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Probing dust properties in the LMC from UV to FIR

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Interstellar dust is a key component of galaxy evolution owing to its crucial role in the chemistry and radiative transfer in galaxies. Our interpretation of extragalactic SEDs and our understanding of galaxy evolution thus critically depend on an accurate characterization of how the dust content and properties vary within and between galaxies. Recent observations suggest that dust grains must grow in the ISM to explain dust masses over cosmic times (Rowlands et al. 2014), leading to changes in the abundance, composition, size, and optical properties of dust grains with environment (e.g., density, metallicity, dynamics). In this talk, I will present results from two recent efforts to characterize the dust properties in the Magellanic Clouds. First, an analysis of the gas-to-dust ratio variations in the LMC and SMC (with metallicities 0.5 and 0.2 solar, respectively) based on the stacking and modeling of the resolved SED from all-sky FIR surveys (IRAS and Planck at 100, 350, 550, and 850 m) suggests that the dust abundances increases by factors 3-7 between the diffuse ISM and dense molecular clouds (Roman-Duval et al. 2017). Second, the large Hubble Space Telescope (HST) program METAL (Metal Evolution, Transport, and Abundance in the LMC - GO-14675, 101 orbits, Roman-Duval et al., in prep) is delivering its first large sample of interstellar depletions at half-solar metallicity toward 33 massive stars in the LMC. The gas-phase abundances of the key components of dust grains (Si, Mg, Fe, Ni, Ti) but also other volatile elements (Zn, S) strongly support dust growth in the ISM via accretion of gas-phase metals onto dust grains. Depletion patterns however differ between the Milky Way, the LMC, and SMC, with the dust-to-metal ratio offsetting almost exactly the metallicity differences, leading to constant gas-phase metallicities in those galaxies. Additionally, parallel WFC3 imaging obtained as part of METAL allow us to derive high-resolution extinction maps, which can be directly compared to FIR emission seen in Spitzer and Herschel to characterize the FIR dust emissivity. Preliminary results suggest that the emissivity of dust could increase by a factor 3 between the diffuse ISM and denser molecular regions, likely due to coagulation. These results have important implications for the sub-grid modeling of galaxy evolution, and for the calibration of dust-based gas mass estimates used for star-formation studies, both locally and at high-redshift.

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Yes

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