Characterizing dust in debris disks: Recent advances and unsolved issues

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Debris disks are tenuous gas-poor, dusty disks that are often found around Main Sequence stars. In our Solar System, the zodiacal light is empirical evidence that even stars several Gyr old can possess such dusty disks. The dust grains these disks contain are the result of the continuous collisional grinding of planetesimals (asteroids and comets) that are the leftover byproducts of the planet formation process. Furthermore, the dynamics of the dust grains can be significantly influenced by gravitational interactions with planetary-mass objects. Studying the properties and spatial distribution of dust in debris disks therefore provide key insight on the structure of mature planetary systems. A number of observational approaches are available to study these disks, in particular by spatially and/or spectrally characterizing the thermal emission from the dust, or by imaging scattered starlight off the dust grains. All of these provide independent and complementary insights on the properties of the dust grains hosted in the system.

Here I will review the fundamental methodologies employed in this context and describe how a series of instrumental developments over the past two decades has led to major improvements in our understanding of debris disks. I will focus on what we have learned about dust properties, specifically the composition, size distribution and structure of dust grains, highlighting both key discoveries and currently unexplained features. Whenever possible, I will also discuss direct comparisons to the dust populations found in our Solar System and in protoplanetary disks.