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Investigating Silicate Dust in Galaxies Using Quasar Absorption Systems

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The properties of silicate and carbonaceous dust grains in galaxies, as well as those of neutral and ionized gasses and of molecules, can be studied in galaxies ranging from the local Universe to moderate redshifts using absorption lines detected in the spectra of background quasars. By exploiting serendipitous lines of sight to distant quasars that pass through foreground galaxies, we can study the absorption signatures superposed in the quasar spectra by the dust and gas in these galaxies. Since quasars are luminous across a broad spectral range, this technique allows the simultaneous investigation of carbonaceous dust grains in the rest-frame ultraviolet (e.g., the 2175 Angstrom bump), metal ion lines at rest-frame ultraviolet and optical wavelengths, and silicate dust grains in the mid-infrared. We present results from our ongoing multi-wavelength research program exploring the connections between interstellar gas and dust in both distant and local galaxies using archival data for quasars with at least moderately gas-rich, foreground quasar absorption systems. In this presentation we will predominately focus on our studies of the silicate dust grains in several of these systems, characterized using the shapes of their 10 and 18 micron absorption features in Spitzer IRS spectra. Our measurements include the peak optical depth of the 10 micron feature, the ratio of the 10-to-18 micron features, and constraints on the silicate grain compositions, morphologies, and crystallinities derived from the shape and breadth of the absorption features. As part of our analysis, we will discuss the impact of variations in the underlying quasar continuum shape on our derived properties. We will also discuss correlations and trends between the silicate dust grain properties in these systems, and properties such as the absorber redshift, gas metallicity, velocity spread, carbonaceous dust abundance, and extinction curve shape. In combination, these data may yield important constraints on models of the evolution of metals and dust in galaxies. This work was supported by NASA grants NNX14AG74G and NNX17AJ26G.

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