1F	4711.65	17.80	0.252	0.279	11	
4713.14	He I	12	4713.47	20.99	0.882	0.978	6	
—	?	—	4732.34	—	0.034	0.037	:	
4733.93	[Fe III]	3F	4734.12	12.03	0.053	0.058	32	
4740.17	[Ar IV]	1F	4740.51	21.49	0.806	0.877	6	
4754.69	[Fe III]	3F	4754.98	18.29	0.031	0.034	:	
4861.33	H I	H4	4861.62	17.89	100.000	100.000	5	
4881.00	[Fe III]	2F	4881.29	17.81	0.094	0.093	21	
4921.93	He I	48	4922.23	18.26	1.635	1.569	6	
4924.50	[Fe III]	2F	4924.86	21.91	0.045	0.043	36	
4931.32	[O III]	1F	4931.52	12.17	0.102	0.098	19	
4958.91	[O III]	1F	4959.24	19.95	317.195	296.914	5	
5006.84	[O III]	1F	5007.19	20.96	987.494	895.916	5	
5015.68	He I	4	5016.00	19.11	3.046	2.748	5	
5041.03	Si II	5	5041.35	19.05	0.103	0.092	11	
5047.74	He I	47	5048.06	18.99	0.258	0.228	14	
5055.98	Si II	5	5056.33	20.76	0.136	0.120	10	
5146.61	O I	28	5147.00	22.72	0.061	0.051	16	
5146.65	O I	28	*	*	*	*	*	
5191.82	[Ar III]	3F	5192.01	10.97	0.133	0.108	10	
5197.90	[N I]	1F	5198.19	16.73	0.219	0.178	8	
5200.26	[N I]	1F	5200.53	15.57	0.159	0.129	9	
5270.40	[Fe III]	1F	5270.73	18.77	0.173	0.134	9	
5342.38	C II	17.06	5342.70	17.97	0.037	0.028	23	
5346.02	[Kr IV]	4S-2D	5346.34	17.93	0.020	0.015	35	
5517.71	[Cl III]	1F	5518.06	19.02	0.387	0.261	7	
5537.88	[Cl III]	1F	5538.15	14.62	0.929	0.618	6	
5666.64	N II	3	5666.98	17.98	0.072	0.044	15	
5676.02	N II	3	5676.33	16.38	0.029	0.018	28	
5679.56	N II	3	5679.91	18.48	0.138	0.084	10	
5710.76	N II	3	5711.16	21.02	0.020	0.012	36	
5754.64	[N II]	3F	5754.96	16.66	3.949	2.290	7	
5867.74	[Kr IV]	4S-2D	5868.05	15.82	0.037	0.020	23	
5875.64	He I	11	5876.01	18.86	33.373	18.009	7	
5927.82	N II	28	5928.06	12.15	0.018	0.009	39	
5931.78	N II	28	5932.08	15.18	0.029	0.015	28	

Table 13. continued.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
5940.24	N II	28	5940.66	21.19	0.022	0.012	33	
5941.65	N II	28	5942.00	17.66	0.041	0.022	22	
5958.39	O I	23	5958.65	13.07	0.109	0.056	12	
5958.58	O I	23	*	*	*	*	*	
5978.93	Si II	4	5979.29	18.04	0.055	0.028	18	
6046.23	O I	22	6046.74	25.30	0.099	0.049	13	
6046.44	O I	22	*	*	*	*	*	
6046.49	O I	22	*	*	*	*	*	
6101.83	[K IV]	1F	6102.08	12.28	0.048	0.023	20	
6151.43	C II	16.04	6151.69	12.66	0.044	0.021	21	
6300.30	[O I]	1F	6300.70	19.05	10.752	4.767	8	
6312.10	[S III]	3F	6312.46	17.09	5.016	2.212	8	
6347.11	Si II	2	6347.51	18.89	0.179	0.078	11	
6363.78	[O I]	1F	6364.18	18.86	3.662	1.580	8	
6371.36	Si II	2	6371.76	18.82	0.128	0.055	12	
6461.95	C II	17.04	6462.23	12.98	0.113	0.047	13	
6548.03	[N II]	1F	6548.45	19.25	46.878	18.742	9	
6562.82	H I	H3	6563.19	16.91	699.208	277.931	9	
6578.05	C II	2	6578.42	16.87	0.558	0.221	9	
6583.41	[N II]	1F	6583.82	18.65	143.959	56.765	9	
6678.15	He I	46	6678.56	18.41	11.980	4.559	9	
6716.47	[S II]	2F	6716.85	16.96	3.844	1.443	9	
6730.85	[S II]	2F	6731.22	16.48	8.391	3.134	9	
7001.92	O I	21	7002.55	26.97	0.131	0.045	13	
7062.26	He I	1/11	7062.77	21.66	0.082	0.028	16	
7065.28	He I	10	7065.66	16.14	30.266	10.138	10	
7135.78	[Ar III]	1F	7136.21	18.07	66.567	21.827	10	
7155.16	[Fe II]	14F	7155.70	22.63	0.113	0.037	14	
7160.61	He I	1/10	7161.00	16.33	0.095	0.031	15	
7170.62	[Ar IV]	2F	7171.13	21.31	0.066	0.021	18	
7172.00	[Fe II]	14F	7172.30	12.53	0.036	0.012	25	
7231.34	C II	3	7231.75	17.00	0.303	0.097	11	
7236.42	C II	3	7236.99	23.63	0.670	0.213	11	
7254.15	O I	20	7254.83	28.11	0.366	0.116	11	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7281.80	18.51	3.050	0.958	11	
7298.05	He I	1/9	7298.50	18.49	0.141	0.044	13	
7318.92	[O II]	2F	7319.56	26.22	7.735	2.402	11	
7319.99	[O II]	2F	7320.60	24.98	19.753	6.132	11	
7329.66	[O II]	2F	7330.17	20.85	12.393	3.836	11	
7330.73	[O II]	2F	7331.26	21.66	10.232	3.167	11	
7377.83	[Ni II]	2F	7378.42	23.97	0.052	0.016	20	
—	?	—	7402.08	—	0.197	0.060	13	
7499.85	He I	1/8	7500.31	18.38	0.210	0.062	13	
7519.49	C II	16.08	7520.30	32.27	0.036	0.011	25	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7530.93	15.53	0.356	0.104	12	
7751.10	[Ar III]	2F	7751.59	18.94	18.721	5.177	12	c
—	?	—	7895.51	—	0.077	0.021	17	
7816.13	He I	1/7	7816.62	18.80	0.341	0.093	12	
8035.04	He I	4/19	8035.57	19.77	0.032	0.008	28	
8045.63	[Cl IV]	1F	8046.20	21.25	0.883	0.229	12	
8116.30	He I	4/16	8116.78	17.73	0.051	0.013	21	
8155.66	He I	4/15	8156.08	15.44	0.062	0.016	19	
8184.85	N I	2	8185.34	17.94	0.045	0.011	23	
8188.01	N I	2	8188.46	16.48	0.096	0.024	16	
8203.85	He I	4/14	8204.34	17.91	0.064	0.016	19	
8210.72	N I	2	8211.19	17.19	0.042	0.011	23	

Table 13. continued.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
8216.34	N I	2	8216.70	13.15	0.124	0.031	15	
8223.14	N I	2	8223.62	17.52	0.110	0.027	16	
8255.02	H I	P38	8255.52	18.16	0.264	0.065	13	
8257.85	H I	P37	8258.38	19.25	0.283	0.070	13	
8260.93	H I	P36	8261.45	18.89	0.312	0.077	13	
8264.28	H I	P35	8264.93	23.56	0.452	0.111	13	d
8267.94	H I	P34	8268.45	18.48	0.339	0.083	13	
8271.93	H I	P33	8272.45	18.86	0.325	0.079	13	
8276.31	H I	P32	8276.81	18.11	0.389	0.095	13	
8281.12	H I	P31	8281.66	19.55	0.473	0.115	13	c
8286.43	H I	P30	8286.91	17.38	0.506	0.123	13	c
8292.31	H I	P29	8292.82	18.46	0.536	0.130	13	
8298.83	H I	P28	8299.31	17.32	0.680	0.165	13	c
8306.11	H I	P27	8306.63	18.75	0.635	0.154	13	
8314.26	H I	P26	8314.78	18.77	0.700	0.169	13	
8323.42	H I	P25	8323.94	18.75	0.773	0.186	13	
8329.87	He I	6/23	8330.48	21.96	0.052	0.013	21	
8333.78	H I	P24	8334.30	18.69	0.862	0.207	13	
8342.33	He I	4/12	8343.16	29.83	0.169	0.040	14	c
8345.55	H I	P23	8346.07	18.70	0.945	0.226	13	
8359.00	H I	P22	8359.50	17.93	1.105	0.262	13	
8361.67	He I	1/6	8362.23	20.10	0.674	0.160	13	
8374.48	H I	P21	8374.98	17.90	1.162	0.274	13	
8376.55	He I	6/20	8376.82	9.68	0.081	0.019	18	
8392.40	H I	P20	8392.92	18.56	1.355	0.317	13	
8397.41	He I	6/19	8397.89	17.12	0.074	0.017	18	
8413.32	H I	P19	8413.83	18.16	1.515	0.352	13	
8421.96	He I	6/18	8422.53	20.30	0.075	0.017	18	
8424.39	He I	7/18	8424.78	13.90	0.025	0.006	33	
8433.85	[Cl III]	3F	8434.24	13.88	0.126	0.029	16	
8437.96	H I	P18	8438.48	18.49	1.767	0.406	13	
8444.34	He I	4/11	8445.00	23.44	0.152	0.035	15	
8446.25	O I	4	8447.02	27.31	2.998	0.686	13	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8451.67	23.76	0.090	0.021	17	c
8453.61	He I	7/17	8453.98	13.12	0.054	0.012	21	
8467.25	H I	P17	8467.78	18.77	2.023	0.459	13	
8480.90	[Cl III]	3F	8481.35	15.88	0.124	0.028	16	
8486.27	He I	6/16	8486.75	16.97	0.100	0.022	17	
8488.73	He I	7/16	8489.35	21.86	0.038	0.009	25	
8488.77	He I	5/16	*	*	*	*	*	
8499.70	[Cl III]	3F	8500.56	30.31	0.146	0.033	15	c
8502.48	H I	P16	8503.00	18.32	2.390	0.533	13	
8518.04	He I	2/8	8518.60	19.69	0.054	0.012	21	
8528.99	He I	6/15	8529.54	19.32	0.129	0.028	16	
8531.48	He I	7/15	8532.12	22.48	0.045	0.010	23	
8545.38	H I	P15	8545.92	18.94	2.889	0.632	13	
8578.70	[Cl II]	1F	8579.25	19.21	0.817	0.176	14	
8582.54	He I	3/10	8582.86	11.19	0.378	0.081	14	
8584.38	He I	7/14	8584.92	18.86	0.049	0.011	22	
8598.39	H I	P14	8598.92	18.49	3.489	0.744	13	
8616.95	[Fe II]	4H-2I	8617.61	22.97	0.154	0.033	15	
8648.10	He I	6/13	8648.84	25.66	0.182	0.038	15	c
8665.02	H I	P13	8665.56	18.68	4.441	0.919	14	c
8680.28	N I	1	8680.80	17.94	0.098	0.020	17	
8683.40	N I	1	8684.05	22.42	0.077	0.016	19	c
8703.25	N I	1	8703.77	17.89	0.058	0.012	21	
8711.70	N I	1	8712.23	18.25	0.098	0.020	17	

Table 13. continued.

			M 1-61					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8727.13	[C I]	3F	8727.65	17.88	0.063	0.013	20	
8729.89	He I	10/13	8730.16	9.29	0.041	0.008	25	
8733.43	He I	6/12	8733.96	18.20	0.237	0.048	15	
8736.04	He I	7/12	8736.59	18.87	0.077	0.015	19	
8739.97	He I	5/12	8740.81	28.80	0.020	0.004	38	
8747.37	N I	1	8747.77	13.69	0.032	0.006	29	
8750.47	H I	P12	8751.00	18.17	5.310	1.057	14	
8776.60	He I	4/9	8777.30	23.92	0.263	0.052	15	c
—	?	—	8810.47	—	0.027	0.005	31	
8816.50	He I	10/12	8817.17	22.78	0.041	0.008	25	
8829.40	[S III]	3F	8830.29	30.20	0.071	0.014	20	
8845.38	He I	6/11	8845.91	17.97	0.318	0.061	15	
8848.05	He I	7/11	8848.58	17.97	0.105	0.020	17	c
8854.11	He I	5/11	8854.66	18.61	0.038	0.007	26	
8862.79	H I	P11	8863.33	18.27	7.172	1.362	14	
8891.91	[Fe II]	13F	8892.60	23.24	0.056	0.011	22	
8930.97	He I	10/11	8931.27	10.06	0.051	0.009	23	
8996.99	He I	6/10	8997.53	17.99	0.450	0.081	15	
8999.40	He I	7/10	9000.16	25.31	0.107	0.019	18	
9009.28	He I	3/10	9009.68	13.29	0.028	0.005	31	
9014.91	H I	P10	9015.47	18.61	9.589	1.724	15	
9063.29	He I	4/8	9063.93	21.16	0.440	0.078	15	
9068.60	[S III]	1F	9069.49	29.44	176.055	31.150	15	
9085.13	He I	10/10	9085.98	28.07	0.056	0.010	22	
9094.83	C I	3	9096.44	53.07	0.050	0.009	23	
9123.60	[Cl II]	1F	9124.21	20.05	0.247	0.043	16	

[a] Where F is the unreddened flux in units of 100.00 = 2.448×10^{-12}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.24±0.10, in units of 100.00 = 4.254×10^{-11}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 14. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			M 3-15					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
3498.64	He I	40	3499.77	96.81	0.269	1.253	32	
3705.04	He I	25	3705.06	1.62	0.302	1.059	29	
3713.08	Ne II	5	3713.27	15.33	0.464	1.612	22	
3721.83	[S III]	2F	3723.03	96.62	0.751	2.574	17	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3727.24	97.32	3.301	11.265	10	
3728.82	[O II]	1F	3729.99	94.03	1.415	4.814	13	
3734.37	H I	H13	3735.60	98.71	0.450	1.521	23	
3750.15	H I	H12	3751.29	91.12	0.594	1.972	19	
3770.63	H I	H11	3771.82	94.60	0.721	2.339	17	
3797.63	[S III]	2F	3799.10	116.02	1.122	3.535	14	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3820.84	96.51	0.331	1.017	27	
3835.39	H I	H9	3836.60	94.57	1.788	5.413	11	
3868.75	[Ne III]	1F	3870.00	96.83	18.602	54.407	8	
3888.65	He I	2	3890.17	117.14	4.829	13.839	9	
3889.05	H I	H8	*	*	*	*	*	
3964.73	He I	5	3965.97	93.73	0.255	0.676	33	
3967.46	[Ne III]	1F	3968.84	104.25	3.660	9.687	9	
3970.07	H I	H7	3971.34	95.87	4.818	12.718	9	
4026.21	He I	18	4027.48	94.54	0.872	2.167	15	
4068.60	[S II]	1F	4069.91	96.48	0.484	1.145	21	
4069.62	O II	10	4070.98	100.14	0.153	0.362	:	
4069.89	O II	10	*	*	*	*	*	
4075.86	O II	10	4077.51	85.28	0.289	0.677	30	
4076.35	[S II]	1F	*	*	*	*	*	
4097.33	N III	1	4098.68	106.79	0.246	0.565	33	
4101.74	H I	H6	4103.05	95.68	9.720	22.162	7	
4267.15	C II	6	4268.54	97.63	0.276	0.545	30	
4340.47	H I	H5	4341.86	95.95	24.484	45.498	6	
4363.21	[O III]	2F	4364.60	95.48	1.739	3.154	10	
4387.93	He I	51	4389.40	100.38	0.351	0.619	26	
4391.94	Ne II	55e	4391.27	-45.74	0.102	0.180	:	
4409.30	Ne II	55e	4408.68	-42.14	0.049	0.085	:	
4437.55	He I	50	4438.84	87.13	0.055	0.092	:	
4471.47	He I	14	4472.94	98.51	3.706	5.869	7	
4634.14	N III	2	4635.70	100.89	0.308	0.399	28	
4638.86	O II	1	4640.28	91.74	0.151	0.195	:	
4640.64	N III	2	4642.12	95.58	0.467	0.602	21	
4641.81	O II	1	4643.28	94.89	0.348	0.448	26	
4641.85	N III	2	*	*	*	*	*	
4649.13	O II	1	4650.62	96.06	0.438	0.558	22	
4650.84	O II	1	4652.32	95.37	0.200	0.255	38	
4658.05	[Fe III]	3F	4659.50	93.31	0.102	0.129	:	
4661.63	O II	1	4663.07	92.57	0.152	0.191	:	
4711.37	[Ar IV]	1F	4712.86	94.76	0.528	0.627	19	
4713.14	He I	12	4714.65	96.00	0.644	0.763	17	
4740.17	[Ar IV]	1F	4741.75	99.90	0.799	0.919	15	
4861.33	H I	H4	4862.89	96.18	100.000	100.000	5	
4921.93	He I	48	4923.51	96.18	1.635	1.521	11	
4958.91	[O III]	1F	4960.51	96.67	331.191	295.400	5	
5006.84	[O III]	1F	5008.51	99.96	1054.795	892.657	5	
5015.68	He I	4	5017.37	100.98	3.219	2.700	8	
5270.40	[Fe III]	1F	5272.10	96.68	0.158	0.103	18	
5342.38	C II	17.06	5344.08	95.38	0.077	0.047	27	
5517.71	[Cl III]	1F	5519.47	95.61	0.787	0.403	9	
5537.88	[Cl III]	1F	5539.63	94.71	1.387	0.695	8	
5666.64	N II	3	5668.57	102.05	0.149	0.065	19	

Table 14. continued.

