

Probing Interstellar Silicate Dust Grain Properties in Quasar Absorption Systems at Redshifts $z < 1.4$

Monique C. Aller (University of South Carolina), Varsha P. Kulkarni (University of South Carolina), Donald G. York (University of Chicago), Daniel E. Welty (University of Chicago), Giovanni Vladilo (Osservatorio Astronomico di Trieste), and Debopam Som (University of South Carolina)

Absorption lines in the spectra of distant quasars whose sightlines serendipitously pass through foreground galaxies provide a valuable tool to simultaneously probe the dust and gas compositions of the interstellar medium (ISM) in galaxies. In particular, the damped and sub-damped Lyman-alpha (DLA/sub-DLA) absorbers trace gas-rich galaxies, independent of the intrinsic luminosities or star-formation rates of the associated galaxy stellar populations. Our previous work provided the first evidence of silicate dust in a quasar absorption system, through detection of the 10 micron silicate feature in the $z=0.52$ DLA absorber toward the quasar AO 0235+164. We will present results from an ongoing extension of this project using archival Spitzer Space Telescope infrared spectra to study interstellar silicate dust grain properties in 13 quasar absorption systems at $0.1 < z < 1.4$. Our research finds clear detections of the 10 micron silicate feature in the quasar absorption systems studied. In addition, we also detect the 18 micron silicate feature in the sources with adequate spectral coverage. We find variations in the breadth, peak wavelength, and substructure of the 10 micron interstellar silicate absorption features among the absorbers. This suggests that the silicate dust grain properties in these distant galaxies may differ relative to one another, and relative to those in the Milky Way. We also find suggestions in several sources, based on comparisons with laboratory-derived profiles from the literature, that the silicate dust grains may be significantly more crystalline than those in the amorphous Milky Way ISM. This is particularly evident in the $z=0.89$ absorber toward the quasar PKS 1830-211, where substructure near 10 microns is consistent with a crystalline olivine composition. If confirmed, these grain property variations may have implications for both dust and galaxy evolution over the past 9 Gyrs, and for the commonly-made assumptions about the similarity of dust properties at all epochs. We will also discuss indications of trends in these systems between gas-phase metal properties such as metallicity and gas velocity spread (as probed using complementary ground-based absorption spectra) with silicate dust grain absorption properties. Support for this work is provided by NASA through an award issued by JPL/Caltech and from the US National Science Foundation (NSF) grants AST-0908890 and AST-1108830 to the University of South Carolina. Additional support in the form of an International Travel Grant from the American Astronomical Society and NSF has enabled attendance at this conference.