

Contents

1	Introduction	1
1.1	Historical Perspective	3
1.1.1	The structure of local galaxies	6
1.2	Integral Field Unit observations	9
1.2.1	Low-redshift galaxy IFU surveys	10
1.2.2	High-redshift galaxy IFU surveys	12
1.3	Sub-mm/mm molecular gas observations	16
1.3.1	CO molecule as gas tracer	16
1.3.2	Local galaxy CO surveys	18
1.3.3	High-redshift galaxy CO observations	21
1.4	The star formation activity	22
1.5	This Thesis	23
1.5.1	Main Scientific Goals	24
1.5.2	Outline	24
2	Methods	25
2.1	Emission Line Fitting	25
2.2	Kinematic Model	28
2.2.1	Morphological models	29
2.2.2	Inclination angles	30
2.2.3	Single-map kinematic modelling	31
2.2.4	Double-map kinematic modelling	32
2.2.5	Kinematic asymmetries	34
2.3	Global Morpho-Kinematic Properties	36
2.3.1	Spatial extent	36
2.3.2	Rotational Velocity and velocity dispersion	36
3	The dynamics, merger rates & metallicity gradients of ‘typical’ star-forming galaxies at $z = 0.8 - 2.2$	39
3.1	Introduction	40
3.2	Sample selection, Observations & Data Reduction	41
3.2.1	HiZELS	41
3.2.2	SINFONI Observations	42
3.2.3	Stellar Masses	43
3.2.4	Star-Formation Rates	43
3.2.5	Spatial extent	44

3.2.6	Average ISM properties	44
3.3	ANALYSIS, RESULTS & DISCUSSION	45
3.3.1	Galaxy Dynamics	45
3.3.2	The Stellar-Mass Tully-Fisher and M_{\star} - $S_{0.5}$ Relations	50
3.3.3	Merger Fraction	53
3.3.4	Metallicity Content	54
3.3.5	Spatially Resolved Chemical Abundances	57
3.4	Conclusions	59
3.5	Appendix	60
3.5.1	Appendix A: Serendipitous detection	60
4	The kiloparsec-scale gas kinematics in two star-forming galaxies at $z \sim 1.47$ seen with ALMA and VLT-SINFONI at matched resolution	63
4.1	Introduction	64
4.2	Observations & Data Reduction	65
4.2.1	The SHiZELS Survey	65
4.2.2	ALMA observations & data reduction	67
4.3	ANALYSIS, RESULTS & DISCUSSION	68
4.3.1	CO emission & CO-to-H ₂ conversion factor	68
4.3.2	The SHiZELS-8 galaxy	70
4.3.3	The SHiZELS-19 galaxy	71
4.3.4	Dynamical Mass & Dark Matter content	76
4.3.5	The Kennicutt-Schmidt law at \sim kpc-scales	80
4.4	Conclusions	84
4.5	Appendix	85
4.5.1	Appendix A: α_{CO} RADIAL PROFILE	85
4.5.2	Appendix B: α_{CO} UPPER LIMIT FROM DYNAMICS	86
5	A kinematic analysis of the molecular gas content in dusty galaxies at $z \sim 0.03 - 0.35$ using ALMA	89
5.1	Introduction	90
5.2	SAMPLE SELECTION & OBSERVATIONS	91
5.2.1	VALES Survey	91
5.2.2	Galaxy Dynamics	94
5.3	METHODS	94
5.3.1	GAMA's morphological models	94
5.3.2	Kinematic model	97
5.3.3	Spatial and spectral resolutions effects	98
5.4	RESULTS & DISCUSSION	100
5.4.1	Morphological and kinematic properties	100
5.4.2	Luminosity dependence on galactic kinematics	104
5.4.3	PDR modelling & molecular gas kinematics	108
5.4.4	Dynamical Masses of Turbulent Thick Galactic Discs	110
5.4.5	Gravitationally stable discs	112
5.4.6	Energy sources of turbulent motions	116
5.4.7	Kennicutt-Schmidt Law Efficiency & Depletion Times	119
5.5	Conclusions	123

5.6	Appendix	125
5.6.1	Appendix A: KINEMATIC MAPS AND VELOCITY PROFILES . .	125
5.6.2	Appendix B: DYNAMICAL MASS ESTIMATES FOR DIFFERENT DENSITY PROFILES	125
5.6.3	Appendix C: EDGE-CALIFA SURVEY	131
	Future Work	133
	Summary & Conclusion	139
	Bibliography	144