			M 3-15					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
5679.56	N II	3	5681.38	96.03	0.253	0.109	14	
5754.64	[N II]	3F	5756.50	96.86	1.397	0.555	9	
5846.77	[Xe III]	—	5848.22	74.34	0.080	0.029	27	
5875.64	He I	11	5877.57	98.43	50.539	17.814	8	
6151.43	C II	16.04	6153.29	90.61	0.136	0.038	21	
6300.30	[O I]	1F	6302.45	102.29	4.266	1.080	10	
6312.10	[S III]	3F	6314.12	95.91	5.519	1.385	10	
6347.11	Si II	2	6349.19	98.22	0.304	0.074	15	
6363.78	[O I]	1F	6365.94	101.73	1.490	0.360	11	
6371.36	Si II	2	6373.42	96.90	0.286	0.069	15	
6461.95	C II	17.04	6463.92	91.35	0.341	0.077	15	
6548.03	[N II]	1F	6550.27	102.53	35.504	7.553	11	
6562.82	H I	H3	6564.94	96.82	1283.433	270.409	11	
6578.05	C II	2	6580.16	96.15	0.973	0.203	12	
6583.41	[N II]	1F	6585.64	101.51	113.027	23.494	11	
6678.15	He I	46	6680.34	98.28	23.555	4.612	11	
6716.47	[S II]	2F	6718.71	99.94	7.616	1.457	12	
6730.85	[S II]	2F	6733.09	99.73	14.470	2.745	12	
7065.28	He I	10	7067.52	95.03	43.814	6.921	13	
7135.78	[Ar III]	1F	7138.11	97.86	115.621	17.618	13	
7160.61	He I	1/10	7162.86	94.17	0.223	0.034	19	
7231.34	C II	3	7233.61	94.08	0.873	0.127	14	
7236.42	C II	3	7238.76	96.90	1.603	0.232	14	
7281.35	He I	45	7283.73	97.95	6.438	0.912	13	
7298.05	He I	1/9	7300.39	96.11	0.281	0.039	18	
7318.92	[O II]	2F	7322.33	139.62	16.744	2.327	13	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7332.62	121.02	13.720	1.897	13	
7330.73	[O II]	2F	*	*	*	*	*	
7499.85	He I	1/8	7502.30	97.89	0.388	0.050	17	
7530.54	[Cl IV]	1F	7532.89	93.53	0.965	0.121	15	
7751.10	[Ar III]	2F	7753.65	98.59	36.881	4.219	14	
7816.13	He I	1/7	7818.64	96.25	0.602	0.067	15	
8045.63	[Cl IV]	1F	8048.29	99.09	2.546	0.262	15	
8257.85	H I	P37	8260.51	96.54	0.717	0.067	17	
8260.93	H I	P36	8263.54	94.70	0.709	0.066	17	
8264.28	H I	P35	8267.07	101.18	1.057	0.099	16	c
8271.93	H I	P33	8274.68	99.63	0.884	0.082	16	c
8281.12	H I	P31	8283.86	99.17	0.877	0.081	16	c
8286.43	H I	P30	8289.23	101.29	1.263	0.116	16	c
8292.31	H I	P29	8295.32	108.81	2.122	0.195	16	c
8298.83	H I	P28	8301.55	98.22	1.517	0.139	16	c
8306.11	H I	P27	8308.84	98.48	1.543	0.141	16	
8314.26	H I	P26	8316.96	97.33	1.607	0.146	16	
8323.42	H I	P25	8326.15	98.31	1.705	0.154	16	
8333.78	H I	P24	8336.51	98.16	2.011	0.181	16	c
8342.33	He I	4/12	8345.31	107.03	0.333	0.030	16	
8345.55	H I	P23	8348.34	100.19	2.295	0.205	19	
8359.00	H I	P22	8361.73	97.90	2.906	0.257	16	
8374.48	H I	P21	8377.21	97.68	2.863	0.250	16	
8392.40	H I	P20	8395.15	98.20	3.241	0.280	16	
8413.32	H I	P19	8416.04	96.88	3.655	0.311	16	
8437.96	H I	P18	8440.69	96.98	4.200	0.351	16	
8444.34	He I	4/11	8447.22	102.21	0.360	0.030	19	
8446.25	O I	4	8449.37	110.70	0.638	0.053	18	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8453.83	100.36	0.201	0.017	22	
8467.25	H I	P17	8469.99	96.99	4.940	0.403	16	

Table 14. continued.

			M 3-15					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8480.90	[Cl III]	3F	8483.64	96.80	0.194	0.016	22	
8486.27	He I	6/16	8489.05	98.19	0.256	0.021	21	
8502.48	H I	P16	8505.26	97.96	6.245	0.496	17	
8528.99	He I	6/15	8531.73	96.29	0.290	0.023	20	
8545.38	H I	P15	8548.13	96.45	9.189	0.706	17	
8578.70	[Cl II]	1F	8581.57	100.27	0.918	0.069	18	
8582.54	He I	3/10	8585.10	89.38	0.913	0.068	18	
8598.39	H I	P14	8601.19	97.62	9.351	0.689	17	
8648.10	He I	6/13	8651.34	112.28	0.307	0.022	20	c
8665.02	H I	P13	8667.87	98.59	12.576	0.880	17	
8733.43	He I	6/12	8736.28	97.82	0.756	0.050	19	
8736.04	He I	7/12	8738.83	95.71	0.269	0.018	21	
8750.47	H I	P12	8753.35	98.63	15.527	1.018	18	
8776.60	He I	4/9	8779.62	103.14	0.827	0.053	19	c
8845.38	He I	6/11	8848.03	89.80	0.618	0.038	19	
8848.05	He I	7/11	8850.97	98.90	0.389	0.024	20	
8862.79	H I	P11	8865.79	101.44	23.296	1.411	18	
8996.99	He I	6/10	8999.67	89.26	0.586	0.033	20	
8999.40	He I	7/10	9002.51	103.55	0.455	0.025	21	
9014.91	H I	P10	9017.86	98.08	27.648	1.529	19	
9063.29	He I	4/8	9066.37	101.85	1.323	0.071	19	
9068.60	[S III]	1F	9071.91	109.40	532.315	28.665	19	
9085.13	He I	10/10	9088.03	95.68	0.373	0.020	21	
9123.60	[Cl II]	1F	9126.65	100.21	0.423	0.022	21	

[a] Where F is the unreddened flux in units of 100.00 = 9.010×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=2.09±0.13, in units of 100.00 = 1.108×10^{-10}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 15. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			NGC 5189					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3340.77	O III	3	3340.56	-18.84	2.733	4.085	9	
3345.83	[Ne v]	3P-1D	3345.70	-11.66	1.395	2.081	9	
3425.87	[Ne v]	3P-1D	3425.79	-7.01	3.019	4.374	8	
3428.65	O III	15	3428.42	-20.11	0.868	1.256	9	
3444.07	O III	15	3443.84	-20.02	6.225	8.963	8	
3554.42	He I	34	3554.16	-21.93	0.245	0.340	13	
3568.50	Ne II	5	3568.28	-18.48	0.416	0.576	10	
3587.28	He I	32	3587.03	-20.89	0.215	0.295	14	
3613.64	He I	6	3613.31	-27.37	0.137	0.187	18	
3634.25	He I	28	3633.96	-23.93	0.310	0.420	11	
3659.42	H I	H33	3659.09	-27.02	0.209	0.282	14	
3660.28	H I	H32	3659.94	-27.86	0.180	0.243	15	
3661.22	H I	H31	3660.92	-24.57	0.191	0.257	15	
3662.26	H I	H30	3661.96	-24.56	0.185	0.249	15	
3663.40	H I	H29	3663.15	-20.46	0.261	0.351	12	
3664.68	H I	H28	3664.40	-22.91	0.331	0.445	11	
3666.10	H I	H27	3665.80	-24.54	0.235	0.315	13	
3667.68	H I	H26	3667.38	-24.53	0.271	0.364	12	
3669.47	H I	H25	3669.16	-25.33	0.301	0.404	11	
3671.48	H I	H24	3671.19	-23.68	0.303	0.406	11	
3673.76	H I	H23	3673.48	-22.85	0.420	0.563	10	
3676.37	H I	H22	3676.05	-26.10	0.375	0.502	10	
3679.36	H I	H21	3679.08	-22.82	0.569	0.761	9	
3682.81	H I	H20	3682.50	-25.24	0.506	0.676	9	
3686.83	H I	H19	3686.53	-24.40	0.707	0.944	8	
3691.56	H I	H18	3691.26	-24.37	0.750	1.000	8	
3694.22	Ne II	1	3693.89	-26.79	0.052	0.070	35	
3697.15	H I	H17	3696.84	-25.12	0.851	1.132	8	
3703.86	H I	H16	3703.56	-24.29	0.930	1.234	8	
3705.04	He I	25	3704.70	-27.52	0.470	0.623	9	
3711.97	H I	H15	3711.72	-20.19	1.277	1.690	7	
3721.83	[S III]	2F	3721.49	-27.40	4.147	5.474	7	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3725.71	-25.75	104.378	137.635	7	
3728.82	[O II]	1F	3728.46	-28.95	82.060	108.130	7	
3734.37	H I	H13	3734.09	-22.48	1.924	2.532	7	
3750.15	H I	H12	3749.88	-21.59	2.462	3.226	7	
3754.69	O III	2	3754.49	-15.97	0.641	0.839	8	
3757.24	O III	2	3757.11	-10.36	0.550	0.719	9	
3759.87	O III	2	3759.64	-18.36	1.368	1.789	7	
3770.63	H I	H11	3770.35	-22.25	3.112	4.057	7	
3774.02	O III	2	3773.87	-11.91	0.292	0.380	11	
3781.72	He II	4.21	3781.41	-24.58	0.094	0.122	23	
3791.27	O III	2	3791.08	-15.02	0.209	0.271	14	
3797.63	[S III]	2F	3797.62	-0.77	4.098	5.307	7	
3797.90	H I	H10	*	*	*	*	*	
3813.50	He II	4.19	3813.27	-18.08	0.123	0.159	19	
3819.61	He I	22	3819.31	-23.55	0.851	1.096	8	
3833.57	He I	62	3833.54	-2.35	0.165	0.212	16	
3835.39	H I	H9	3835.11	-21.87	5.870	7.535	7	
3858.07	He II	4.17	3857.93	-10.89	0.239	0.305	12	
3868.75	[Ne III]	1F	3868.48	-20.93	122.747	156.328	6	
3871.82	He I	60	3871.43	-30.21	0.069	0.088	29	
3887.44	He II	4.16	3887.25	-14.65	0.192	0.243	14	
3888.65	He I	2	3888.58	-5.38	14.790	18.750	6	
3889.05	H I	H8	*	*	*	*	*	
3923.48	He II	4.15	3923.29	-14.51	0.284	0.357	11	
3926.53	He I	58	3926.23	-22.91	0.096	0.121	22	

Table 15. continued.

			NGC 5189					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3964.73	He I	5	3964.41	-24.20	0.562	0.700	8	
3967.46	[Ne III]	1F	3967.17	-21.92	38.515	47.963	6	
3970.07	H I	H7	3969.78	-21.90	13.202	16.430	6	
4009.26	He I	55	4008.93	-24.68	0.151	0.187	16	
4025.60	He II	4.13	4025.31	-21.60	0.290	0.356	11	
4026.21	He I	18	4025.84	-27.54	1.803	2.213	6	
4041.31	N II	39	4041.00	-23.00	0.022	0.026	:	
4068.60	[S II]	1F	4068.25	-25.80	6.809	8.270	6	
4068.91	C III	16	*	*	*	*	*	
4069.62	O II	10	4068.80	-60.42	0.340	0.413	10	g
4069.89	O II	10	*	*	*	*	*	
4070.26	C III	16	4069.53	-53.78	0.145	0.176	17	
4072.15	O II	10	4071.81	-25.02	0.122	0.148	19	
4075.86	O II	10	4075.48	-27.96	0.062	0.075	31	
4076.35	[S II]	1F	4076.00	-25.75	2.494	3.023	6	
4085.11	O II	10	4084.80	-22.76	0.033	0.040	:	
4087.15	O II	48	4086.83	-23.46	0.028	0.033	:	
4089.29	O II	48	4089.07	-16.13	0.036	0.043	:	
4097.22	O II	20	4097.09	-17.58	0.761	0.918	7	
4097.26	O II	48	*	*	*	*	*	
4097.33	N III	1	*	*	*	*	*	
4100.04	He II	4.12	4099.86	-13.17	0.524	0.632	8	
4101.74	H I	H6	4101.44	-21.95	23.013	27.714	6	
4103.43	N III	1	4103.15	-20.48	0.472	0.568	9	
4104.99	O II	20	*	*	*	*	*	
4119.22	O II	20	4118.87	-25.48	0.038	0.045	:	
4120.82	He I	16	4120.51	-22.56	0.191	0.229	14	
4143.76	He I	53	4143.43	-23.85	0.289	0.344	11	
4168.97	He I	52	4168.65	-23.04	0.051	0.060	36	
4185.45	O II	36	4185.10	-25.08	0.029	0.034	:	
4186.90	C III	18	4186.60	-21.47	0.019	0.023	:	
4189.79	O II	36	4189.40	-27.92	0.027	0.032	:	
4199.83	He II	4.11	4199.65	-12.86	0.807	0.952	7	
—	?	—	4227.62	—	0.178	0.209	15	
4236.91	N II	48	4236.61	-21.25	0.028	0.032	:	
4237.05	N II	48	*	*	*	*	*	
4241.78	N II	48	4241.50	-19.78	0.024	0.028	:	
4267.15	C II	6	4266.88	-18.97	0.254	0.296	12	
4303.61	O II	65	4303.50	-22.28	0.037	0.043	:	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4316.96	-12.51	0.035	0.040	:	
4338.67	He II	4.10	4338.45	-15.18	1.014	1.166	7	
4340.47	H I	H5	4340.13	-23.51	42.335	48.690	6	
4345.55	O II	65	4345.20	-24.83	0.024	0.027	:	
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4349.09	-23.46	0.057	0.065	33	
4363.21	[O III]	2F	4362.92	-19.93	10.635	12.166	6	
4366.89	O II	2	4366.66	-15.79	0.061	0.070	31	
4379.11	N III	18	4378.95	-10.93	0.145	0.166	17	
4387.93	He I	51	4387.57	-24.62	0.481	0.547	8	
4391.94	Ne II	55e	4391.66	-19.10	0.031	0.035	:	
4409.30	Ne II	55e	4408.87	-29.22	0.016	0.018	:	
4414.85	O III	46a	4414.56	-19.70	0.020	0.022	:	
4414.90	O II	5	*	*	*	*	*	
4416.97	O II	5	4416.62	-23.76	0.031	0.035	:	
4437.55	He I	50	4437.15	-27.02	0.049	0.055	37	
4452.38	O II	5	4452.64	17.52	0.030	0.034	:	
4471.47	He I	14	4471.14	-22.13	3.914	4.344	5	
4491.23	O II	86a	4490.90	-22.03	0.030	0.034	:	

Table 15. continued.

			NGC 5189					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
4510.92	N III	3	4510.76	-10.64	0.111	0.122	20	
4541.59	He II	4.9	4541.37	-14.50	1.487	1.616	6	
4562.60	Mg I]	1	4562.18	-27.59	0.133	0.144	18	
4571.10	Mg I]	1	4570.69	-26.90	0.164	0.177	15	
4590.97	O II	15	4590.58	-25.48	0.033	0.036	:	
4595.95	O II	15	4595.85	-6.53	0.024	0.025	:	
4596.18	O II	15	*	*	*	*	*	
4630.54	N II	5	4630.19	-22.67	0.052	0.056	35	
—	?	—	4631.95	—	0.031	0.033	:	
4634.14	N III	2	4633.82	-20.72	0.565	0.600	7	
4638.86	O II	1	4638.47	-25.18	0.068	0.072	29	
4640.64	N III	2	4640.30	-21.99	1.140	1.207	6	
4641.81	O II	1	4641.50	-20.03	0.226	0.239	12	
4641.85	N III	2	*	*	*	*	*	
4647.42	C III	1	4647.15	-17.42	0.039	0.041	:	
4649.13	O II	1	4648.78	-22.58	0.149	0.157	16	
4650.84	O II	1	4650.47	-23.83	0.093	0.098	23	
4658.05	[Fe III]	3F	4657.74	-19.93	0.046	0.048	39	
4658.54	C IV	8	4658.41	-8.37	0.068	0.071	29	
4661.63	O II	1	4661.28	-22.52	0.083	0.088	25	
4676.24	O II	1	4675.86	-24.39	0.047	0.049	38	
4685.68	He II	3.4	4685.49	-12.15	45.966	48.130	5	
4711.37	[Ar IV]	1F	4711.14	-14.63	3.797	3.949	5	
4713.14	He I	12	4712.77	-23.54	0.484	0.504	8	
4714.36	[Ne IV]	2D-2P	4714.00	-22.89	0.283	0.294	11	
4715.80	[Ne IV]	2D-2P	4715.55	-15.89	0.058	0.060	32	
4724.15	[Ne IV]	1F	4723.94	-13.32	0.282	0.293	11	
4725.62	[Ne IV]	1F	4725.40	-13.97	0.189	0.196	14	
4740.17	[Ar IV]	1F	4740.01	-10.13	3.256	3.362	5	
4859.32	He II	4.8	4859.05	-16.66	2.420	2.422	5	
4861.33	H I	H4	4860.94	-24.06	100.000	100.000	5	
4881.00	[Fe III]	2F	4881.36	22.10	0.011	0.011	:	
4921.93	He I	48	4921.53	-24.39	1.193	1.175	6	
4931.32	[O III]	1F	4930.87	-27.34	0.130	0.127	18	
4958.91	[O III]	1F	4958.56	-21.17	401.260	391.339	5	
5006.84	[O III]	1F	5006.50	-20.35	1240.777	1195.847	5	
5015.68	He I	4	5015.29	-23.32	1.734	1.667	7	
5047.74	He I	47	5047.33	-24.36	0.125	0.119	21	
5191.82	[Ar III]	3F	5191.35	-27.13	0.330	0.305	7	
5197.90	[N I]	1F	5197.48	-24.22	3.529	3.259	5	
5200.26	[N I]	1F	5199.82	-25.36	3.003	2.771	5	
5346.02	[Kr IV]	4S-2D	5345.83	-10.65	0.012	0.011	:	
5411.52	He II	4.7	5411.27	-13.85	4.026	3.548	5	
5517.71	[Cl III]	1F	5517.30	-22.29	1.757	1.512	6	
5537.88	[Cl III]	1F	5537.45	-23.26	1.547	1.325	6	
5592.37	O III	5	5591.98	-20.92	0.280	0.237	8	
5666.64	N II	3	5666.18	-24.34	0.056	0.046	21	
5676.02	N II	3	5675.59	-22.72	0.020	0.016	:	
5677.66	N II	3	5677.09	-30.12	0.021	0.017	:	
5679.56	N II	3	5679.16	-21.11	0.078	0.065	16	
5701.82	[Mn V]	4F-2G	5701.85	1.59	0.029	0.024	34	
5710.76	N II	3	5710.39	-19.41	0.021	0.017	:	
5754.64	[N II]	3F	5754.14	-26.05	8.505	6.918	6	
5846.77	[Xe III]	—	5846.23	-27.69	0.048	0.038	23	
5857.26	He II	5.30	5856.86	-20.47	0.035	0.028	30	
5861.00	[Mn V]	4F-2G	5861.27	13.81	0.039	0.031	27	
5867.74	[Kr IV]	4S-2D	5867.36	-19.44	0.098	0.078	14	
5869.02	He II	5.29	5869.05	1.52	0.058	0.046	20	c
5875.64	He I	11	5875.19	-22.97	15.215	12.043	6	

Table 15. continued.

