Exploring Grain and Gas Properties in Debris Disks with Millimeter Interferometry

Meredith A. MacGregor[1]

[1] *Carnegie Department of Terrestrial Magnetism, Washington, D.C., USA*

At least 20% of nearby main sequence stars are surrounded by disks of dusty material resulting from the collisional erosion or evaporation of planetesimals, large bodies leftover from the process of planet formation. The small dust grains produced through these collisions can be observed via scattered light at visible to near-infrared wavelengths or thermal emission at mid-infrared to millimeter wavelengths. Since the dust-producing planetesimals are expected to persist in stable regions like belts and resonances, the locations, morphologies, and physical properties of dust in these 'debris disks' provide probes of planet formation and subsequent dynamical evolution. Thus, observations of these systems can simultaneously reveal the locations of planet formation and the compositions of the resulting planets. Observations at millimeter wavelengths are especially critical to our understanding of debris disks, since the large grains that dominate emission at these long wavelengths do not travel far from their origin and therefore reliably trace the underlying planetesimal distribution.

In this talk, I will present ongoing investigations into the grain and gas properties of nearby debris disk systems. We can constrain the grain size distribution by measuring the spectral dependence of the flux density at long wavelengths, providing the first observational test of collision models of debris disks. In addition, there is now a growing sample of debris disks with atomic and molecular gas detections. Resolved ALMA observations of molecular gas lines allow us to explore the kinematics of this gaseous material, and test theories of its origin and evolution. Together, measurements of both dust and gas properties can reveal the composition and distribution of planetesimals in these systems, and probe the environments where young planets are formed and acquire their final compositions.