

Contents

1. Introduction	1
1.1. Galactic Background	1
1.1.1. The Halo of the Milky Way	2
1.1.2. The Galactic Neighborhood	3
1.2. Variable Stars	4
1.2.1. RR Lyrae stars	6
1.2.2. The Role of RR Lyrae Stars in Galactic Astronomy	9
1.3. Previous Surveys	11
1.4. This Work	11
2. Dataset	13
2.1. Context & Observations	13
2.2. Data Analysis	15
2.3. Selection of RR Lyrae Star Candidates	17
2.3.1. Period Determination	17
2.3.2. Other Filters	19
2.4. Photometric Uncertainties	21
2.5. Completeness Estimation	22
2.6. Photometric Calibrations	24
2.6.1. Sloan Digital Sky Survey Zeropoint	24
2.6.2. Pan-STARRS Zeropoint	27
2.7. Heliocentric Distance Determination	27
2.7.1. Reddening Correction	27
2.7.2. Anchoring Distances to the Catalina Survey's Data	28
2.7.3. Using Period-Luminosity-Metallicity Relations	29
3. RR Lyrae stars in HiTS 2014	31
3.1. The sample	31
3.1.1. Pulsational Properties and Classification	35
3.1.2. Spatial Distribution	37
3.1.3. Comparison with previous surveys	37
3.1.4. Color-color distribution	41
3.2. RR Lyrae Stars in Known Dwarf Spheroidal Galaxies	43
3.2.1. Sextans dSph	43
3.2.2. Leo IV Ultra-Faint dSph	48
3.2.3. Leo V Ultra-Faint dSph	49

3.3. Distant RR Lyrae Stars	50
3.4. Number Density Profiles	51
3.4.1. Spherical Halo Model	53
3.4.2. Ellipsoidal Halo Model	54
4. RR Lyrae stars from HiTS 2015	62
4.1. The sample	62
4.1.1. Pulsational Properties and Classification	66
4.1.2. Spatial distribution	66
4.1.3. RR Lyrae Stars in the Sextans dSph	68
4.1.4. Faint RR Lyrae Stars	69
4.2. Importance of the Sample in an Astrophysical Context	69
Conclusions	69
Bibliography	119

List of Tables

3.1. Full list of the RRLs presented in Chapter 3, excluding the candidates in the Sextans dSph galaxy. The table shows the main properties of the RRLs, as well as their number of observations (N)	33
3.1. Full list of the RRLs presented in Chapter 3, excluding the candidates in the Sextans dSph galaxy. The table shows the main properties of the RRLs, as well as their number of observations (N)	34
3.1. Full list of the RRLs presented in Chapter 3, excluding the candidates in the Sextans dSph galaxy. The table shows the main properties of the RRLs, as well as their number of observations (N)	35
3.2. Sextans RR Lyrae stars found by HiTS in 2014. Previous ID's with prefixes V and MV are from Mateo et al.'s work, while stars with C come from Amigo et al. 's. Prefixes VV and VI are from Lee et al.'s catalog, and LSQ are from Zinn et al.'s	47
3.2. Sextans RR Lyrae stars found by HiTS in 2014. Previous ID's with prefixes V and MV are from Mateo et al.'s work, while stars with C come from Amigo et al. 's. Prefixes VV and VI are from Lee et al.'s catalog, and LSQ are from Zinn et al.'s	48
3.3. Most distant RR Lyrae stars found in the data from HiTS 2014.	51
3.4. Parameters for the different power law models described in Section 3.4, with RRLs from Leo IV and Leo V.	54
3.5. Parameters for the different power law models described in Section 3.4, without Leo IV and Leo V.	55
3.6. Power-law slopes of number density profiles of the halo from the literature	56
4.1. List of the HiTS 2015-exclusive RRLs presented in Chapter 4.	64
4.1. List of the HiTS 2015-exclusive RRLs presented in Chapter 4.	65
4.1. List of the HiTS 2015-exclusive RRLs presented in Chapter 4.	66

List of Figures

1.1.	Variability Tree	5
1.2.	Example of a Bailey diagram	7
1.3.	Typical light curves of RR Lyrae stars	8
2.1.	DECam CCD orientation	14
2.2.	Spatial distribution of the HiTS fields	15
2.3.	Example of the determination of a relative zeropoint	18
2.4.	Example of a distribution of periodic sources	19
2.5.	Example of the period analysis output	20
2.6.	Estimation of mean magnitude uncertainties	22
2.7.	Theoretical recovery rate	23
2.8.	Overlap with the SDSS and PS1	25
2.9.	Zeropoint calibration with the SDSS	26
2.10.	Zeropoint values distributions	26
3.1.	Histogram of the mean magnitude distribution for RRLs in HiTS 2014	32
3.2.	Period-Amplitude diagram of the RRLs from HiTS 2014	36
3.3.	Spatial distribution of RRLs from HiTS 2014 in the sky	38
3.4.	Radial plot with heliocentric distances and equatorial right ascension	39
3.5.	Color-color diagram of stars in common with the SDSS	42
3.6.	Color-color diagrams of stars in common with PS1	42
3.7.	Position in the sky of the RRLs found in the Sextans dSph	44
3.8.	Distribution of distances of the RRLs in Sextans	45
3.9.	Light curves of the sample of distant RRLs	57
3.10.	Number density profiles for a spheroidal halo	58
3.11.	Number density profiles for an ellipsoidal halo	59
3.12.	Corner plot of the posterior distribution of a simple power law for the number density profile	60
3.13.	Corner plot of the posterior distribution of a broken power law for the number density profile	61
4.1.	Histogram of the magnitude and color distribution for RRLs in HiTS 2015	63
4.2.	Period-Amplitude diagram of the RRLs from HiTS 2015	67
4.3.	Spatial distribution of RRLs from 2015 in the sky	68
4.4.	Phased lightcurves of RR Lyrae stars in the Sextans dwarf spheroidal galaxy, from HiTS 2014 (1/3).	74

4.5. Phased lightcurves of RR Lyrae stars in the Sextans dwarf spheroidal galaxy, from HiTS 2014 (2/3).	75
4.6. Phased lightcurves of RR Lyrae stars in the Sextans dwarf spheroidal galaxy, from HiTS 2014 (3/3).	76
4.7. Phased lightcurves of nearby (< 90 kpc) RR Lyrae stars in the field, from HiTS 2014 (1/4).	77
4.8. Phased lightcurves of nearby (< 90 kpc) RR Lyrae stars in the field, from HiTS 2014 (2/4).	78
4.9. Phased lightcurves of nearby (< 90 kpc) RR Lyrae stars in the field, from HiTS 2014 (3/4).	79
4.10. Phased lightcurves of nearby (< 90 kpc) RR Lyrae stars in the field, from HiTS 2014 (4/4).	80
4.11. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (1/6).	81
4.12. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (2/6).	82
4.13. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (3/6).	83
4.14. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (4/6).	84
4.15. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (5/6).	85
4.16. Phased lightcurves of RR Lyrae stars from HiTS 2015 exclusively (6/6).	86