			NGC 5189					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
5882.13	He II	5.28	5881.82	-15.80	0.038	0.030	28	
5885.40	[Mn v]	4F-2G	5885.50	5.10	0.017	0.014	:	
5896.78	He II	5.27	5896.52	-13.21	0.034	0.027	30	
5913.24	He II	5.26	5912.98	-13.20	0.054	0.043	21	
5931.78	N II	28	5931.41	-18.68	0.074	0.058	17	
5941.65	N II	28	5941.29	-18.16	0.031	0.024	33	
5952.39	N II	28	5952.54	7.55	0.053	0.041	22	c
5977.03	He II	5.23	5976.88	-7.52	0.161	0.125	11	
6004.73	He II	5.22	6004.22	-25.45	0.120	0.093	13	
6036.70	He II	5.21	6036.49	-10.43	0.096	0.074	14	
6074.10	He II	5.20	6073.88	-10.87	0.105	0.080	14	
6101.83	[K IV]	1F	6101.45	-18.67	0.135	0.102	12	
6118.20	He II	5.19	6117.97	-11.27	0.122	0.092	13	
6151.43	C II	16.04	6150.85	-28.27	0.029	0.022	34	
6170.60	He II	5.18	6170.05	-26.74	0.045	0.034	25	c
6233.80	He II	5.17	6233.44	-17.31	0.150	0.112	11	c
6300.30	[O I]	1F	6299.79	-24.26	25.841	18.985	7	
6310.85	He II	5.16	6310.46	-18.53	0.172	0.126	11	
6312.10	[S III]	3F	6311.64	-21.85	7.576	5.555	7	
6363.78	[O I]	1F	6363.27	-24.02	8.684	6.314	7	
6371.36	Si II	2	6370.92	-20.70	0.034	0.024	31	
6406.30	He II	5.15	6406.06	-11.22	0.285	0.206	9	
6435.10	[Ar v]	2P-1D	6434.90	-9.33	0.325	0.233	9	c
6461.95	C II	17.04	6461.49	-21.34	0.082	0.058	16	e
6527.11	He II	5.14	6526.74	-16.98	0.454	0.322	9	
6548.03	[N II]	1F	6547.49	-24.70	238.395	168.419	8	
6560.00	He II	4.6	6559.77	-10.51	8.474	5.976	8	
6562.82	H I	H3	6562.28	-24.67	418.744	295.179	8	
6583.41	[N II]	1F	6582.85	-25.51	730.007	513.035	8	
6678.15	He I	46	6677.63	-23.35	4.620	3.203	8	
6683.20	He II	5.13	6682.88	-14.37	0.420	0.291	9	
6716.47	[S II]	2F	6715.89	-25.89	69.284	47.789	8	
6730.85	[S II]	2F	6730.28	-25.40	84.095	57.894	8	
6795.00	[K IV]	1F	6794.76	-10.60	0.035	0.024	30	
6890.88	He II	5.12	6890.61	-11.75	0.651	0.439	9	
7005.67	[Ar v]	3P-1D	7005.61	-2.57	0.738	0.491	9	
7065.28	He I	10	7064.68	-25.44	4.772	3.152	9	
7135.78	[Ar III]	1F	7135.28	-21.01	60.062	39.359	9	
7170.62	[Ar IV]	2F	7170.37	-10.45	0.201	0.131	11	
7177.50	He II	5.11	7177.18	-13.36	0.728	0.475	9	
7236.42	C II	3	7235.88	-22.37	0.059	0.038	21	
7237.17	C II	3	7236.86	-12.84	0.045	0.029	25	
7237.40	[Ar IV]	2F	7237.49	3.74	0.123	0.079	14	
7262.76	[Ar IV]	2F	7262.68	-3.29	0.195	0.126	11	
7281.35	He I	45	7280.79	-23.06	0.999	0.644	9	
7318.92	[O II]	2F	7319.38	18.84	9.591	6.156	9	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7329.58	-3.28	8.474	5.433	9	
7330.73	[O II]	2F	*	*	*	*	*	
—	?	—	7400.38	—	0.150	0.095	13	c
7499.85	He I	1/8	7499.32	-21.20	0.066	0.042	20	
7530.54	[Cl IV]	1F	7529.88	-26.28	0.219	0.138	11	c
7592.74	He II	5.10	7592.37	-14.61	1.052	0.656	10	
7751.10	[Ar III]	2F	7750.54	-21.66	16.838	10.345	10	
7771.93	O I	1	7771.42	-19.68	0.032	0.020	32	
7775.39	O I	1	7774.78	-23.53	0.014	0.009	:	
8045.63	[Cl IV]	1F	8045.37	-9.68	0.926	0.555	10	
8160.10	[Cr II]	4G-2D	8159.45	-23.88	0.166	0.099	13	
8236.77	He II	5.9	8236.40	-13.44	1.749	1.029	10	

Table 15. continued.

			NGC 5189					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8257.85	H I	P37	8257.26	-21.42	0.096	0.056	16	
8260.93	H I	P36	8260.28	-23.57	0.097	0.057	16	
8264.28	H I	P35	8263.73	-19.95	0.106	0.062	16	c
8265.71	He I	2/9	8265.24	-17.04	0.060	0.035	21	
8267.94	H I	P34	8267.43	-18.52	0.105	0.062	16	
8276.31	H I	P32	8275.76	-19.92	0.120	0.070	15	
8292.31	H I	P29	8291.70	-22.03	0.151	0.089	14	
8306.11	H I	P27	8305.50	-22.03	0.183	0.107	13	
8314.26	H I	P26	8313.68	-20.92	0.201	0.117	13	
8323.42	H I	P25	8322.81	-21.99	0.254	0.148	12	
8333.78	H I	P24	8333.27	-18.37	0.306	0.178	12	
8359.00	H I	P22	8358.37	-22.59	0.323	0.187	12	
8361.67	He I	1/6	8360.96	-25.46	0.200	0.116	13	
—	?	—	8362.56	—	0.030	0.017	35	
8374.48	H I	P21	8373.82	-23.63	0.341	0.197	12	
8376.55	He I	6/20	8375.46	-39.01	0.061	0.035	21	
8392.40	H I	P20	8391.78	-22.15	0.451	0.260	11	
8413.32	H I	P19	8412.73	-21.02	0.487	0.280	11	
8437.96	H I	P18	8437.36	-21.31	0.565	0.323	11	
8444.34	He I	4/11	8443.78	-19.87	0.044	0.025	26	
8446.25	O I	4	8445.74	-18.09	0.096	0.055	17	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8467.25	H I	P17	8466.66	-20.89	0.648	0.369	11	
8480.67	He II	6.33	8480.24	-15.19	0.068	0.039	20	
8486.27	He I	6/16	8485.66	-21.53	0.037	0.021	30	
8502.48	H I	P16	8501.89	-20.83	0.859	0.486	11	
8545.38	H I	P15	8544.78	-21.04	1.023	0.575	11	
8578.70	[Cl II]	1F	8577.99	-24.81	1.452	0.811	11	
8598.39	H I	P14	8597.72	-23.36	1.369	0.762	11	
8665.02	H I	P13	8664.21	-28.01	1.999	1.100	11	c
—	?	—	8703.63	—	0.047	0.026	25	
8733.43	He I	6/12	8732.74	-23.67	0.059	0.032	22	
8747.00	He II	6.24	8746.52	-16.47	0.073	0.040	20	
8750.47	H I	P12	8749.86	-20.88	1.957	1.061	12	
—	?	—	8794.21	—	0.059	0.032	22	
8798.90	He II	6.23	8798.51	-13.31	0.058	0.031	22	
8845.38	He I	6/11	8844.96	-14.23	0.158	0.084	15	
8848.05	He I	7/11	8847.07	-33.19	0.042	0.022	28	
8859.10	He II	6.22	8858.79	-10.48	0.079	0.042	19	
8862.79	H I	P11	8862.17	-20.98	2.767	1.474	12	
9011.20	He II	6.20	9010.69	-16.96	0.100	0.052	17	
9014.91	H I	P10	9014.27	-21.31	3.477	1.815	12	
9063.29	He I	4/8	9062.58	-23.49	0.101	0.053	17	
9068.60	[S III]	1F	9068.30	-9.91	136.444	70.770	12	
9108.50	He II	6.19	9108.11	-12.83	0.109	0.056	17	
9123.60	[Cl II]	1F	9122.87	-23.97	0.409	0.211	13	

[a] Where F is the unreddened flux in units of 100.00 = 1.165×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=0.47±0.08, in units of 100.00 = 3.438×10^{-13}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.
[g] Partially blended with a strong emission line.

Table 16. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			NGC 6369					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
3703.86	H I	H16	3702.57	-104.45	0.415	1.335	9	
3705.04	He I	25	3703.72	-106.85	0.289	0.930	11	
3711.97	H I	H15	3710.68	-104.22	0.470	1.488	9	
3721.83	[S III]	2F	3720.59	-99.91	0.847	2.651	7	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3724.87	-93.35	8.621	26.875	6	
3728.82	[O II]	1F	3727.65	-94.11	4.772	14.833	6	
3734.37	H I	H13	3733.08	-103.60	0.721	2.227	8	
3750.15	H I	H12	3748.86	-103.14	0.886	2.692	7	
3770.63	H I	H11	3769.33	-103.38	1.192	3.547	7	
3797.63	[S III]	2F	3796.57	-83.69	1.721	4.982	7	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3818.31	-102.07	0.518	1.469	9	
3835.39	H I	H9	3834.06	-103.98	2.420	6.752	6	
3868.75	[Ne III]	1F	3867.43	-102.33	33.120	89.519	6	
3888.65	He I	2	3887.52	-87.13	6.804	18.047	6	
3889.05	H I	H8	*	*	*	*	*	
3964.73	He I	5	3963.35	-104.38	0.337	0.834	10	
3967.46	[Ne III]	1F	3966.09	-103.55	11.191	27.586	6	
3970.07	H I	H7	3968.76	-98.96	5.045	12.403	6	
4009.26	He I	55	4007.89	-102.49	0.082	0.193	24	
4026.21	He I	18	4024.82	-103.53	0.982	2.283	7	
4067.94	C III	16	4066.51	-105.42	0.064	0.142	29	
4068.60	[S II]	1F	4067.32	-117.18	0.488	1.084	8	
4068.91	C III	16	*	*	*	*	*	
4070.26	C III	16	4068.47	-131.90	0.107	0.238	20	
4075.86	O II	10	4074.34	-111.80	0.142	0.314	:	
4076.35	[S II]	1F	4075.13	-89.72	0.163	0.361	:	
4097.33	N III	1	4095.89	-105.41	0.193	0.417	14	
4101.74	H I	H6	4100.32	-103.85	11.344	24.374	6	
4103.43	N III	1	4101.93	-109.63	0.131	0.282	17	
4120.82	He I	16	4119.48	-97.51	0.108	0.228	20	
4132.80	O II	19	4131.33	-106.65	0.058	0.120	31	
4143.76	He I	53	4142.34	-102.76	0.178	0.367	14	
4145.90	O II	106	4144.57	-96.21	0.025	0.050	:	
4146.08	O II	106	*	*	*	*	*	
4267.15	C II	6	4265.67	-104.01	0.421	0.792	9	
4340.47	H I	H5	4338.96	-104.35	26.532	47.180	5	
4345.56	O II	2	4344.05	-104.23	0.022	0.022	:	
4349.43	O II	2	4348.04	-95.85	0.031	0.031	:	
4363.21	[O III]	2F	4361.69	-104.48	5.391	9.380	5	
4379.11	N III	18	4377.72	-95.16	0.025	0.043	:	
4387.93	He I	51	4386.44	-101.85	0.393	0.667	9	
4437.55	He I	50	4436.08	-99.32	0.062	0.099	29	
4471.47	He I	14	4469.96	-101.29	3.467	5.326	5	
4562.60	Mg I]	1	4561.15	-95.32	0.126	0.173	18	
4571.10	Mg I]	1	4569.61	-97.77	0.361	0.493	9	
4616.39	N III	4P-4P$_0$	4614.91	-96.14	0.026	0.034	:	
4630.54	N II	5	4628.98	-101.04	0.018	0.023	:	
4634.14	N III	2	4632.51	-105.51	0.131	0.167	17	
4638.86	O II	1	4637.19	-107.96	0.058	0.074	30	
4640.64	N III	2	4639.01	-105.36	0.268	0.340	11	
4641.81	O II	1	4640.24	-101.42	0.145	0.184	16	
4641.85	N III	2	*	*	*	*	*	
4647.42	C III	1	4645.79	-105.18	0.091	0.115	22	
4649.13	O II	1	4647.53	-103.22	0.148	0.186	16	
4650.25	C III	1	4648.98	-81.90	0.119	0.150	18	
4650.84	O II	1	*	*	*	*	*	

Table 16. continued.

			NGC 6369					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4651.47	C III	1	*	*	*	*	*	
4661.63	O II	1	4660.05	-101.65	0.065	0.081	28	
4676.24	O II	1	4674.68	-100.05	0.030	0.037	:	
4685.68	He II	3.4	4684.20	-94.72	0.394	0.477	9	
4711.37	[Ar IV]	1F	4709.71	-105.68	0.889	1.047	7	
4713.14	He I	12	4711.54	-101.81	0.626	0.737	7	
4740.17	[Ar IV]	1F	4738.54	-103.12	1.089	1.244	6	
4861.33	H I	H4	4859.64	-104.25	100.000	100.000	5	
4921.93	He I	48	4920.22	-104.19	1.505	1.414	6	
4931.32	[O III]	1F	4929.59	-105.21	0.134	0.125	17	
4958.91	[O III]	1F	4957.25	-100.40	425.135	384.265	5	
5006.84	[O III]	1F	5005.17	-100.02	1343.513	1156.596	5	
5015.68	He I	4	5013.96	-102.85	2.675	2.283	6	
5047.74	He I	47	5045.94	-106.96	0.271	0.225	15	
5191.82	[Ar III]	3F	5190.00	-105.12	0.147	0.107	23	
5197.90	[N I]	1F	5196.50	-80.76	0.161	0.117	22	
5200.26	[N I]	1F	5198.65	-92.84	0.177	0.128	20	
5346.02	[Kr IV]	4S-2D	5344.30	-96.50	0.139	0.088	24	
5411.52	He II	4.7	5409.88	-90.89	0.033	0.020	:	
5517.71	[Cl III]	1F	5515.82	-102.73	1.118	0.605	7	
5537.88	[Cl III]	1F	5535.96	-103.97	1.383	0.734	7	
5647.40	C III	3H-3G	5645.45	-103.54	0.049	0.024	:	
5679.56	N II	3	5677.67	-99.80	0.082	0.038	36	
5754.64	[N II]	3F	5752.71	-100.59	2.360	1.012	6	
5867.74	[Kr IV]	4S-2D	5865.73	-102.74	0.319	0.123	14	
5875.64	He I	11	5873.67	-100.56	42.824	16.423	6	
6101.83	[K IV]	1F	6099.65	-107.15	0.324	0.105	14	
6151.43	C II	16.04	6149.36	-100.93	0.143	0.045	24	
6300.30	[O I]	1F	6298.37	-91.85	8.361	2.360	6	
6312.10	[S III]	3F	6309.95	-102.14	6.437	1.803	6	
6347.11	Si II	2	6345.00	-99.69	0.071	0.019	:	
6363.78	[O I]	1F	6361.84	-91.42	2.896	0.783	7	
6371.36	Si II	2	6369.28	-97.91	0.089	0.024	34	
6461.95	C II	17.04	6459.57	-110.47	0.364	0.092	13	
6548.03	[N II]	1F	6546.12	-87.46	45.135	10.847	7	
6562.82	H I	H3	6560.61	-100.99	1193.262	284.246	7	
6578.05	C II	2	6575.82	-101.66	1.229	0.290	8	
6583.41	[N II]	1F	6581.48	-87.92	140.750	33.107	7	
6678.15	He I	46	6675.90	-101.04	19.222	4.278	7	
6716.47	[S II]	2F	6714.27	-98.24	13.030	2.838	7	
6730.85	[S II]	2F	6728.63	-98.92	21.951	4.744	7	
6779.93	C II	14	6777.84	-92.46	0.141	0.030	24	
6780.59	C II	14	*	*	*	*	*	
6791.47	C II	14	6789.24	-98.47	0.075	0.016	39	
6795.00	[K IV]	1F	6792.69	-101.95	0.097	0.020	32	
6800.69	C II	14	6798.61	-91.72	0.049	0.010	:	
6826.70	[Kr III]	—	6824.59	-92.70	0.100	0.021	31	e
6989.47	He I	1/12	6987.46	-86.25	0.115	0.022	28	
7065.28	He I	10	7062.88	-101.87	34.423	6.281	7	
—	?	—	7082.64	—	0.082	0.015	37	
7112.48	C II	20	7110.39	-88.11	0.041	0.007	:	
7113.04	C II	20	*	*	*	*	*	
7115.63	C II	20	7113.26	-99.89	0.061	0.011	:	
7135.78	[Ar III]	1F	7133.37	-101.27	106.047	18.718	7	
7160.61	He I	1/10	7158.21	-100.51	0.160	0.028	23	
7170.62	[Ar IV]	2F	7168.29	-97.45	0.202	0.035	19	
7231.34	C II	3	7228.89	-101.59	0.883	0.149	9	
7236.42	C II	3	7234.09	-96.56	1.997	0.336	8	
7262.76	[Ar IV]	2F	7260.46	-94.96	0.209	0.035	19	

Table 16. continued.

