Forbidden mass ranges for shower meteoroids

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ABSTRACT

Burns et al. (1979) use the parameter β to describe the ratio of radiation pressure to gravity for a particle in the Solar System. The central potential that these particles experience is effectively reduced by a factor of $(1 - \beta)$, which in turn lowers the escape velocity. Burns et al. (1979) derived a simple expression for the value of β at which particles ejected from a comet follow parabolic orbits and thus leave the Solar System; we expand on this to derive an expression for critical β values that takes ejection velocity into account, assuming geometric optics. We use our expression to compute the critical β value and corresponding mass for cometary ejecta leading, trailing, and following the parent comet's nucleus for 10 major meteor showers. Finally, we numerically solve for critical β values in the case of non-geometric optics. These values determine the mass regimes within which meteoroids are ejected from the Solar System and therefore cannot contribute to meteor showers.