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Insights into galaxy evolution with strong gravitational lensing

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Investigating the connection between star formation and AGN growth in the high redshift Universe is challenging due to limitations in sensitivity and resolution of observational data. Previous studies have revealed high levels of star formation in quasar host galaxies, but studies of individual quasars have inevitably focused on a few bright sources. By targeting quasars that are gravitationally lensed we probe intrinsically lower luminosities, allowing us to study more typical quasars and construct a more complete sample of the population.

We have derived FIR luminosities and SFRs for the 104 gravitationally-lensed quasars observed with Herschel/SPIRE, the largest such sample ever studied. We find evidence for dust-obscured star formation in 66% of the sample, a result is in line with current models of quasar evolution and suggests that most quasars exist in a transitional phase between a dusty star-forming galaxy and AGN-dominated system.

Using the radio-infrared correlation, we differentiate radio-bright and radio-faint quasars and compare their FIR emission. With this method, we identify a population of optically-selected quasars with a radio excess which suggests they have low-power radio jets. We highlight the importance of VLBI to measure compact emission and understand the emission mechanisms, and hence AGN feedback mechanisms, at play in these objects.

A full understanding of our results requires detailed, multifrequency observations of individual objects. In this respect, high-resolution follow-up of lensed quasars from within our sample will be important as it will allow the radio jets, heated dust and molecular gas to be mapped on small angular scales. In addition to the Herschel study, we present preliminary results of our high-resolution studies of dust, molecular gas and radio emission which will be reconstructed on scales of 10-200 parsecs in combination with sophisticated gravitational lens modelling techniques. With our results, we demonstrate that gravitational lensing can provide important insights into the evolutionary process at cosmologically-interesting redshifts.