			NGC 6369					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
7281.35	He I	45	7278.90	-100.91	5.467	0.902	8	
7298.05	He I	1/9	7295.92	-87.52	0.346	0.057	14	
7318.92	[O II]	2F	7317.42	-61.45	25.466	4.128	8	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7327.81	-75.69	20.954	3.381	8	
7330.73	[O II]	2F	*	*	*	*	*	
—	?	—	7396.46	—	0.203	0.032	19	
7499.85	He I	1/8	7497.34	-100.38	0.364	0.055	14	
7530.54	[Cl IV]	1F	7527.91	-104.73	1.105	0.163	9	
—	?	—	7540.51	—	0.205	0.030	19	
7592.74	He II	5.10	7589.75	-118.11	0.112	0.016	29	
7751.10	[Ar III]	2F	7748.49	-100.98	33.736	4.567	8	
7816.13	He I	1/7	7813.53	-99.76	0.577	0.076	11	
7876.03	[P II]	1D-1S	7873.46	-97.85	0.275	0.036	16	
—	?	—	7898.47	—	0.248	0.032	17	
8045.63	[Cl IV]	1F	8042.99	-98.39	3.315	0.407	8	
8057.59	He I	4/18	8054.89	-100.48	0.068	0.008	:	
8116.30	He I	4/16	8113.79	-92.73	0.086	0.010	35	
—	?	—	8138.38	—	0.211	0.025	19	
8155.66	He I	4/15	8152.78	-105.92	0.122	0.014	27	
8196.48	C III	43	8193.93	-93.33	0.615	0.071	11	
8203.85	He I	4/14	8201.27	-94.31	0.151	0.017	24	
8264.28	H I	P35	8261.61	-96.88	0.926	0.104	10	
8264.56	He I	4/13	*	*	*	*	*	
8267.94	H I	P34	8265.17	-100.49	0.693	0.078	11	
8271.93	H I	P33	8269.15	-100.76	0.829	0.093	10	
8276.31	H I	P32	8273.48	-102.51	0.858	0.096	10	
8281.12	H I	P31	8278.39	-98.88	1.293	0.144	9	
8286.43	H I	P30	8283.56	-103.87	1.077	0.120	10	
8292.31	H I	P29	8289.54	-100.16	1.119	0.124	10	
8298.83	H I	P28	8296.17	-96.13	1.733	0.191	9	
8306.11	H I	P27	8303.26	-102.92	1.453	0.160	9	
8323.42	H I	P25	8320.58	-102.32	1.659	0.181	9	
8329.87	He I	6/23	8327.15	-97.91	0.113	0.012	29	
8333.78	H I	P24	8330.93	-102.58	2.074	0.225	9	
8342.33	He I	4/12	8339.54	-100.30	0.392	0.042	14	
8345.55	H I	P23	8342.85	-97.03	2.550	0.275	9	
8357.64	[Cr II]	1F	8356.19	-51.99	2.488	0.266	9	
8361.67	He I	1/6	8358.90	-99.33	1.106	0.118	10	
8374.48	H I	P21	8371.69	-99.91	2.900	0.307	9	
8392.40	H I	P20	8389.58	-100.78	3.120	0.326	9	
8413.32	H I	P19	8410.49	-100.88	3.511	0.362	9	
8421.96	He I	6/18	8419.36	-92.57	0.218	0.022	19	
8437.96	H I	P18	8435.11	-101.28	4.173	0.423	9	
8444.34	He I	4/11	8441.66	-95.16	0.328	0.033	15	
8446.25	O I	4	8443.95	-81.65	0.454	0.046	13	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8448.36	-93.67	0.183	0.018	21	
8453.61	He I	7/17	8450.82	-98.98	0.101	0.010	32	
8467.25	H I	P17	8464.42	-100.24	4.456	0.443	9	
8486.27	He I	6/16	8483.41	-101.05	0.204	0.020	20	
8488.73	He I	7/16	8486.04	-95.05	0.116	0.011	29	
8502.48	H I	P16	8499.58	-102.30	5.972	0.579	9	
8518.04	He I	2/8	8515.14	-102.11	0.128	0.012	27	
8528.99	He I	6/15	8526.17	-99.17	0.318	0.030	15	
8531.48	He I	7/15	8528.76	-95.63	0.133	0.013	26	
8545.38	H I	P15	8542.50	-101.07	7.278	0.685	9	
8578.70	[Cl II]	1F	8575.95	-96.13	1.437	0.132	10	

Table 16. continued.

			NGC 6369					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8581.89	He I	6/14	8579.44	-85.58	0.940	0.086	10	
8598.39	H I	P14	8595.51	-100.44	9.083	0.822	9	
8648.10	He I	6/13	8645.40	-93.60	0.487	0.043	13	
8649.88	He I	7/13	8648.00	-65.17	0.176	0.015	22	
8665.02	H I	P13	8662.11	-100.69	11.353	0.979	9	
8727.13	[C I]	3F	8724.35	-95.54	0.618	0.051	12	
8733.43	He I	6/12	8730.51	-100.27	0.562	0.046	12	
8736.04	He I	7/12	8733.09	-101.28	0.173	0.014	22	
8750.47	H I	P12	8747.52	-101.11	13.875	1.127	9	
8776.60	He I	4/9	8773.76	-97.04	0.701	0.056	11	
8845.38	He I	6/11	8842.44	-99.66	0.788	0.060	11	
8848.05	He I	7/11	8845.31	-92.87	0.408	0.031	14	
8862.79	H I	P11	8859.82	-100.49	19.320	1.458	9	
8996.99	He I	6/10	8993.92	-102.34	1.278	0.089	11	
8999.40	He I	7/10	8996.68	-90.66	0.430	0.030	14	
9014.91	H I	P10	9011.85	-101.81	24.223	1.678	10	
9063.29	He I	4/8	9060.35	-97.29	1.355	0.092	11	
9068.60	[S III]	1F	9065.93	-88.29	370.052	25.008	10	
9085.13	He I	10/10	9082.51	-86.48	0.186	0.012	21	
9123.60	[Cl II]	1F	9120.81	-91.71	0.432	0.029	14	
9210.28	He I	6/9	9207.24	-98.99	1.586	0.102	11	
9213.20	He I	7/9	9210.14	-99.62	0.576	0.037	13	
—	?	—	9220.52	—	0.237	0.015	18	
9229.01	H I	P9	9225.90	-101.04	40.830	2.610	10	

[a] Where F is the unreddened flux in units of 100.00 = 6.724×10^{-14}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.93±0.06, in units of 100.00 = 5.723×10^{-12}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

Table 17. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			PC 14					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(\mathrm{H}\beta)^a$	$I(\lambda)/I(\mathrm{H}\beta)^b$	Err(%)	not
3340.77	O III	3	3340.41	-32.32	0.770	1.320	8	
3428.65	O III	15	3428.27	-33.22	0.196	0.322	15	
3444.07	O III	15	3443.71	-31.35	1.520	2.478	7	
3447.59	He I	7	3447.27	-27.83	0.127	0.207	21	
3512.51	He I	38	3512.05	-39.26	0.163	0.258	17	
3530.50	He I	36	3530.13	-31.43	0.126	0.197	21	
3554.42	He I	34	3554.03	-32.89	0.152	0.236	18	
3587.28	He I	32	3586.90	-31.77	0.257	0.394	13	
3613.64	He I	6	3613.27	-30.69	0.226	0.342	14	
3634.25	He I	28	3633.89	-29.71	0.374	0.562	10	
3666.10	H I	H27	3665.72	-31.09	0.243	0.361	13	
3667.68	H I	H26	3667.31	-30.24	0.264	0.392	12	
3669.47	H I	H25	3669.08	-31.86	0.300	0.445	11	
3671.48	H I	H24	3671.12	-29.39	0.351	0.521	10	
3673.76	H I	H23	3673.39	-30.21	0.392	0.580	10	
3676.37	H I	H22	3675.99	-31.00	0.440	0.651	9	
3679.36	H I	H21	3678.97	-31.79	0.501	0.740	9	
3682.81	H I	H20	3682.43	-30.95	0.532	0.784	8	
3686.83	H I	H19	3686.46	-30.10	0.651	0.959	8	
3691.56	H I	H18	3691.17	-31.69	0.657	0.966	8	
3694.22	Ne II	1	3693.99	-18.66	0.130	0.192	20	
3697.15	H I	H17	3696.77	-30.81	0.797	1.170	7	
3703.86	H I	H16	3703.50	-29.15	0.886	1.297	7	
3705.04	He I	25	3704.64	-32.38	0.532	0.777	8	
3707.25	O III	14	3706.89	-29.12	0.109	0.160	23	
3711.97	H I	H15	3711.60	-29.88	1.080	1.573	7	
3715.08	O III	14	3714.72	-29.06	0.069	0.101	34	
3721.83	[S III]	2F	3721.45	-30.62	2.006	2.911	6	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3725.64	-31.39	19.203	27.825	6	
3728.82	[O II]	1F	3728.39	-34.59	10.159	14.706	6	
3734.37	H I	H13	3733.99	-30.52	1.518	2.193	7	
3750.15	H I	H12	3749.75	-31.97	2.147	3.085	6	
3754.69	O III	2	3754.32	-29.54	0.239	0.343	13	
3757.24	O III	2	3756.92	-25.54	0.084	0.121	29	
3759.87	O III	2	3759.49	-30.31	0.408	0.584	9	
3770.63	H I	H11	3770.24	-31.00	2.573	3.672	6	
3774.02	O III	2	3773.62	-31.77	0.056	0.080	:	
3791.27	O III	2	3790.95	-25.31	0.083	0.117	29	
3797.63	[S III]	2F	3797.51	-9.46	3.437	4.861	6	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.23	-29.84	0.963	1.352	7	
3831.66	S II	—	3831.14	-40.69	0.046	0.064	:	
3833.57	He I	62	3833.18	-30.51	0.060	0.084	38	
3835.39	H I	H9	3834.99	-31.26	4.999	6.986	6	
3862.59	Si II	1	3862.25	-26.40	0.042	0.058	:	
3868.75	[Ne III]	1F	3868.38	-28.68	72.805	100.690	6	
3871.82	He I	60	3871.41	-31.76	0.067	0.092	35	
3882.19	O II	12	3881.80	-30.11	0.038	0.053	:	
3888.65	He I	2	3888.45	-15.42	14.299	19.655	6	
3889.05	H I	H8	*	*	*	*	*	
3918.98	C II	4	3918.52	-35.19	0.028	0.038	:	
3920.68	C II	4	3920.23	-34.41	0.037	0.050	:	
3923.48	He II	4.15	3923.14	-25.99	0.039	0.053	:	
3926.53	He I	58	3926.20	-25.20	0.111	0.151	23	
3964.73	He I	5	3964.33	-30.24	0.647	0.868	8	
3967.46	[Ne III]	1F	3967.06	-30.22	21.526	28.889	6	
3970.07	H I	H7	3969.66	-30.98	11.261	15.100	6	

Table 17. continued.

			PC 14					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4009.26	He I	55	4008.86	-29.91	0.162	0.214	17	
4026.21	He I	18	4025.79	-31.27	1.940	2.555	6	
4041.31	N II	39	4040.95	-26.72	0.025	0.032	:	
4068.60	[S II]	1F	4068.18	-30.96	1.193	1.548	6	
4069.62	O II	10	4069.43	-14.00	0.325	0.422	10	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4071.75	-29.44	0.225	0.291	13	
4075.86	O II	10	4075.74	-8.84	0.626	0.810	7	
4076.35	[S II]	1F	*	*	*	*	*	
4078.84	O II	10	4078.42	-30.89	0.042	0.055	:	
4083.90	O II	47	4083.40	-36.71	0.036	0.047	:	
4085.11	O II	10	4084.72	-28.63	0.047	0.061	:	
4087.15	O II	48	4086.79	-26.40	0.041	0.053	:	
4089.29	O II	48	4088.84	-32.99	0.110	0.142	23	
4092.93	O II	10	4092.49	-32.23	0.026	0.033	:	
4095.64	O II	48	4095.22	-30.74	0.028	0.037	:	
4097.22	O II	20	4096.92	-21.97	0.618	0.794	8	
4097.26	O II	48	*	*	*	*	*	
4100.04	He II	4.12	4099.73	-22.67	0.065	0.083	36	
4101.74	H I	H6	4101.31	-31.44	20.040	25.713	6	
4103.43	N III	1	4102.92	-37.28	0.363	0.465	10	
4104.99	O II	20	4104.72	-19.72	0.023	0.029	:	
4119.22	O II	20	4118.80	-30.60	0.080	0.102	30	
4120.82	He I	16	4120.41	-29.81	0.212	0.270	14	
4132.80	O II	19	4132.44	-26.11	0.034	0.043	:	
4143.76	He I	53	4143.34	-30.38	0.301	0.381	11	
4145.90	O II	106	4145.63	-19.53	0.026	0.033	:	
4146.08	O II	106	*	*	*	*	*	
4153.30	O II	19	4152.88	-30.31	0.070	0.088	33	
4156.53	O II	19	4155.91	-44.70	0.067	0.085	34	
4168.97	He I	52	4168.60	-26.62	0.060	0.075	38	
4185.45	O II	36	4185.02	-30.82	0.045	0.057	:	
4186.90	C III	18	4186.49	-29.34	0.063	0.079	36	
4189.79	O II	36	4189.38	-29.35	0.059	0.073	39	
4199.83	He II	4.11	4199.45	-27.12	0.095	0.118	26	
4219.76	Ne II	52	4219.36	-28.41	0.032	0.040	:	
4241.78	N II	48	4241.44	-24.02	0.023	0.029	:	
4253.90	O II	109	4253.57	-23.26	0.036	0.044	:	
4253.91	O II	109	*	*	*	*	*	
4267.15	C II	6	4266.71	-30.91	0.720	0.884	7	
4275.55	O II	67	4275.17	-26.64	0.038	0.047	:	
4276.75	O II	67	4276.37	-26.63	0.017	0.021	:	
4277.90	O II	67	4277.50	-28.03	0.015	0.018	:	
4282.96	O II	67	4282.76	-14.01	0.016	0.019	:	
4285.69	O II	78	4285.19	-34.98	0.019	0.024	:	
4287.39	[Fe II]	7F	4287.96	39.84	0.039	0.048	:	
4288.82	O II	53	*	*	*	*	*	
4291.25	O II	55	4290.81	-30.74	0.014	0.017	:	
4294.78	S II	49	4294.47	-31.39	0.033	0.041	:	
4294.92	O II	54	*	*	*	*	*	
4303.61	O II	65	4303.40	-29.25	0.066	0.080	35	
4303.82	O II	53	*	*	*	*	*	
4317.14	O II	2	4316.78	-25.03	0.052	0.063	:	
4319.63	O II	2	4319.20	-29.82	0.043	0.052	:	
4325.76	O II	2	4325.25	-35.33	0.038	0.047	:	
4336.83	O II	2	4336.35	-33.18	0.034	0.041	:	
4338.67	He II	4.10	4338.30	-25.58	0.123	0.148	21	
4340.47	H I	H5	4340.02	-31.10	40.714	49.114	5	
4345.55	O II	65	4345.15	-28.30	0.059	0.071	38	

Table 17. continued.

			PC 14					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4345.56	O II	2	*	*	*	*	*	
4349.43	O II	2	4348.99	-30.33	0.112	0.135	23	
4363.21	[O III]	2F	4362.78	-29.56	5.152	6.170	5	
4366.89	O II	2	4366.44	-30.91	0.063	0.076	36	
4379.11	N III	18	4378.73	-26.01	0.077	0.092	31	
4387.93	He I	51	4387.49	-30.06	0.581	0.690	7	
4391.94	Ne II	55e	4391.52	-28.67	0.044	0.052	:	
4409.30	Ne II	55e	4408.90	-27.19	0.035	0.041	:	
4414.90	O II	5	4414.44	-31.24	0.045	0.053	:	
4416.97	O II	5	4416.50	-31.92	0.061	0.071	37	
4428.54	Ne II	57	4428.09	-30.48	0.025	0.029	:	
4437.55	He I	50	4437.09	-31.08	0.066	0.077	35	
4465.41	O II	94	4465.06	-23.51	0.025	0.028	:	
4471.47	He I	14	4471.05	-28.19	4.620	5.313	5	
4491.23	O II	86a	4490.79	-29.37	0.035	0.040	:	
4510.92	N III	3	4510.55	-24.60	0.033	0.038	:	
4541.59	He II	4.9	4541.14	-29.69	0.126	0.141	20	
4552.52	N II	—	4552.09	-28.33	0.015	0.017	:	
4562.60	Mg I]	1	4562.10	-32.86	0.047	0.052	:	
4571.10	Mg I]	1	4570.61	-32.16	0.135	0.150	19	
4590.97	O II	15	4590.52	-29.40	0.059	0.065	38	
4595.95	O II	15	4595.71	-15.67	0.054	0.059	:	
4596.18	O II	15	*	*	*	*	*	
4602.13	O II	92b	4601.56	-37.12	0.023	0.025	:	
4609.44	O II	92a	4609.02	-27.31	0.070	0.077	33	
4630.54	N II	5	4630.10	-28.49	0.039	0.042	:	
4634.14	N III	2	4633.69	-29.13	0.305	0.331	11	
4638.86	O II	1	4638.38	-31.02	0.136	0.147	19	
4640.64	N III	2	4640.22	-27.13	0.669	0.723	7	
4641.81	O II	1	4641.43	-24.54	0.302	0.326	11	
4641.85	N III	2	*	*	*	*	*	
4647.42	C III	1	4646.97	-29.01	0.113	0.122	22	
4649.13	O II	1	4648.70	-27.71	0.379	0.408	9	g
4650.84	O II	1	4650.33	-32.86	0.140	0.151	19	g
4658.05	[Fe III]	3F	4657.64	-26.37	0.082	0.088	29	
4661.63	O II	1	4661.17	-29.58	0.155	0.167	17	
4676.24	O II	1	4675.76	-30.81	0.110	0.117	23	
4685.68	He II	3.4	4685.25	-27.53	4.390	4.671	5	
4711.37	[Ar IV]	1F	4710.94	-27.38	1.121	1.182	6	
4713.14	He I	12	4712.72	-26.71	0.601	0.633	7	
4740.17	[Ar IV]	1F	4739.78	-24.68	1.334	1.393	6	
4859.32	He II	4.8	4858.83	-30.22	0.369	0.369	9	
4861.33	H I	H4	4860.82	-31.47	100.000	100.000	5	
4881.00	[Fe III]	2F	4880.53	-28.88	0.040	0.040	:	
4902.65	Si II	7.23	4902.08	-34.85	0.021	0.020	:	
4906.81	O II	28	4906.39	-25.66	0.037	0.037	:	
4921.93	He I	48	4921.43	-30.46	1.421	1.392	6	
4924.53	O II	28	4924.08	-27.38	0.046	0.045	:	
4931.32	[O III]	1F	4930.80	-31.62	0.109	0.107	23	
4958.91	[O III]	1F	4958.43	-29.02	407.790	394.391	5	
—	?	—	4979.79	—	0.102	0.098	24	
5006.84	[O III]	1F	5006.38	-27.54	1255.454	1195.069	5	
5015.68	He I	4	5015.18	-29.89	2.224	2.111	5	
5041.03	Si II	5	5040.53	-29.74	0.073	0.069	32	
5047.74	He I	47	5047.28	-27.35	0.140	0.131	19	
5191.82	[Ar III]	3F	5191.12	-40.41	0.095	0.085	18	
5197.90	[N I]	1F	5197.44	-26.53	0.133	0.120	13	
5200.26	[N I]	1F	5199.77	-28.24	0.093	0.083	18	
5270.40	[Fe III]	1F	5269.99	-23.30	0.054	0.047	29	

Table 17. continued.

