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Unveiling HI and Gas-PAH Relations at Sub-kpc Scales: A VLA Perspective

Recent studies with JWST and ALMA have revealed an almost-linear scaling relation between mid-infrared polycyclic aromatic hydrocarbons (PAHs) and CO J=2-1 (tracing H2) emissions at hundred-parsec resolution. This scaling relation could be a powerful tool for studying neutral gas structure within molecular clouds. However, whether this gas-PAH relation holds in atomic-gas-dominated environments remains unclear due to the spatial resolution and sensitivity of existing HI data. To advance our understanding of the gas-PAH relation across different phases of the ISM, we conducted observations of HI 21-cm emission in 4 PHANGS-JWST Cycle 1 galaxies: NGC628, NGC1087, NGC3627 and NGC4254. These galaxies possess extensive ancillary data, including JWST F335M, F770W and F1130W PAH emission, along with filters necessary for continuum calculation. Using the VLA B+C+D configurations (total observing time ~45 hr per galaxy), we produced new HI data cubes with ~7”beam sizes, ~5.5 K sensitivity, and 2.1 km/s spectral resolution, processed through the PHANGS imaging pipeline. Our preliminary results indicate that at ~7”scales, PAH emission strength scales with gas surface density across both atomic- and molecular-gas-dominated phases of ISM. The normalization of this scaling appears to depend on the H2/HI ratio, indicating a preferential mixture of PAHs with molecular gas over atomic gas. These findings offer new insights on how JWST observations can be leveraged to trace ISM gas structures.

Section

Galaxy/Extragalactic

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