PHANGS-JWST Fractal Analysis of the Dusty ISM

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The Physics at High Angular resolution in Nearby GalaxieS (PHANGS) collaboration is a multi-instrument effort to investigate how gas, dust, and star formation interact in nearby galaxies [1]. In this project, we leverage the James Webb Space Telescope's (JWST) infrared capabilities to study emissions from polycyclic aromatic hydrocarbons (PAHs), carbon-based molecules associated with small dust grains [2] to trace regions of recent star formation and their impact on the interstellar medium (ISM) [3].

To quantify the structure of dusty ISM regions, we apply wavelet transforms to JWST infrared images to compute the wavelet power spectrum and estimate their fractal dimensions. These values serve as diagnostics of turbulence, fractal dimensions around 2.5 are predicted by classical turbulence theory, though other values may indicate different physical processes.[4]. Our pipeline automates preprocessing and power-law fitting to extract structural properties across the ISM in 70 PHANGS galaxies [5].

This framework offers a new approach to studying how dominant turbulent processes shape star-forming environments and contributes to broader questions of galaxy evolution. Our analysis draws on recent observational results [5], theoretical understanding [6], visualization tools [7], and outreach materials [1] to connect fractal structure with ISM physics.

References

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