			PC 14					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
5342.38	C II	17.06	5341.81	-31.98	0.043	0.037	36	
5346.02	[Kr IV]	4S-2D	5345.44	-32.53	0.049	0.043	31	
5411.52	He II	4.7	5410.95	-31.57	0.436	0.368	7	
5517.71	[Cl III]	1F	5517.10	-33.14	0.770	0.629	6	
5537.88	[Cl III]	1F	5537.25	-34.10	0.897	0.729	6	
5666.64	N II	3	5666.08	-29.63	0.043	0.033	36	
5679.56	N II	3	5678.97	-31.14	0.077	0.060	21	
5754.64	[N II]	3F	5754.02	-32.31	0.721	0.547	6	
5846.77	[Xe III]	—	5846.24	-27.17	0.010	0.007	:	
5867.74	[Kr IV]	4S-2D	5867.21	-27.09	0.077	0.056	21	
5875.64	He I	11	5875.04	-30.62	21.378	15.629	6	
6101.83	[K IV]	1F	6101.15	-33.42	0.134	0.093	14	
6118.20	He II	5.19	6117.62	-28.43	0.015	0.010	:	
6151.43	C II	16.04	6150.67	-37.06	0.046	0.032	34	
6170.60	He II	5.18	6170.24	-17.48	0.036	0.024	:	
6233.80	He II	5.17	6233.06	-35.58	0.021	0.014	:	
6300.30	[O I]	1F	6299.78	-24.75	3.627	2.399	6	
6312.10	[S III]	3F	6311.41	-32.77	2.752	1.816	6	
6347.11	Si II	2	6346.40	-33.54	0.072	0.047	23	
6363.78	[O I]	1F	6363.24	-25.42	1.232	0.804	7	
6371.36	Si II	2	6370.71	-30.58	0.071	0.046	23	
6406.30	He II	5.15	6405.69	-28.54	0.042	0.027	37	
6461.95	C II	17.04	6461.13	-38.06	0.131	0.084	14	
6527.10	[N II]	1F	6526.39	-32.61	0.056	0.035	28	
6548.03	[N II]	1F	6547.37	-30.20	16.359	10.269	7	
6560.00	He II	4.6	6559.48	-23.77	1.213	0.759	7	
6562.82	H I	H3	6562.12	-31.97	457.511	286.346	7	
6578.05	C II	2	6577.33	-32.80	0.519	0.324	8	
6583.41	[N II]	1F	6582.74	-30.51	49.738	31.003	7	
6678.15	He I	46	6677.46	-30.98	6.774	4.147	7	
6683.20	He II	5.13	6682.42	-35.01	0.059	0.036	27	
6716.47	[S II]	2F	6715.70	-34.37	6.220	3.781	7	
6730.85	[S II]	2F	6730.08	-34.30	10.357	6.280	7	
7065.28	He I	10	7064.53	-31.83	8.156	4.679	7	
7135.78	[Ar III]	1F	7135.04	-31.08	29.843	16.937	7	
7155.16	[Fe II]	14F	7154.71	-18.86	0.023	0.013	:	
7160.61	He I	1/10	7159.84	-32.24	0.043	0.025	36	
7170.62	[Ar IV]	2F	7169.98	-26.77	0.069	0.039	24	
7177.50	He II	5.11	7176.72	-32.57	0.095	0.054	18	
7231.34	C II	3	7230.53	-33.59	0.252	0.141	10	
7236.42	C II	3	7235.76	-27.35	0.499	0.279	8	
7262.76	[Ar IV]	2F	7262.24	-21.45	0.052	0.029	31	
7281.35	He I	45	7280.60	-30.88	1.297	0.720	8	
7298.05	He I	1/9	7296.65	-57.52	0.102	0.057	17	
7318.92	[O II]	2F	7319.16	9.84	4.451	2.457	8	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7329.45	-8.59	3.796	2.092	8	
7330.73	[O II]	2F	*	*	*	*	*	
—	?	—	7398.76	—	0.107	0.059	17	
—	?	—	7400.80	—	0.093	0.051	19	
7499.85	He I	1/8	7499.11	-29.59	0.083	0.045	21	
7519.49	C II	16.08	7518.29	-47.86	0.033	0.018	:	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7529.81	-29.06	0.452	0.242	9	c
7592.74	He II	5.10	7591.94	-31.60	0.142	0.075	14	
7751.10	[Ar III]	2F	7750.33	-29.79	7.797	4.058	8	
7816.13	He I	1/7	7815.33	-30.68	0.124	0.064	15	
—	?	—	7896.10	—	0.075	0.038	22	
8045.63	[Cl IV]	1F	8044.95	-25.33	0.990	0.499	8	

Table 17. continued.

			PC 14					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
8196.48	C III	43	8195.82	-24.15	0.185	0.092	12	
8203.85	He I	4/14	8203.02	-30.34	0.043	0.021	36	
8236.77	He II	5.9	8235.97	-29.11	0.251	0.124	11	
8264.56	He I	4/13	8263.55	-36.63	0.155	0.076	14	
8267.94	H I	P34	8267.10	-30.49	0.132	0.064	15	
8276.31	H I	P32	8275.49	-29.68	0.164	0.080	13	
8286.43	H I	P30	8285.84	-21.34	0.252	0.123	11	c
8292.31	H I	P29	8291.39	-33.26	0.241	0.118	11	
8306.11	H I	P27	8305.26	-30.70	0.256	0.125	11	
8314.26	H I	P26	8313.33	-33.53	0.295	0.143	10	
8323.42	H I	P25	8322.60	-29.55	0.305	0.148	10	
8333.78	H I	P24	8332.87	-32.74	0.362	0.175	10	
8342.33	He I	4/12	8341.40	-33.41	0.072	0.035	23	
8359.00	H I	P22	8358.12	-31.56	0.449	0.216	9	
8361.67	He I	1/6	8360.86	-29.03	0.207	0.099	12	
8374.48	H I	P21	8373.63	-30.45	0.502	0.241	9	
8392.40	H I	P20	8391.51	-31.82	0.549	0.262	9	
8413.32	H I	P19	8412.44	-31.36	0.622	0.296	9	
8421.96	He I	6/18	8421.10	-30.63	0.032	0.015	:	
8437.96	H I	P18	8437.09	-30.92	0.722	0.342	9	
8444.34	He I	4/11	8444.55	7.45	0.133	0.063	15	
8446.25	O I	4	*	*	*	*	*	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8451.00	He I	6/17	8450.35	-23.07	0.037	0.018	:	
8467.25	H I	P17	8465.97	-45.34	1.219	0.573	9	c
8480.90	[Cl III]	3F	8480.05	-30.07	0.030	0.014	:	
8486.27	He I	6/16	8485.53	-26.12	0.035	0.017	:	
8502.48	H I	P16	8501.60	-31.06	1.043	0.487	9	
8518.04	He I	2/8	8517.31	-25.71	0.019	0.009	:	
8528.99	He I	6/15	8528.16	-29.18	0.049	0.023	32	
8545.38	H I	P15	8544.50	-30.87	1.242	0.574	9	
8578.70	[Cl II]	1F	8577.79	-31.81	0.263	0.121	11	
8582.54	He I	3/10	8581.50	-36.33	0.148	0.068	14	
8598.39	H I	P14	8597.49	-31.36	1.528	0.697	9	
8648.10	He I	6/13	8647.29	-28.07	0.109	0.049	17	c
8665.02	H I	P13	8664.15	-30.07	2.019	0.907	9	
8727.13	[C I]	3F	8726.32	-27.81	0.050	0.022	32	
8733.43	He I	6/12	8732.56	-29.87	0.093	0.041	20	
8736.04	He I	7/12	8735.19	-29.16	0.022	0.010	:	
8747.00	He II	6.24	8746.23	-26.38	0.025	0.011	:	
8750.47	H I	P12	8749.57	-30.82	2.338	1.030	9	
8776.60	He I	4/9	8776.19	-13.98	0.267	0.117	11	
8845.38	He I	6/11	8844.56	-27.81	0.143	0.062	15	
8848.05	He I	7/11	8847.26	-26.77	0.043	0.019	37	
8862.79	H I	P11	8861.88	-30.79	3.221	1.385	9	
8996.99	He I	6/10	8996.07	-30.66	0.171	0.072	14	
9014.91	H I	P10	9013.98	-30.92	4.298	1.798	10	
9063.29	He I	4/8	9062.39	-29.79	0.176	0.073	14	
9068.60	[S III]	1F	9067.95	-21.47	83.412	34.604	10	
9123.60	[Cl II]	1F	9122.66	-30.87	0.073	0.030	24	

[a] Where *F* is the unreddened flux in units of 100.00 = 5.045×10^{-13}.
[b] Where *I* is the reddened corrected flux, with c(Hβ)=0.63±0.06, in units of 100.00 = 2.152×10^{-12}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.
[g] Both lines affected by C III λ4650.25

Table 18. Observed and reddening corrected line ratios (F(Hβ) = 100) and line identifications.

			Pe 1-1					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(\mathrm{H}\beta)^{a}$	$I(\lambda)/I(\mathrm{H}\beta)^{b}$	Err(%)	not
3613.64	He I	6	3613.90	21.57	0.116	0.379	23	
3634.25	He I	28	3634.52	22.27	0.173	0.555	17	
3664.68	H I	H28	3664.84	13.10	0.121	0.376	22	
3666.10	H I	H27	3666.31	17.17	0.126	0.391	22	
3667.68	H I	H26	3667.96	22.89	0.133	0.410	21	
3669.47	H I	H25	3669.72	20.42	0.159	0.489	18	
3671.48	H I	H24	3671.76	22.86	0.198	0.607	16	
3673.76	H I	H23	3674.05	23.67	0.227	0.697	15	
3676.37	H I	H22	3676.63	21.18	0.253	0.773	14	
3679.36	H I	H21	3679.69	26.87	0.324	0.988	12	
3682.81	H I	H20	3683.12	25.24	0.332	1.007	12	
3686.83	H I	H19	3687.13	24.38	0.378	1.143	11	
3691.56	H I	H18	3691.83	21.93	0.424	1.275	11	
3697.15	H I	H17	3697.41	21.08	0.470	1.405	10	
3703.86	H I	H16	3704.10	19.42	0.505	1.489	10	
3705.04	He I	25	3705.26	17.80	0.271	0.797	13	
3711.97	H I	H15	3712.26	23.42	0.603	1.761	9	
3721.83	[S III]	2F	3722.09	20.94	1.077	3.118	8	
3721.93	H I	H14	*	*	*	*	*	
3726.03	[O II]	1F	3726.28	20.11	13.147	37.891	7	
3728.82	[O II]	1F	3729.03	16.88	5.210	14.975	7	
3734.37	H I	H13	3734.64	21.66	0.871	2.490	8	
3750.15	H I	H12	3750.39	19.18	1.087	3.061	8	
3770.63	H I	H11	3770.90	21.47	1.346	3.716	8	
3797.63	[S III]	2F	3798.15	41.05	1.943	5.227	7	
3797.90	H I	H10	*	*	*	*	*	
3819.61	He I	22	3819.89	21.96	0.477	1.257	10	
3835.39	H I	H9	3835.65	20.32	2.764	7.184	7	
3868.75	[Ne III]	1F	3869.03	21.70	31.053	78.353	7	
3888.65	He I	2	3889.14	37.77	7.502	18.600	7	
3889.05	H I	H8	*	*	*	*	*	
3926.53	He I	58	3926.87	25.96	0.063	0.151	37	
3964.73	He I	5	3965.01	21.17	0.359	0.834	11	
3967.46	[Ne III]	1F	3967.73	20.40	9.522	22.047	7	
3970.07	H I	H7	3970.35	21.14	6.243	14.421	7	
4009.26	He I	55	4009.53	20.19	0.080	0.179	30	
4026.21	He I	18	4026.49	20.85	1.107	2.428	7	
4068.60	[S II]	1F	4068.87	19.89	1.604	3.373	7	
4069.62	O II	10	4070.10	35.35	0.073	0.073	24	
4069.89	O II	10	*	*	*	*	*	
4072.15	O II	10	4072.45	22.09	0.065	0.065	25	
4075.86	O II	10	4076.58	16.91	0.642	1.340	8	
4076.35	[S II]	1F	*	*	*	*	*	
4089.29	O II	48	4089.44	10.99	0.035	0.071	:	
4097.26	O II	48	4097.59	24.15	0.073	0.148	33	
4097.33	N III	1	*	*	*	*	*	
4101.74	H I	H6	4102.03	21.16	12.152	24.747	6	
4103.43	N III	1	4103.57	10.22	0.079	0.161	35	
4104.99	O II	20	4105.16	12.42	0.028	0.056	:	
4120.82	He I	16	4121.12	21.84	0.132	0.265	20	
4132.80	O II	19	4132.93	9.46	0.034	0.068	:	
4143.76	He I	53	4144.05	20.98	0.190	0.372	16	
4153.30	O II	19	4153.51	15.15	0.025	0.048	:	
4185.45	O II	36	4185.72	19.34	0.025	0.047	:	
4189.79	O II	36	4190.03	17.15	0.029	0.054	:	
4267.15	C II	6	4267.47	22.50	0.620	1.117	8	
4317.14	O II	2	4317.42	19.43	0.031	0.031	31	
4319.63	O II	2	4320.02	27.07	0.023	0.023	36	

Table 18. continued.

			Pe 1-1					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)^a$	$I(\lambda)/I(H\beta)^b$	Err(%)	not
4325.76	O II	2	4326.32	38.81	0.027	0.047	:	
4336.83	O II	2	4337.20	25.58	0.013	0.022	:	
4340.47	H I	H5	4340.77	20.71	29.130	49.735	6	
4345.56	O II	2	4345.87	21.39	0.036	0.062	:	
4349.43	O II	2	4349.76	22.72	0.048	0.081	:	
4363.21	[O III]	2F	4363.50	19.93	4.305	7.199	6	
4366.89	O II	2	4367.14	17.16	0.045	0.074	:	
4368.19	O I	5	4368.51	21.95	0.073	0.121	32	
4368.25	O I	5	*	*	*	*	*	
4387.93	He I	51	4388.24	21.18	0.447	0.730	9	
4437.55	He I	50	4437.88	22.30	0.052	0.080	:	
4471.47	He I	14	4471.83	24.13	3.705	5.514	6	
4491.23	O II	86a	4491.60	24.70	0.029	0.043	:	
4562.60	Mg I]	1	4562.97	24.32	0.031	0.042	:	
4571.10	Mg I]	1	4571.40	19.66	0.554	0.739	8	
4590.97	O II	15	4591.30	21.52	0.026	0.034	:	
4595.95	O II	15	4596.50	35.86	0.028	0.036	:	
4596.18	O II	15	*	*	*	*	*	
4630.54	N II	5	4630.91	23.96	0.043	0.055	:	
4634.14	N III	2	4634.48	21.98	0.060	0.075	38	
4638.86	O II	1	4639.17	20.04	0.077	0.096	31	
4640.64	N III	2	4641.00	23.25	0.083	0.103	29	
4641.81	O II	1	4642.14	21.32	0.133	0.165	20	
4641.85	N III	2	*	*	*	*	*	
4649.13	O II	1	4649.49	23.23	0.232	0.286	13	
4650.84	O II	1	4651.13	18.69	0.037	0.046	:	
4658.05	[Fe III]	3F	4658.49	28.34	0.161	0.197	17	
4661.63	O II	1	4661.99	23.17	0.069	0.084	34	
4667.01	[Fe III]	3F	4667.49	30.86	0.026	0.032	:	
4669.27	O II	89b	4669.60	21.19	0.041	0.049	:	
4676.24	O II	1	4676.67	27.54	0.057	0.068	39	
4685.68	He II	3.4	4686.13	28.77	0.048	0.057	:	
4711.37	[Ar IV]	1F	4711.66	18.45	0.044	0.052	:	
4713.14	He I	12	4713.50	22.89	0.753	0.874	7	
4740.17	[Ar IV]	1F	4740.54	23.41	0.157	0.177	18	
4861.33	H I	H4	4861.67	20.96	100.000	100.000	5	
4881.00	[Fe III]	2F	4881.42	25.79	0.102	0.100	25	
4921.93	He I	48	4922.28	21.29	1.473	1.386	7	
4958.91	[O III]	1F	4959.27	21.75	362.753	329.290	5	
5006.84	[O III]	1F	5007.22	22.77	1140.079	989.065	5	
5015.68	He I	4	5016.04	21.51	2.864	2.465	6	
5047.74	He I	47	5048.10	21.37	0.246	0.206	17	
5191.82	[Ar III]	3F	5192.04	12.72	0.179	0.133	11	
5197.90	[N I]	1F	5198.21	17.88	0.610	0.449	6	
5200.26	[N I]	1F	5200.55	16.72	0.366	0.269	8	
5270.40	[Fe III]	1F	5270.88	27.30	0.178	0.124	11	
5298.89	O I	26	5299.28	22.04	0.063	0.042	23	
5342.38	C II	17.06	5342.69	17.40	0.089	0.058	18	
5346.02	[Kr IV]	4S-2D	5346.46	24.67	0.083	0.054	19	
5517.71	[Cl III]	1F	5518.08	20.11	0.454	0.255	8	
5537.88	[Cl III]	1F	5538.21	17.87	1.271	0.702	6	
5666.64	N II	3	5666.91	14.28	0.091	0.044	18	
5679.56	N II	3	5680.00	23.22	0.147	0.071	13	
5754.64	[N II]	3F	5754.99	18.24	7.440	3.369	6	
5846.77	[Xe III]	—	5847.20	22.06	0.113	0.047	16	
5867.74	[Kr IV]	4S-2D	5868.17	21.95	0.164	0.067	13	
5875.64	He I	11	5876.07	21.92	41.201	16.812	7	
5958.39	O I	23	5958.89	25.16	0.167	0.064	13	
5958.58	O I	23	*	*	*	*	*	

Table 18. continued.

