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The cold gas component and jet-ISM interplay in nearby low-excitation radio galaxies

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Low excitation radio galaxies (LERGs) are a class of AGN accreting gas at low rates (« 1% of the Eddington limit) and producing almost entirely kinetic (i.e. jet-induced) feedback. LERGs are, by number, the dominant radio galaxy population in the local Universe, preferentially hosted by massive nearby early-type galaxies (ETGs). Despite their prevalence, the powering mechanisms of these objects and associated AGN feedback processes are still poorly understood. We are carrying out for the first time a spatially-resolved, multi-phase (stars, hot/warm/cold gas, dust and radio jets) study of a volume- and flux-limited sample of eleven LERGs in the southern sky. The results obtained so far adds to the developing picture of LERGs as unexpectedly complex systems. The analysis of ALMA CO(2-1) data of nine sample sources demonstrates that the majority of them contain surprisingly large masses of molecular gas in the form of rotating discs confined on (sub-)kpc scales. The bulk of this gas appears to be in ordered rotation and stable orbits, possibly explaining the relatively low accretion rates of these objects. Nevertheless, subtle kinematic perturbations are ubiquitous and can be attributed either to interactions with the jets or to settling effects. The comparison between matched-resolution JVLA 10 GHz continuum and the ALMA CO data allows us to perform a full 3D study of the relative orientations of jet and disc rotation axes in four sample objects. Results from this analysis indicate that there is no simple relation between the rotation axis of the gas and the axis of the radio jets and provide further evidence for a jet-cold gas interaction in two sample sources. Follow-up ALMA observations of multiple molecular gas tracers in one of these two object, NGC 3100, demonstrate jet-induced modifications in the physics (i.e. optically thin conditions and high-excitation temperatures) and kinematics (i.e. low-velocity gas outflow) of the molecular gas on sub-kpc scales. Recently-acquired ATCA HI observations, along with other multi-wavelength indicators, hint to an external cold gas origin in sample sources with nearby companions, supporting an environment-dependent scenario for the cold gas accretion mechanisms in LERGs. Overall, the results obtained so far provide important constraints on the details of jet–cold gas interactions, fuelling and feedback processes in these systems. The high resolution and sensitivity provided by SKA will be crucial to simultaneously look at the HI and radio continuum components of our sample sources with unprecedented details and get further insights on these issues.

Reasearch area

Extragalactic Continuum (galaxies/AGN, galaxy clusters)

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