

Imaging the Disk and Outflow of the Starburst Galaxy NGC 253 with High-Resolution HI

Abstract

We propose to map the nearest massive starburst galaxy, NGC 253, in 21-cm HI with the MeerKAT telescope down to an angular resolution of $\sim 8''$. At a distance of 3.5 Mpc, we will achieve a physical resolution of ~ 135 pc, which is very high for an HI map of an external galaxy, comparable to the highest physical resolution achieved for any galaxy outside the Local Group. We will be able to compare this high resolution HI map with new, in-hand, matched-resolution ALMA CO mapping of the whole galaxy, allowing us to compare the kinematics across multiple phases at nearly equal spatial resolution and to study the HI-to-CO (and HI-to-H₂) ratio at almost the scale of an individual gas cloud across the whole galaxy. Measurements of the structure and kinematics of the HI at this scale will allow us to identify the role played by atomic gas in the outflows seen in NGC 253 using X-rays, H α , and CO emission, but not so far 21-cm HI. Our kinematic analysis will also allow us to investigate the origin of the extraplanar HI. By comparing the wind across different gas phases, we will determine mass outflow rates from both the atomic and the molecular gas as a function of distance from the galaxy, thus also tracing the conversion of gas between phases in the outflow. As one of the nearest massive galaxies and a prototype of the common phenomenon of bar-fed starbursts, NGC 253 should provide an iconic demonstration of MeerKAT's imaging power.