			Pe 1-1					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
6046.23	O I	22	6046.75	25.78	0.153	0.055	13	
6046.44	O I	22	*	*	*	*	*	
6046.49	O I	22	*	*	*	*	*	
6151.43	C II	16.04	6151.79	17.54	0.148	0.050	14	
6300.30	[O I]	1F	6300.69	18.56	29.665	9.102	8	
6312.10	[S III]	3F	6312.50	18.99	6.180	1.882	8	
6347.11	Si II	2	6347.50	18.43	0.140	0.042	14	
6363.78	[O I]	1F	6364.17	18.38	10.229	3.016	8	
6371.36	Si II	2	6371.79	20.24	0.116	0.034	16	
6461.95	C II	17.04	6462.30	16.22	0.377	0.105	10	
6548.03	[N II]	1F	6548.52	22.44	124.553	32.892	8	
6562.82	H I	H3	6563.25	19.65	1089.314	285.258	8	
6578.05	C II	2	6578.52	21.43	2.036	0.529	9	
6583.41	[N II]	1F	6583.88	21.39	375.104	97.091	8	
6678.15	He I	46	6678.62	21.11	17.502	4.302	9	
6716.47	[S II]	2F	6716.90	19.18	8.082	1.947	9	
6730.85	[S II]	2F	6731.29	19.59	17.162	4.105	9	
6779.93	C II	14	6780.58	28.73	0.134	0.031	15	
6787.22	C II	14	6787.71	21.63	0.048	0.011	29	
6791.47	C II	14	6791.93	20.30	0.059	0.014	25	
6800.69	C II	14	6801.19	22.04	0.044	0.010	31	
6809.99	N II	54	6810.38	17.15	0.021	0.005	:	
6989.47	He I	1/12	6990.03	24.00	0.093	0.020	19	
7002.23	O I	21	7002.61	16.26	0.347	0.073	11	
7065.28	He I	10	7065.74	19.54	42.033	8.587	9	
7135.78	[Ar III]	1F	7136.27	20.59	113.025	22.385	10	
7155.16	[Fe II]	14F	7155.67	21.36	0.372	0.073	11	
7160.61	He I	1/10	7161.11	20.93	0.158	0.031	15	
7231.34	C II	3	7231.82	19.90	1.439	0.273	10	
7236.42	C II	3	7237.00	24.03	3.133	0.594	10	
7254.15	O I	20	7254.84	28.51	1.345	0.253	10	
7254.45	O I	20	*	*	*	*	*	
7254.53	O I	20	*	*	*	*	*	
7281.35	He I	45	7281.86	20.99	5.352	0.995	10	
7291.47	[Ca II]	1F	7291.91	18.09	0.155	0.029	15	
7298.05	He I	1/9	7298.54	20.14	0.149	0.027	15	
7318.92	[O II]	2F	7320.42	61.43	78.995	14.451	10	
7319.99	[O II]	2F	*	*	*	*	*	
7329.66	[O II]	2F	7330.72	43.35	64.218	11.697	10	
7330.73	[O II]	2F	*	*	*	*	*	
7377.83	[Ni II]	2F	7378.38	22.34	0.532	0.095	11	
—	?	—	7402.21	—	0.224	0.040	13	c
7411.61	[Ni II]	2F	7412.10	19.83	0.092	0.016	19	
7442.30	N I	3	7442.77	18.94	0.103	0.018	18	
7452.54	[Fe II]	14F	7453.08	21.72	0.153	0.027	15	
7468.31	N I	3	7468.79	19.27	0.159	0.027	15	
7499.85	He I	1/8	7500.36	20.38	0.288	0.049	12	
7504.96	O II	2G-G[5]$_0$	7505.51	21.96	0.077	0.013	22	
—	?	—	7510.34	—	0.043	0.007	32	
7519.49	C II	16.08	7520.47	24.33	0.072	0.012	23	
7519.86	C II	16.08	*	*	*	*	*	
7530.54	[Cl IV]	1F	7531.00	17.12	0.196	0.033	14	c
7530.57	C II	16.08	*	*	*	*	*	
—	?	—	7535.52	—	0.051	0.008	29	
7592.00	[Se II]	4S$_0$-2D$_0$	7592.31	12.24	0.162	0.027	15	
—	?	—	7695.35	—	0.062	0.010	25	
7751.10	[Ar III]	2F	7751.63	20.49	35.468	5.487	11	
7771.93	O I	1	7772.47	20.83	0.108	0.017	:	c
7774.17	O I	1	7775.06	34.32	0.106	0.016	:	

Table 18. continued.

			Pe 1-1					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
7775.39	O I	1	*	*	*	*	*	
7816.13	He I	1/7	7816.68	21.11	0.516	0.078	12	
7876.03	[P II]	1D-1S	7876.49	17.53	0.469	0.070	12	
8045.63	[Cl IV]	1F	8046.29	24.60	0.607	0.086	12	
8116.30	He I	4/16	8116.85	20.32	0.103	0.014	19	
8155.66	He I	4/15	8156.22	20.59	0.091	0.012	20	
8257.85	H I	P37	8258.39	19.60	0.535	0.070	12	
8260.93	H I	P36	8261.51	21.05	0.597	0.078	12	
8264.28	H I	P35	8264.99	25.75	0.882	0.115	12	
8267.94	H I	P34	8268.52	21.00	0.679	0.088	12	
8271.93	H I	P33	8272.50	20.67	0.761	0.099	12	
8276.31	H I	P32	8276.92	22.11	0.809	0.104	12	
8281.12	H I	P31	8282.06	34.01	0.525	0.068	12	c
8286.43	H I	P30	8286.95	18.83	0.856	0.110	12	c
8292.31	H I	P29	8292.88	20.62	1.005	0.129	12	
8298.83	H I	P28	8299.48	23.49	1.161	0.148	12	c
8306.11	H I	P27	8306.72	21.99	1.259	0.160	12	
8314.26	H I	P26	8314.85	21.27	1.365	0.173	12	
8323.42	H I	P25	8324.01	21.24	1.567	0.198	12	
8329.87	He I	6/23	8330.51	23.02	0.084	0.011	21	
8333.78	H I	P24	8334.39	21.92	1.833	0.231	12	
8345.55	H I	P23	8346.13	20.84	1.948	0.243	12	
8359.00	H I	P22	8359.59	21.15	2.400	0.298	12	
8361.67	He I	1/6	8362.32	23.32	1.093	0.135	12	
8374.48	H I	P21	8375.07	21.11	2.580	0.317	12	
8376.55	He I	6/20	8377.00	16.11	0.147	0.018	16	
8392.40	H I	P20	8392.99	21.07	2.817	0.342	12	
8413.32	H I	P19	8413.92	21.36	3.245	0.389	12	c
8421.96	He I	6/18	8422.65	24.57	0.138	0.016	17	
8433.85	[Cl III]	3F	8434.20	12.46	0.343	0.041	13	c
8437.96	H I	P18	8438.55	20.96	3.638	0.429	12	
8446.25	O I	4	8446.94	24.50	10.475	1.230	12	
8446.36	O I	4	*	*	*	*	*	
8446.76	O I	4	*	*	*	*	*	
8467.25	H I	P17	8467.85	21.23	4.290	0.497	12	
8480.90	[Cl III]	3F	8481.43	18.71	0.338	0.039	13	
8486.27	He I	6/16	8486.87	21.22	0.185	0.021	15	
8488.73	He I	7/16	8489.41	24.00	0.079	0.009	22	
8499.70	[Cl III]	3F	8500.54	29.62	0.384	0.044	13	
8502.48	H I	P16	8503.08	21.14	5.162	0.584	12	
8518.04	He I	2/8	8518.66	21.82	0.108	0.012	19	
8528.99	He I	6/15	8529.63	22.48	0.273	0.030	14	
8531.48	He I	7/15	8532.26	27.38	0.092	0.010	21	
8545.38	H I	P15	8545.99	21.41	6.085	0.669	12	
8578.70	[Cl II]	1F	8579.30	20.95	2.866	0.308	12	
8582.54	He I	3/10	8582.91	12.93	0.704	0.076	13	
8598.39	H I	P14	8599.00	21.28	7.408	0.786	12	
8616.95	[Fe II]	4H-2I	8617.52	19.81	0.840	0.088	13	c
8648.10	He I	6/13	8648.64	18.72	0.242	0.025	15	
8665.02	H I	P13	8665.62	20.78	9.674	0.981	12	c
8703.25	N I	1	8703.77	17.89	0.152	0.015	17	
8711.70	N I	1	8712.26	19.26	0.161	0.016	17	
8727.13	[C I]	3F	8727.74	20.97	1.828	0.178	13	
8733.43	He I	6/12	8734.05	21.29	0.470	0.046	14	
8736.04	He I	7/12	8736.70	22.65	0.147	0.014	17	
8750.47	H I	P12	8751.10	21.58	12.063	1.157	13	
8845.38	He I	6/11	8845.93	18.63	0.757	0.069	13	
8854.11	He I	5/11	8854.61	16.93	0.251	0.023	15	
8862.79	H I	P11	8863.41	20.97	17.094	1.531	13	

Table 18. continued.

			Pe 1-1					
λ_0 (Å)	Ion	Mult.	λ_{obs}	V_{rad} (km s^{-1})	$F(\lambda)/F(H\beta)$[a]	$I(\lambda)/I(H\beta)$[b]	Err(%)	not
8996.99	He I	6/10	8997.62	20.99	0.975	0.081	14	
9014.91	H I	P10	9015.46	18.28	21.369	1.769	13	
9063.29	He I	4/8	9064.02	24.13	1.179	0.096	14	
9068.60	[S III]	1F	9069.61	33.41	337.700	27.311	14	
9094.83	C I	3	9095.82	32.64	0.338	0.027	15	
9123.60	[Cl II]	1F	9124.28	22.36	0.919	0.073	14	

[a] Where F is the unreddened flux in units of 100.00 = 2.574×10^{-13}.
[b] Where I is the reddened corrected flux, with c(Hβ)=1.80±0.09, in units of 100.00 = 1.624×10^{-11}.
[c] Affected by telluric emission.
[d] Blended with an unknown line.
[e] Affected by charge transfer.
[f] Affected by atmospheric absorption bands.

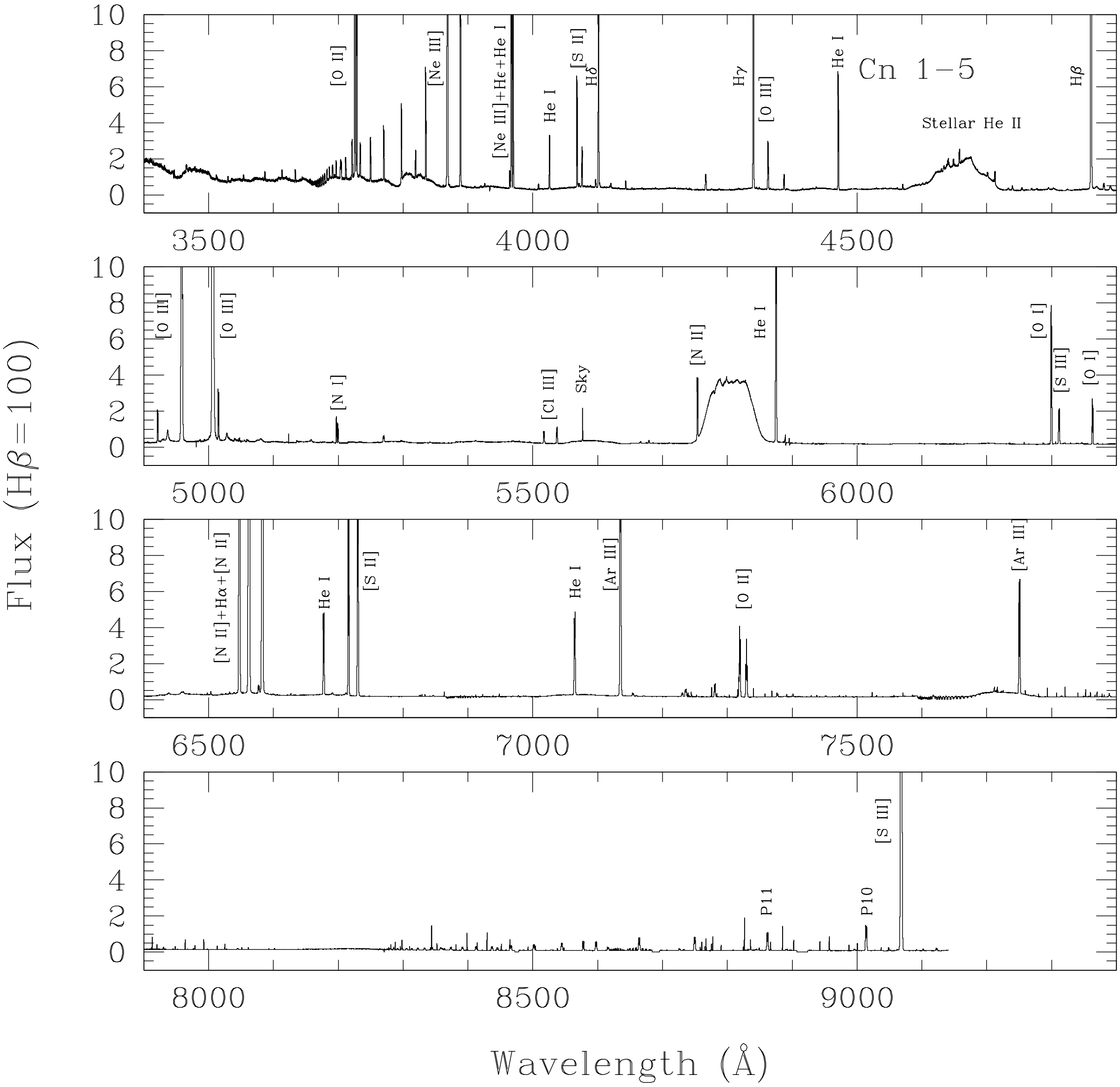

Fig. 3. Complete MIKE-echelle spectra of Cn 1-5. The most characteristic nebular emission lines have been labelled. Wide stellar WR features, generally stellar helium lines, are clearly visible in some spectral regions.

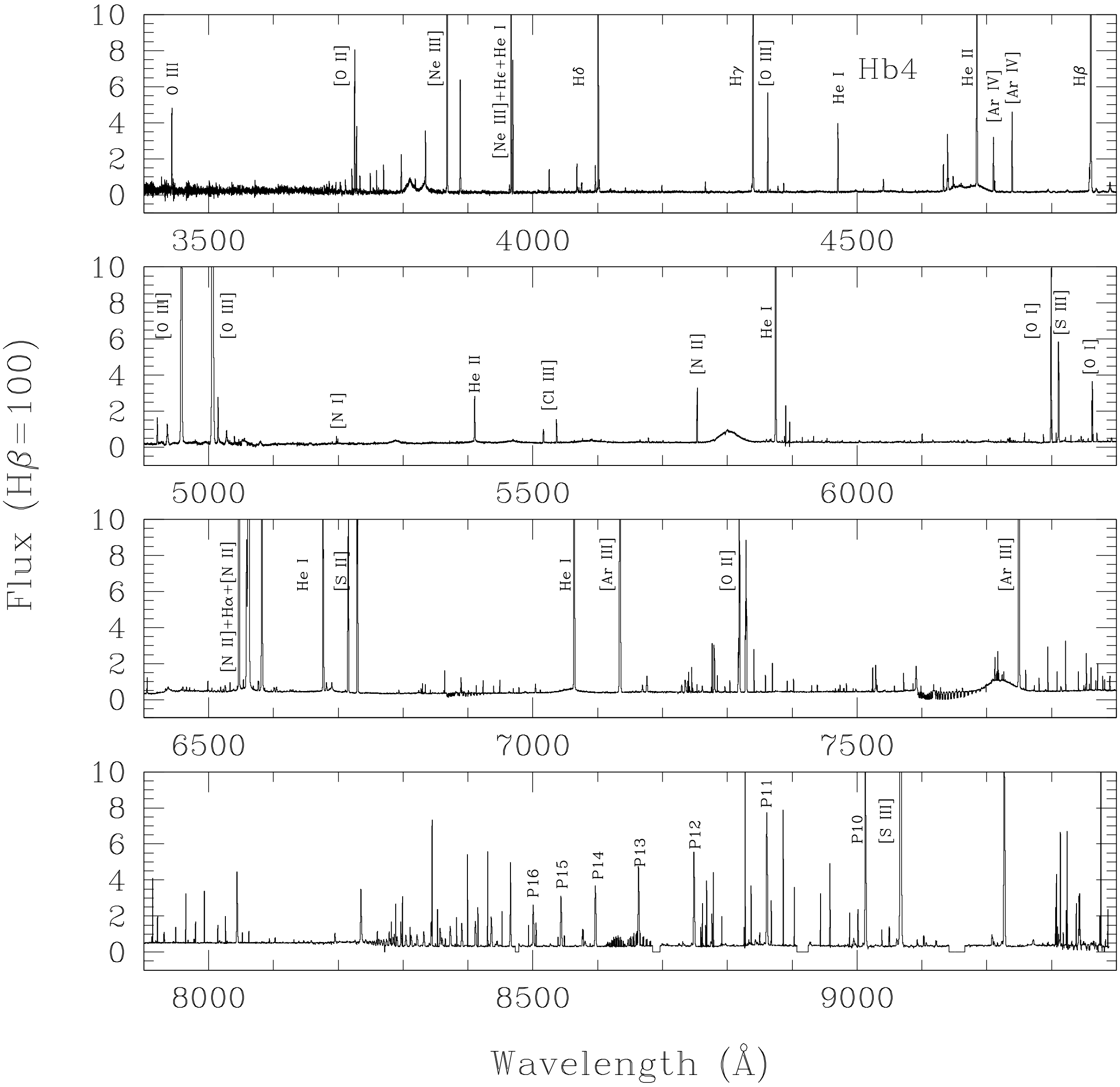

Fig. 3. Complete MIKE-echelle spectra of H b4.

