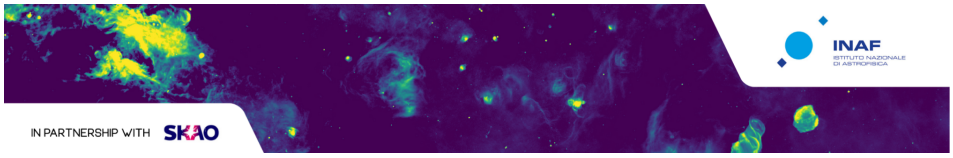

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Gaseous flows as probe of galaxy evolution: the SKA revolution

Gas accretion and depletion processes are key drivers of galaxy evolution. Cold gas may indeed be accreted from the CGM/IGM or recycled internally, becoming the fuel for the formation of new stars. If funnelled sufficiently inward, it can also feed the central super-massive black holes (SMBHs), giving rise to an active galactic nucleus (AGN). Both young stars and the AGN can then release large amounts of energy (i.e. feedback) onto their surroundings, altering the cold ISM physics or even expelling it from the host galaxy, thus dramatically affecting its fate. Mapping the distribution and kinematics of cold gas, from the outskirts to the innermost regions of galaxies, is thus vital to unveil how these processes affect galaxy evolution.

Studies of neutral atomic hydrogen (HI) are crucial in this context. HI traces the bulk of the cold gas reservoirs in the outer regions of galaxies and in their CGM, while absorption studies reveal its presence even close to central SMBHs, tightly linked to the molecular gas phase. It can thus provide direct evidence of galaxy-galaxy interactions or gas stripping phenomena when extended, dark HI filaments/clouds are observed connecting companion galaxies or within the IGM. However, such structures often exhibit very low column densities ($N_{\rm HI}$
$lesssim 10^{19}$ cm^{-2}), requiring ultra-sensitive observations to be detected.

The advent of the SKA precursor MeerKAT has started to revolutionise this type of studies, enabling - for the first time - mapping of diffuse HI gas down to column densities of $\sim 10^{18}$ cm^{-2} with $\sim 10''$ resolution out to $\sim$ 20 Mpc, within only a few tens of observing hours. In this talk, I will present recent results that exploit exquisite MeerKAT's sensitivity to investigate HI flows across multiple environments. I will then focus on the 25h MeerKAT observations of the nearby NGC3557 galaxy group, showing how these very deep (i.e. $N_{\rm HI} \approx 8 \times 10^{18}$ cm^{-2} at $10''$) data allow us to revolutionize our understanding of the $>$ 20 objects within the field of view. I will also illustrate how the combination of MeerKAT (SKA, in the future) and ALMA observations at comparable resolution is crucial to build a complete picture of the cold ISM (both atomic and molecular) across all spatial scales, from galaxy outskirts to the vicinity of SMBHs. These studies mark a turning point, demonstrating how next-generation radio facilities will fundamentally reshape our view of galaxy evolution.

Topics

Galaxy Evolution & AGN

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