The multiphase ISM in infrared-luminous galaxies

Motivation/background

Luminous and ultraluminous infrared galaxies (LIRGs and ULIRGs, with far-IR luminosities > 10^{11} $L_{\odot}$ and > 10^{12} $L_{\odot}$, respectively) are predominantly powered by intense starbursts fueled by substantial reservoirs of molecular gas. Particularly at higher far-IR luminosities, where optical morphologies are increasingly disturbed, (U)LIRGs' starbursts are thought to be triggered by the mergers of gas-rich progenitor galaxies. Fully understanding the merging process requires understanding how the balance of phases (ionized, neutral atomic, and molecular gas) in the interstellar medium (ISM) evolve with time. Because neutral atomic (HI) gas is the most difficult ISM phase to study, due to the intrinsic faintness of the 21 cm spin-flip transition used to probe it, studies of the multiphase ISM in (U)LIRGs have typically been limited to the very lowest redshifts. However, sensitive new observations with the Looking At the Distant Universe with the MeerKAT Array (LADUMA) deep HI survey are now making it possible to probe HI in emission out to a redshift z_{HI} ~ 1.45, through a combination of individual detections and statistical detections of "stacked" samples. LADUMA thus enables more comprehensive studies of the multiphase ISM in (U)LIRGs outside the local universe than have been possible before.

Aims/goals

This project will combine MeerKAT HI observations, SALT optical spectroscopy, and multiwavelength tracers of dense gas content to probe the multiphase ISM in a sample of (U)LIRGs with known spectroscopic redshifts lying in the LADUMA field. Using the combination of these datasets, the visiting student will explore (a) the fate of HI in gas-rich mergers; (b) the dependence of (U)LIRGs' HI properties on their dust obscurations, metallicities, and ionizing spectra; and (c) opportunities for pushing the analysis of (U)LIRGs' HI content out to the highest redshifts MeerKAT can reach, via the refinement of strategies for critical data processing steps such as continuum subtraction and stacking.

Activities

During a one-month stay at Rutgers, the visiting student will have regular interactions with the project host (Baker), the other members of the host's research group, two other faculty members who are members of the LADUMA team (Gawiser, Hughes), and the diverse set of students, postdocs, and faculty (studying galaxy evolution from both observational and theoretical perspectives) who comprise the Rutgers astrophysics group. Because Rutgers is within a 1.5-hour train ride of multiple astronomy departments, the visiting student will also have opportunities to interact with a broader cross-section of the U.S. astronomical community.

Expected outcomes

The visit will contribute to the development of at least one paper (to be led by the visiting student) on the multiphase ISM in (U)LIRGs; this paper will make a unique contribution to the literature on IR-luminous galaxies by virtue of the uniquely deep HI observations on which it will be based. Significant technical contributions to LADUMA's data processing workflow will be recognized by automatic coauthorship on all relevant papers that rely on those contributions.