

Contents

1	Introduction	1
1.1	A Brief History of the Discovery of Galaxies and AGN	1
1.1.1	Galaxies	1
1.1.2	Active Galactic Nuclei	2
1.2	AGN Structure and Multi-wavelength Emission	4
1.2.1	The Growing BH	5
1.2.2	AGN Standard Model and Broad-Band Continuum SEDs	6
1.2.3	AGN Standard Model and the Emission-Line Regions	8
1.2.4	Bolometric Luminosities	10
1.3	The Census of AGN Activity	10
1.3.1	Optical/UV Surveys	10
1.3.2	X-Ray Surveys	11
1.3.3	Infrared Surveys	12
1.3.4	Radio Surveys	13
1.3.5	The AGN Demography	13
1.4	The Co-evolution of BH and Galaxy Growth	14
1.4.1	The Cosmic Space Density of BH Growth and Star Formation Are Similar	15
1.4.2	Most BH Growth Occurs in Star-Forming Galaxies	16
1.4.3	BH Masses Are Related to Galaxy Bulge Properties	18
1.5	The Influence of AGN on the Evolution of Galaxies	19
1.5.1	Matching Models to Observations: AGN to the Rescue	20
1.5.2	Outflows	23
1.5.3	The SFRs of Luminous AGN	26
1.6	Thesis Outline	26
	References	28

2	Integral Field Spectroscopy and Spectral Energy Distributions	37
2.1	Integral Field Spectroscopy	37
2.1.1	Introduction	37
2.1.2	Integral Field Spectroscopy.	38
2.1.3	The Instruments Used in This Thesis	40
2.1.4	Data Reduction	42
2.2	Spectral Energy Distributions	43
2.3	Calculation of SFRs and AGN Luminosities	45
	References	45
3	Energetic Galaxy-Wide Outflows in High-z ULIRGs Hosting AGN Activity.	47
3.1	Motivation	47
3.2	Introduction	48
3.3	Observations and Data Reduction	49
3.3.1	Target Selection	49
3.3.2	IFU Observations	51
3.3.3	Flux Calibration and Stacking.	53
3.4	Star-Formation Rates and AGN Luminosities	54
3.5	Analysis and Results	55
3.5.1	Galaxy-Integrated Spectra.	55
3.5.2	Surface Brightness, Velocity and FWHM Maps.	57
3.5.3	Regions Dominated by Narrow and Broad Emission Lines	59
3.5.4	Velocity Profiles	63
3.6	Discussion	68
3.6.1	Tracing Galaxy Dynamics, Mergers and Outflows	69
3.6.2	Outflow Properties.	71
3.7	Conclusions	78
	References	79
4	Kiloparsec Scale Outflows Are Prevalent in Luminous AGN: Outflows and Feedback in the Context of the Overall AGN Population.	83
4.1	Motivation	83
4.2	Introduction	84
4.3	Targets, Observations and Data Reduction	85
4.3.1	Target Selection	85
4.3.2	Gemini-South GMOS Observations and Data Reduction	89
4.3.3	SFRs, AGN Luminosities and the Origin of the Radio Emission	90

4.4	Velocity Definitions and Spatially Resolved Kinematics	94
4.4.1	Non-parametric Velocity Definitions	94
4.4.2	Emission-Line Profile Fitting Procedure	96
4.4.3	Velocity Maps and Velocity-Distance Profiles	99
4.5	Results	100
4.5.1	Extended Emission-Line Regions: Sizes and Morphologies	102
4.5.2	Spatially-Resolved Ionised Gas Kinematics	103
4.5.3	Outflow Properties: Estimates of Mass, Energy and Momentum	108
4.6	Discussion	110
4.6.1	What Drives the Outflows?	110
4.6.2	What Role Do These Outflows Play in Galaxy Evolution?	117
4.7	Conclusions	118
	References	121
5	Storm in a “Teacup”: A Radio-Quiet Quasar with ≈ 10 kpc Radio-Emitting Bubbles and Extreme Gas Kinematics	125
5.1	Motivation	125
5.2	Introduction	126
5.3	Data Acquisition, Reduction and Analysis	128
5.3.1	VLA Radio Data	128
5.3.2	VIMOS IFU Data	131
5.3.3	HST Imaging	133
5.4	Results and Discussion	134
5.4.1	Summary of Source Structure	134
5.4.2	What Powers the Core Radio Emission and Outflow?	135
5.4.3	What Powers the ≈ 10 kpc Radio Bubbles?	138
5.5	Conclusions	139
	References	139
6	No Submillimetre Signature of Star Formation Suppression Among X-Ray Luminous AGN	143
6.1	Motivation	143
6.2	Introduction	144
6.3	Catalogues and Data	145
6.3.1	X-Ray Data	145
6.3.2	IR Data	146
6.4	Measuring Average Star Formation Rates	147
6.5	Results	149
6.5.1	Discussion	151
	References	153

7	Conclusions	155
7.1	The Identification and Characterisation of Galaxy-Wide Outflows in ULIRGs Hosting AGN Activity	155
7.2	Galaxy-Wide Outflows in the Context of the Overall AGN Population	156
7.3	Observations to Understand the Relationship Between Radio Emission and Outflows	157
7.4	Searching for Observational Evidence That Luminous AGN Suppress Star Formation	157
7.5	Overall Summary and Outstanding Issues	158
	Reference	158
8	Ongoing and Future Work	159
8.1	What Physical Processes Drive the Outflows in AGN?	159
8.2	What Are the Multi Gas-Phase Properties of Galaxy-Wide Outflows?	163
8.3	What Is the Prevalence of Ionised Outflows in Galaxies Across Cosmic Time?	166
8.4	What Impact Do Outflows Have on Galaxy Evolution?	169
8.5	Final Remarks	173
	References	174
	Appendix A: AGN Emission Lines: Some Relevant Information and Applications	175
	Appendix B: Assumed Cosmology	183
	Appendix C: Acronyms	187
	Index	191

Observational Constraints on the Influence of Active
Galactic Nuclei on the Evolution of Galaxies

Harrison, C.M.

2016, XXIII, 193 p. 57 illus., 17 illus. in color., Hardcover

ISBN: 978-3-319-28453-8