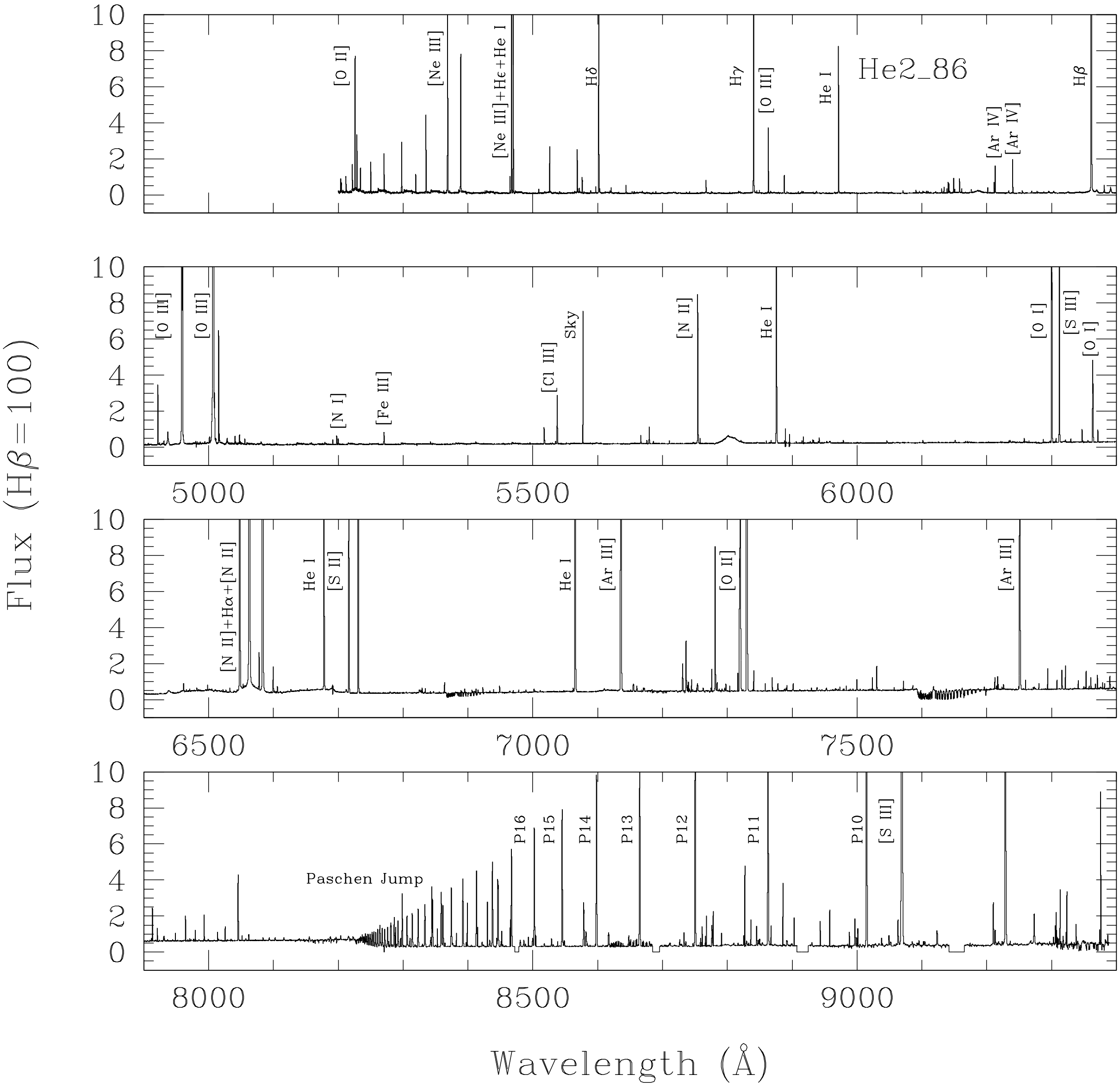

Fig. 3. Complete MIKE-echelle spectra of He 2-86.

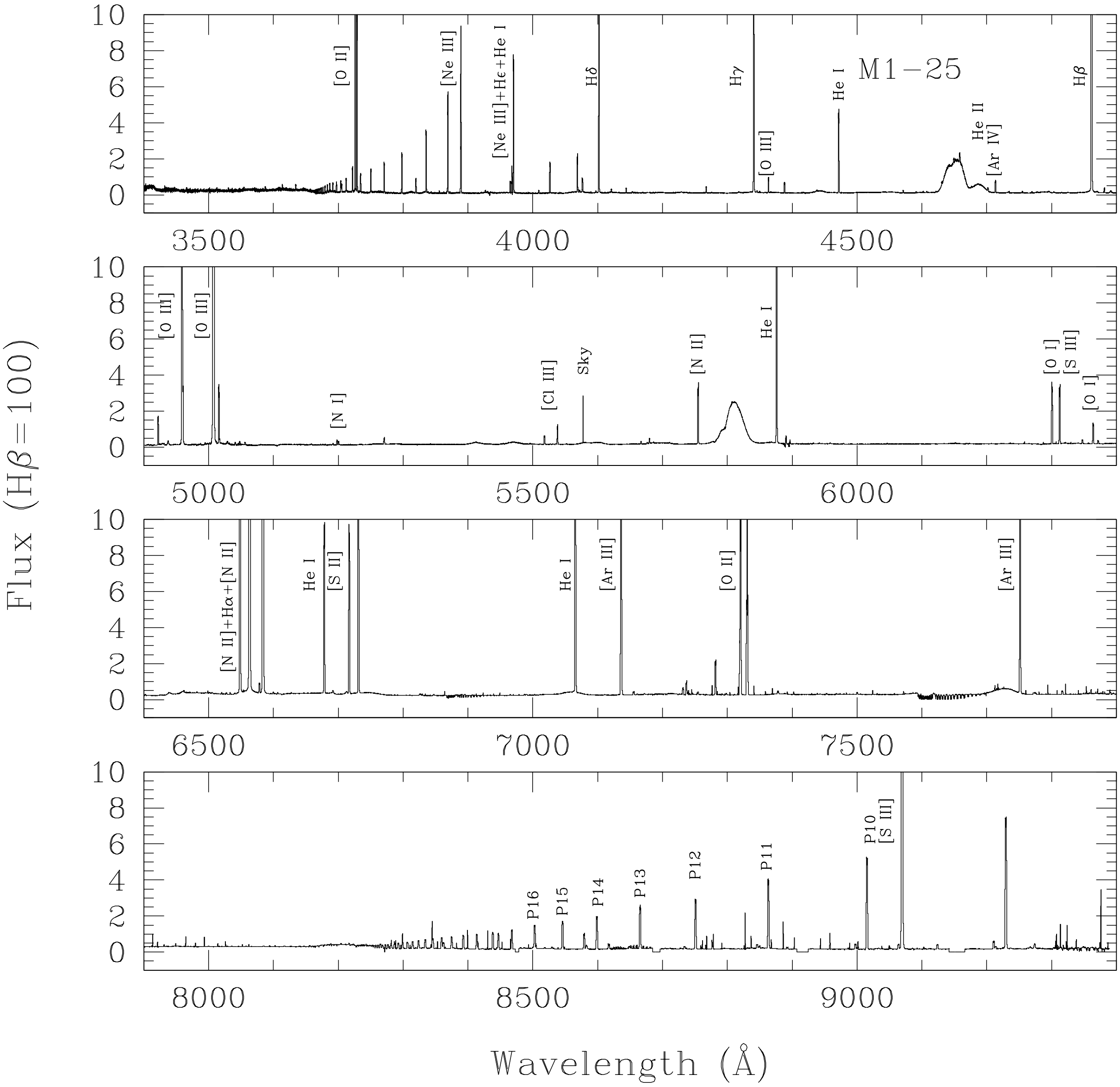

Fig. 3. Complete MIKE-echelle spectra of M 1-25.

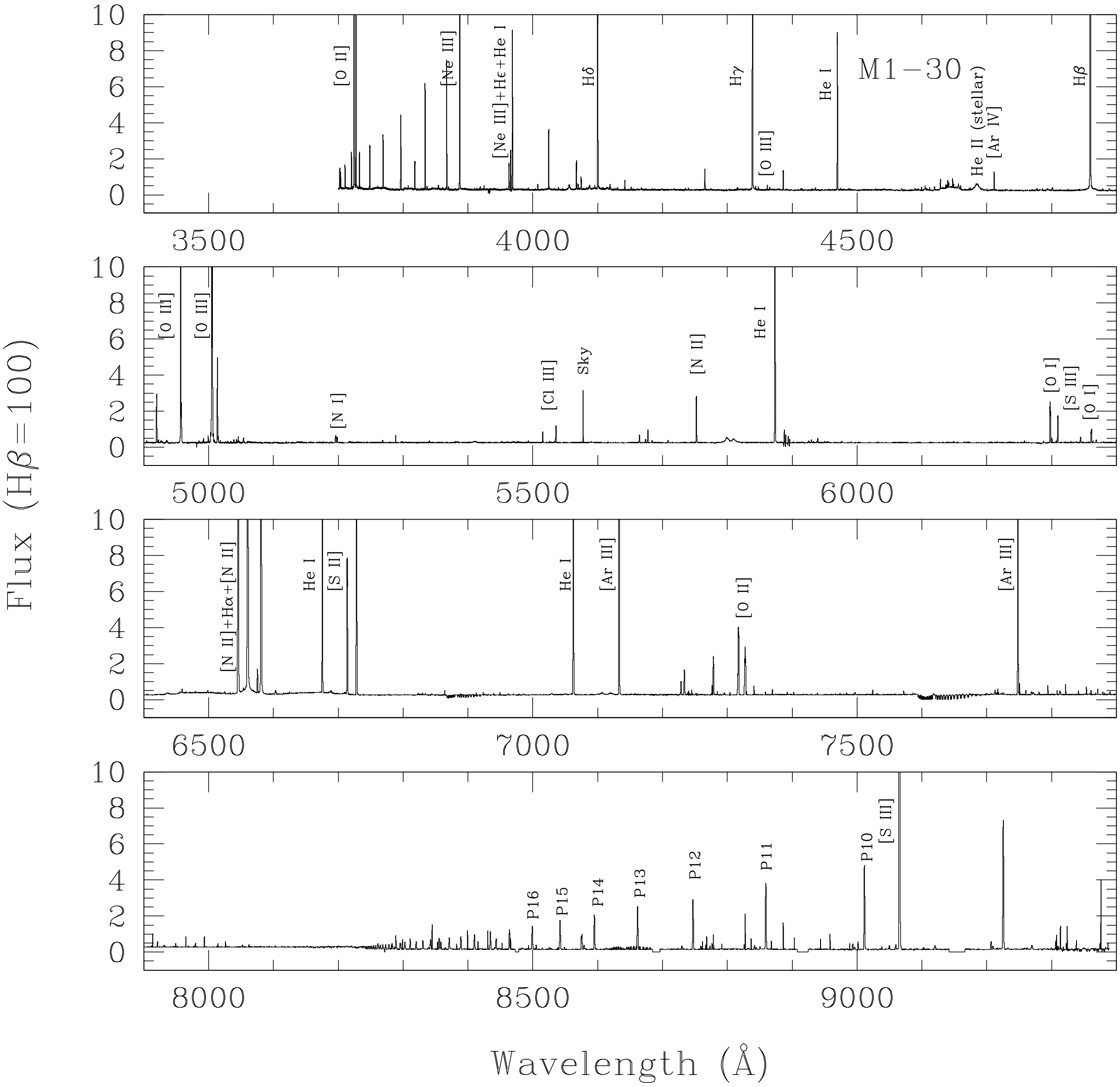

Fig. 3. Complete MIKE-echelle spectra of M 1-30.

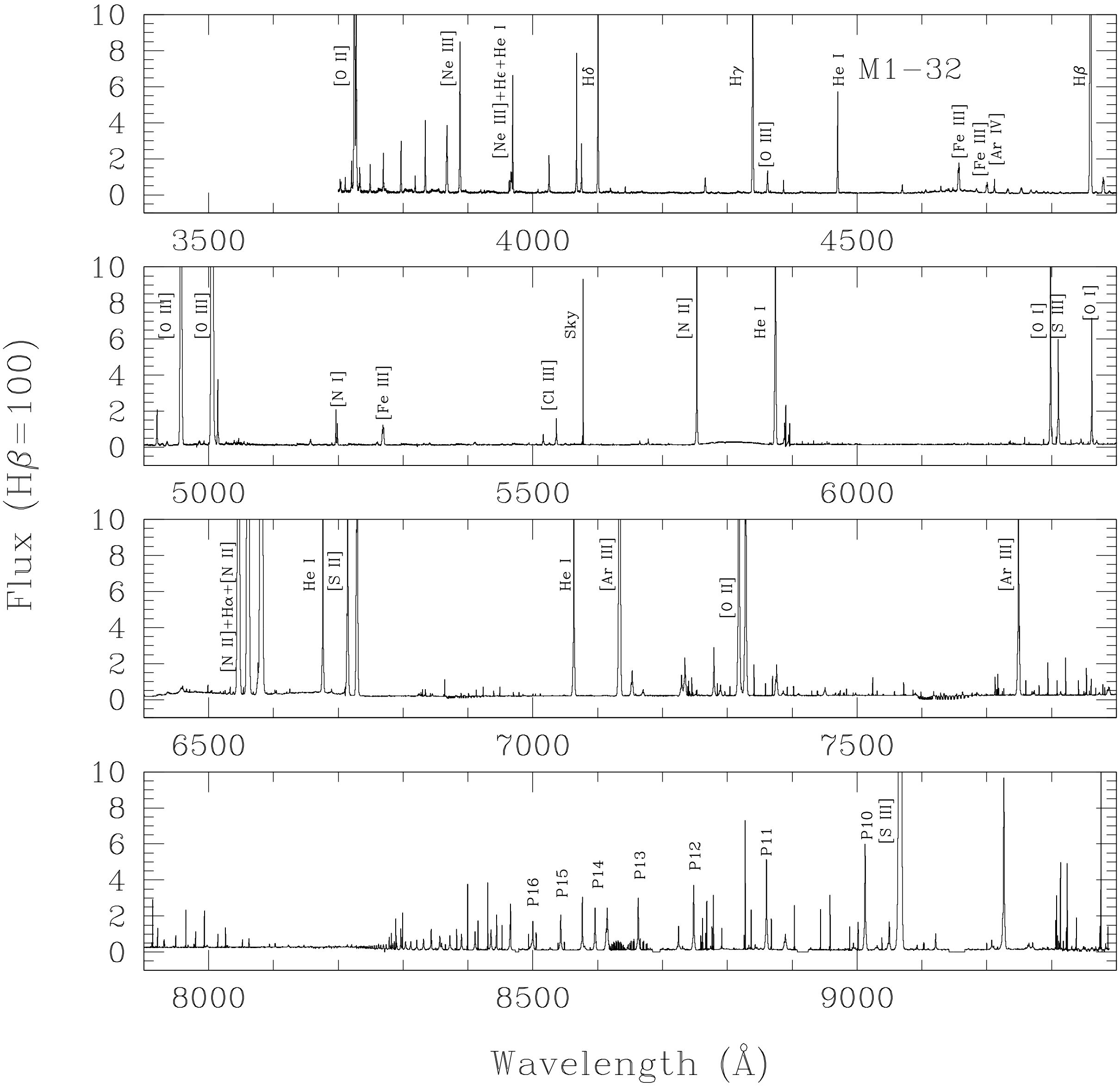

Fig. 3. Complete MIKE-echelle spectra of M 1-32.

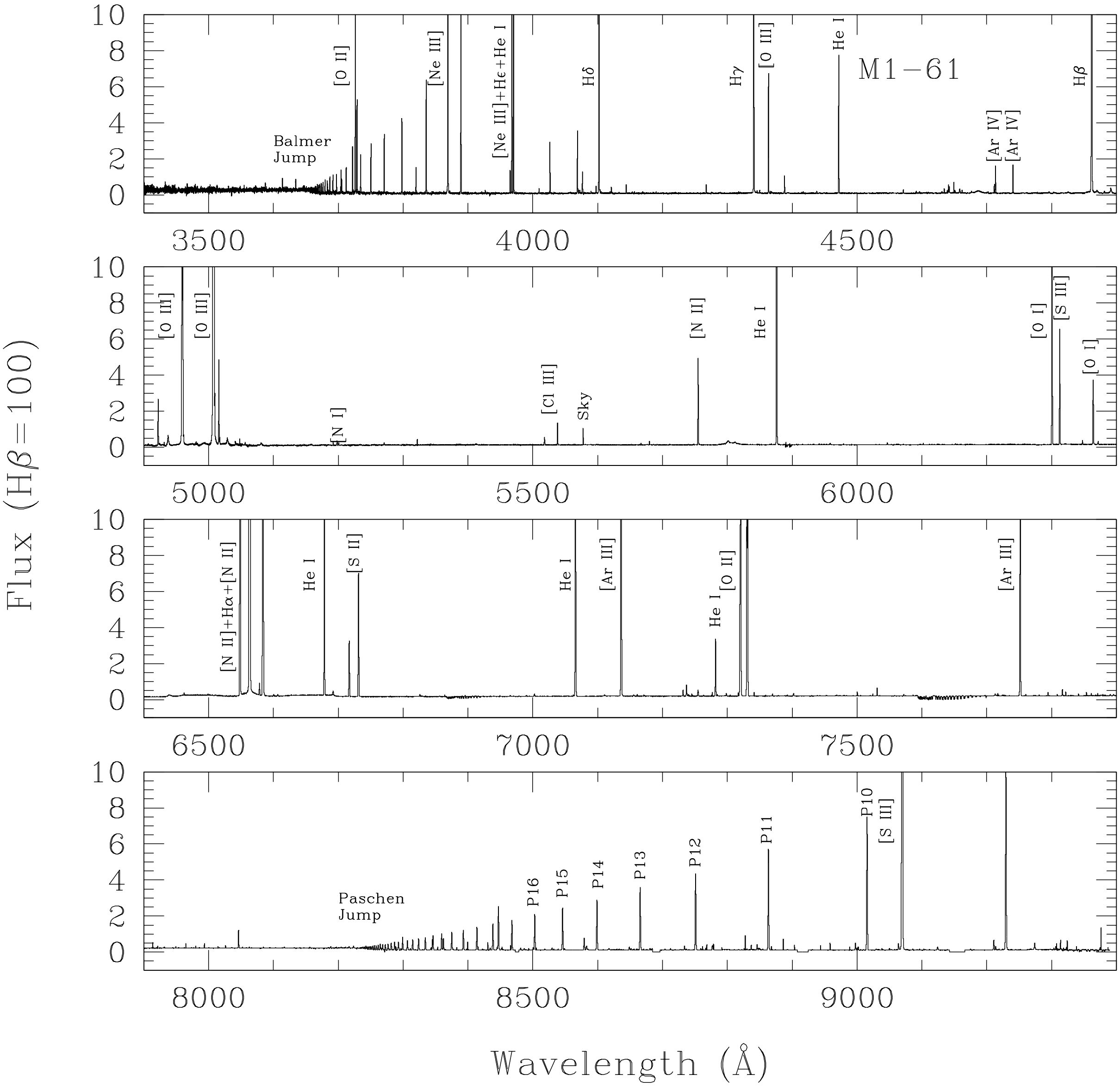

Fig. 3. Complete MIKE-echelle spectra of M 1-61.

