Signatures of Planets in Debris Disks

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Main sequence stars are commonly surrounded by debris disks, composed of cold far-IR emitting dust generated by a reservoir of undetected dust-producing planetesimals. In debris disks harboring massive planets, the trapping of dust in gravitational resonances with the planet creates a density enhancement in a ring-like structure outside the orbit of the planet, while gravitational scattering with the planet creates a clearing of dust inside the planet's orbit. Massive planets, therefore, can create structure in the dust disk, and the study of this structure can help us survey a range of planetary parameters that are not detected by other methods. Spitzer will obtain spatially unresolved spectrophotometric observations of many of these systems. We discuss how the structure carved by massive planets affects the shape of the disk's spectral energy distribution (SED), and consequently how the SED may be used to infer the presence of planets. We show, however, that the SED modeling presents some degeneracies that can only be broken if spatially resolved images of the dust disks are obtained, justifying the need of SAFIR for the interpretation of debris disk structure in terms of planetary architectures. In addition, the very high sensitivity of SAFIR will allow us to understand whether debris disks originate from a steady production of dust, or from stochastic collisional events. SAFIR will provide unique capabilities to study stars at a stage when terrestrial planet formation might be taking place, results that will allow us to learn whether terrestrial planets are common or rare.

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