Solar radiation and collisional balance of the meteoritic complex

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Besides the gravitational forces due to the Sun and other planets, the orbital evolution of interplanetary dust particles (IDPs) is driven by non-gravitational effects (the solar wind, Poynting-Robertson effect). This study presents some new results based on the action of the solar wind and a better comparison of the lifetimes due to the solar radiation action and the collisions.

In the conventional approach (Gruen et al. 1985), the main loss mechanism for particles $10^{-10}\,\mathrm{g} \leq m \leq 10^{-5}\,\mathrm{g}$ is the Poynting-Robertson effect. However, our results show that the effect of the solar wind is more important than the Poynting- Robertson effect, with the real upper limit more than 2×10^{-4} g and the corresponding particle radius of 275 microns instead of 100 microns (Grun et al. 1985). A more elaborate model that compares the drift and collisional lifetimes leads to the conclusion that a particle of the mass 22×10^{-5} g is destroyed by a collision before reaching the heliocentric distances $r = 0.5$ au (assuming the starting position $r_0 = 1$ au). Moreover, particles of sizes greater than 550 micrometers are destructed before reaching $r = 0.5$ au, while smaller particles can move to lower heliocentric distances. Furthermore, the total solar radiation loss rate inside 1 au is (0.6–1.0) tons/sec instead of the conventional value 0.26 tons/sec (Gruen et al. 1985). Consequently, it is important to reevaluate the size distribution of interplanetary meteoroids on the basis of the known real action of the solar wind.

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References: Gruen E., Zook H. A., Fechtig H., Giese R. H., 1985, Icarus, 62, 244.