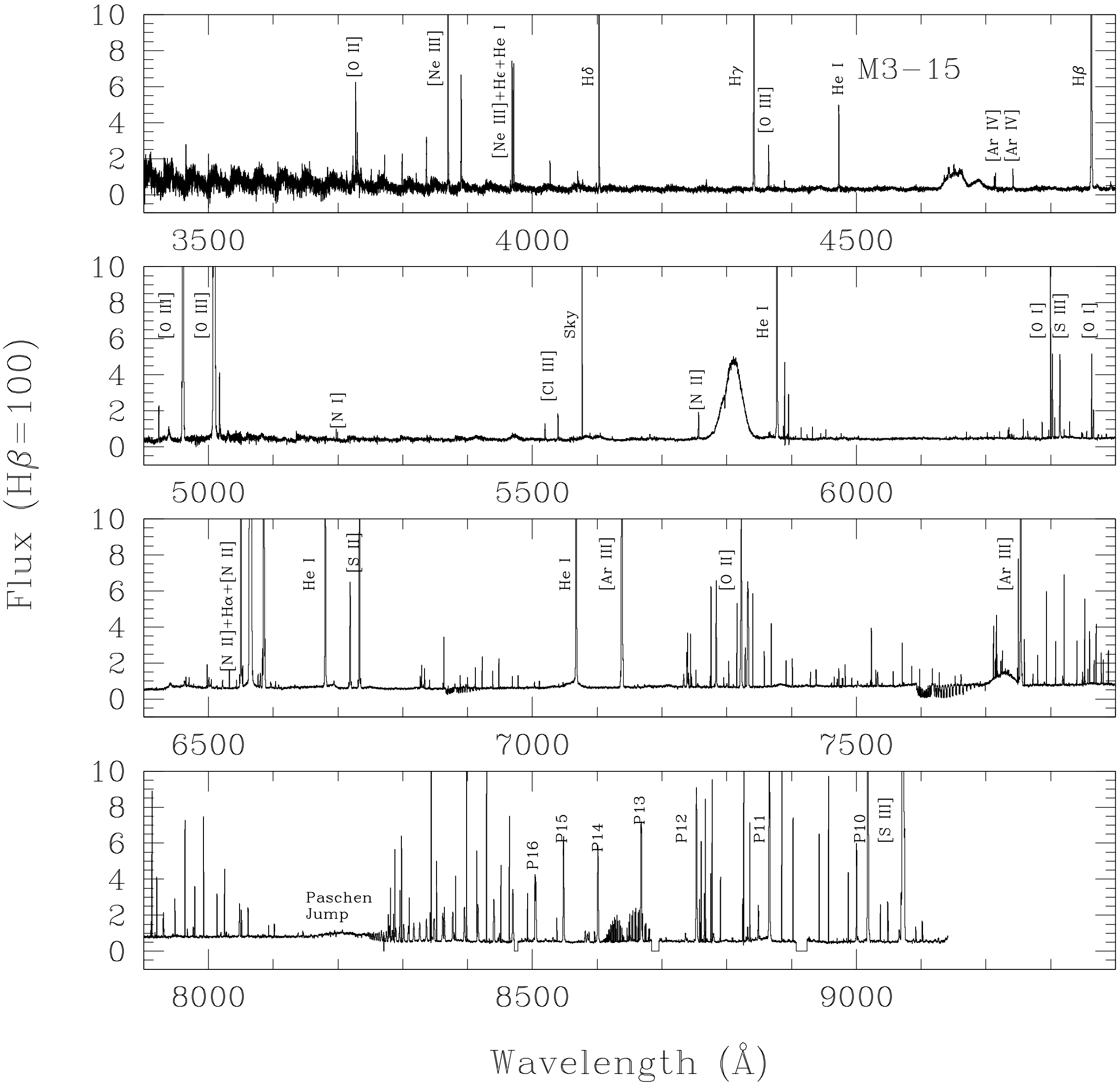

Fig. 3. Complete MIKE-echelle spectra of M 3-15.

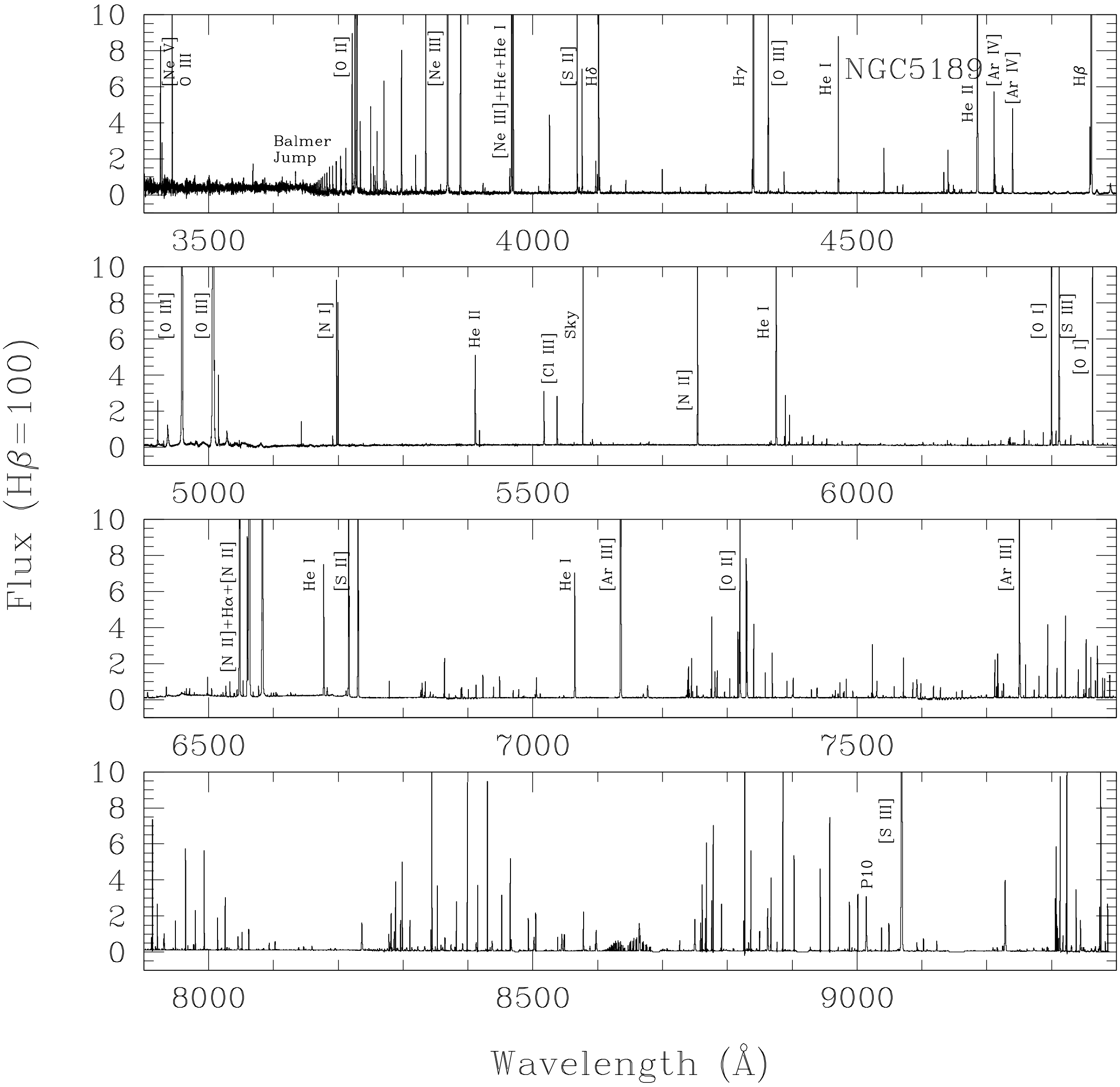

Fig. 3. Complete MIKE-echelle spectra of NGC 5189.

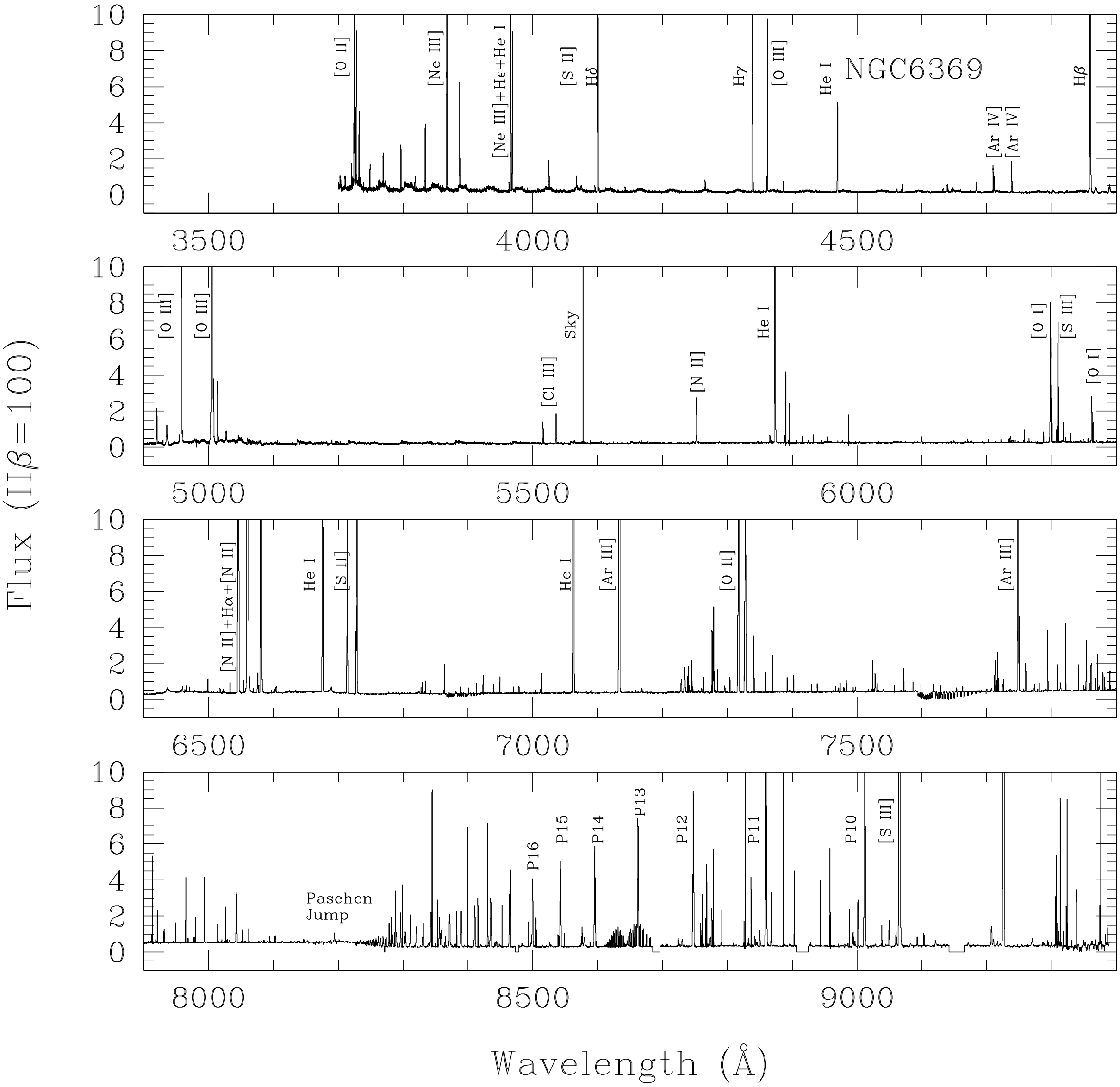

Fig. 3. Complete MIKE-echelle spectra of NGC 6369.

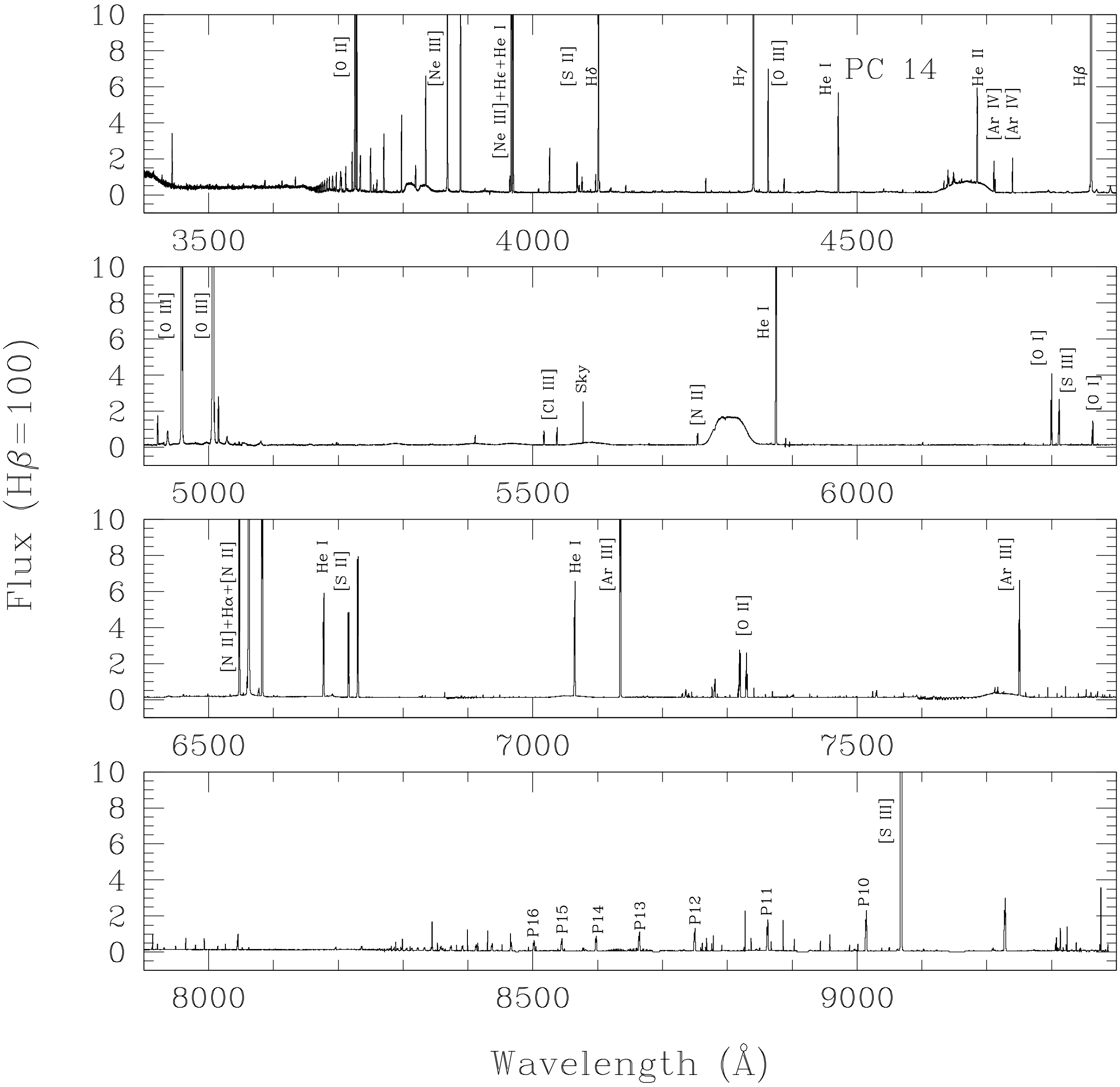

Fig. 3. Complete MIKE-echelle spectra of PC14.

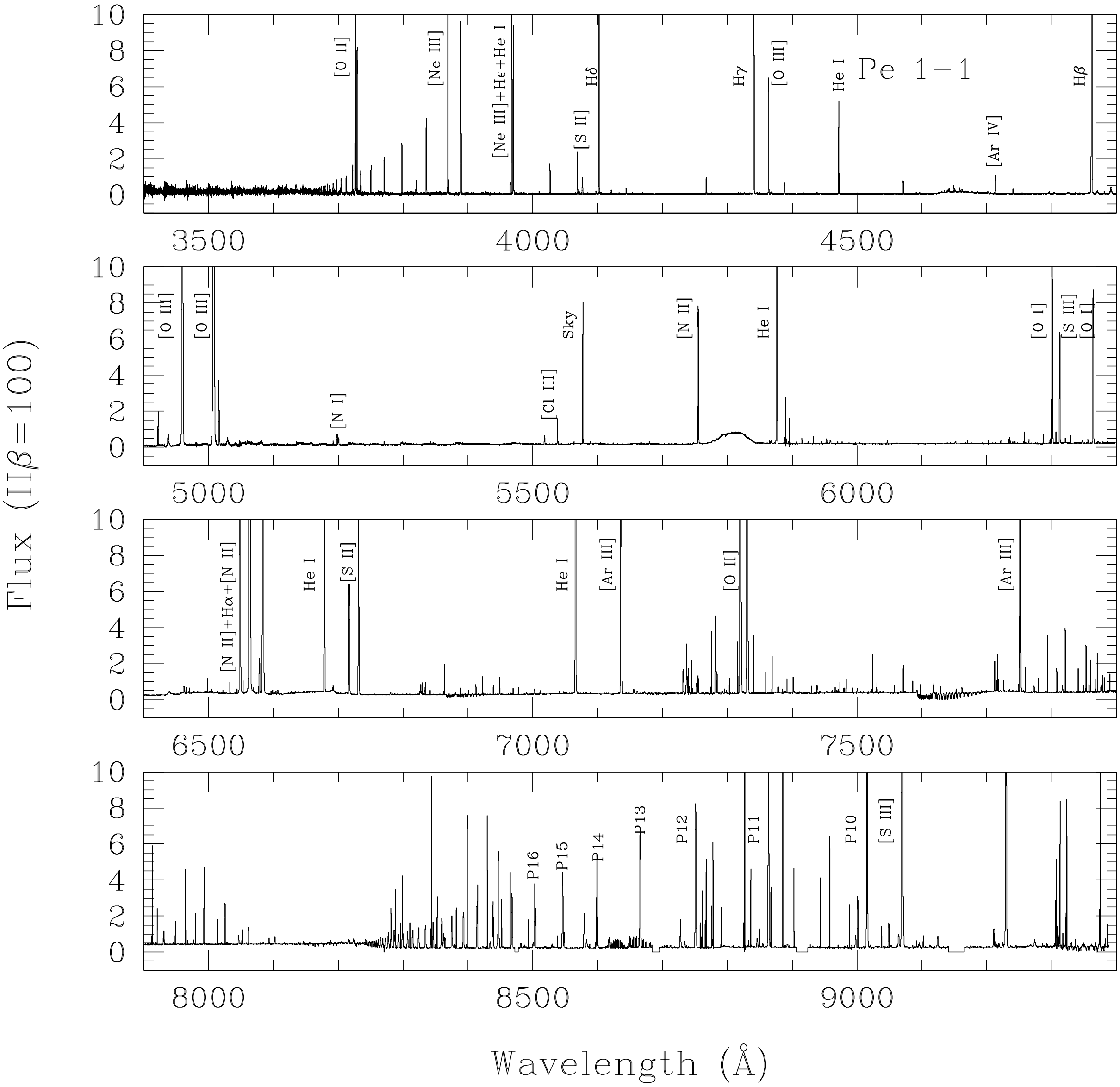

Fig. 3. Complete MIKE-echelle spectra of Pe 1-1.