Molecular hydrogen as a tracer of AGN feedback in radio loud galaxies: the case of 3C 326 N

The physical link between AGN activity and the suppression of star formation in their host galaxies is one of the major open questions of the AGN feedback scenario. The Spitzer space mission revealed a subset of powerful nearby radio galaxies with unusually bright line emission from warm (~100K) molecular hydrogen, while typical star-formation tracers like PAHs or a dust continuum, were exceptionally faint or undetected.

We will present JWST NIRSpec IFU and MIRI MRS observations of one of the best studied galaxies of this class, 3C 326 N at z=0.08979. With NIRSpec, we identify a total of 16 lines of the S, O, and Q series of ro-vibrational H_2 emission that probe gas at ~1000K, a small subset of the galaxies total gas budget. We also map the rotational mid-infrared lines of H_2 0-0 S(3), S(5), and S(6) with MIRI MRS, which most of the $2X10^9$ $M_\odot$ of warm H_2 in this galaxy. Extended line emission shows a bipolar bubble expanding through the molecular disk with clumpy structure possibly indicating gas fragmentation. Extended [FeII]λ1.644 and Paα follow the same morphology, however [NeIII]λ15.56 is more symmetric about the nucleus. We will show that most of the gas, with the exception of [NeIII]λ15.56, is predominantly heated by shocks driven by the radio jets into the gas, both for the ro-vibrational and rotational H_2 lines, and that the accompanying line broadening is sufficient to suppress star formation in the molecular gas.

We will also present our comparison of the morphology and kinematics of the rotational and ro-vibrational lines, finding that the latter can be a good proxy to the global morphology and kinematic properties of the former in strongly turbulent environments. This underlines this interest of using these lines to study turbulent molecular gas in galaxies at intermediate and high redshifts well into the Epoch of Reionization, provided that line emission is bright enough, while most rotational lines are redshifted out of the MIRI bandpass for z~1.5. Finally, we will make comparisons to our investigation of AGN central parsec structure with the VLTI which allows us to make accurate predictions for what we will find with the ELT and what this means for galaxy evolution studies.