Study of the Dynamics of Dust from the Kuiper-Belt, its Delivery Rate to Earth's Vicinity and its Potential for Planet Detection

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This work is part of the SIRTF FEPS Legacy project (P.I. M. Meyer), which one of its goals is ``to establish the diversity of planetary architectures from SEDs capable of diagnosing the radial distribution of dust and the dynamical imprints of embedded giant planets''. In this presentation, we estimate the uncertainties inherent in the prediction of structure in the dust disk, owing to the chaotic dynamics of dust orbital evolution.
We examine carefully the method used by Liou & Zook (1999) to estimate the equilibrium spatial distribution of dust from the KB. This method is based on the ergodic assumption that is generally not applicable in chaotic dynamical systems. Nevertheless, we have established that in practice this method gives reliable results because: (1) the dust spatial structure is created quickly and (2) the radial profile of the equilibrium number density distribution does not strongly depend on the longest-lived particles.

We calculate disk brightness density and SED assuming greybody absorption and emission from the dust grains. We find that the presence of planets modifies the shape of the SED. The Solar System dust disk SED is particularly affected by the clearing of dust from the inner 10 AU due to gravitation scattering by Jupiter and Saturn.

We find that KB dust grains, when crossing the orbit of the Earth, have eccentricities and inclinations similar to cometary grains and not to asteroidal grains. As a consequence, they have encountering velocities and capture rates similar to cometary dust; this is contrary to the results of Liou, Zook & Dermott (1996). Extending the work of Kortenkamp & Dermott (1998) we estimate that at most 25% of capture IPDs have cometary or KB origin. Using observationally based dust production rates by Landgraf et al. (2002), we estimate the radial number density profile of KB dust and its delivery rate to Earth's vicinity.