Probing the Spatially Resolved Characteristics of Interstellar Dust with the *z*0MGS Dataset

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We present the spatially resolved studies on interstellar dust using data products from the z=0 Multiwavelength Galaxy Synthesis (z0MGS). The z0MGS program aims to create a large, uniform database of resolved measurements of gas and dust in nearby galaxies. The key data products includes: (1) WISE & GALEX: we have released WISE infrared (IR) and GALEX ultraviolet (UV) maps of $\sim 15,750$ local galaxies at matched resolutions (FWHM 7.″5 and 15″). These maps can be utilized to derive surface densities of star formation rate (SFR) and stellar mass as ancillary data for dust sciences. (2) *Herschel* and Dust: In a sub-sample of ~ 900 galaxies, we uniformly reduce their *Herschel* data. We then fit their dust properties with WISE and *Herschel* IR data and the Draine & Li (2007) model at SPIRE 250 μm resolution ($\sim 21''$). The data product includes the dust surface density, PAH fraction and properties of interstellar radiation field. (3) H I 21 cm: We conduct new H I 21 cm observations with the VLA for galaxies with *Herschel* data but missing in previous H I surveys (e.g. THINGS, HALOGAS). Around 40 galaxies have science-ready H I cubes.

The z0MGS data offer unprecedented insights into the resolved properties of interstellar dust and how dust interacts with the interstellar medium. One of the projects we conduct utilizing this catalog is to study the properties of dust temperature in terms of local environmental quantities at kpc scale, using a sub-sample where CO (1–0) or CO (2–1) is available. We find that the dust temperature correlates well with the SFR surface density, which traces the radiation from young stars. The dust temperature decreases with increasing dust-to-gas ratio (D/G) at fixed SFR surface density as expected from stronger dust shielding at high D/G, when SFR surface density is higher than $2 * 10^{-3}$ $M_\odot\,yr^{-1}\,kpc^{-2}$. These measurements align well with the dust temperatures predicted by our proposed analytical model. We also use a subset of nearest galaxies to examine how resolution affects the fitted temperature. We observed a systematic increase of approximately 2 K in the dust temperature as we degrade the resolution of IR maps from ~ 10 pc to ~ 1 kpc.

We also use the z0MGS-*Herschel* dust data to trace other quantities in the interstellar medium. For instance, we utilize the fitted dust surface density and an assumed D/G(Z) relation to trace the gas mass surface density to study the environmental dependence of the CO-to-H2 conversion factor. We found that the CO-to-H2 conversion factor scales with the stellar mass surface density as a power law in the high-surface-density regime. The power-law index is ~ -0.5 for CO (2–1) and ~ -0.2 for CO (1–0), and it is invariant of assumed D/G(Z) relation. The derived conversion factor also shows anti-correlation with local CO (2–1) linewidth, consistent with observations made with CO isotopologues. The above findings underscore the significant potential of the z0MGS dataset in advancing our understanding of interstellar dust and its role in galactic chemistry.