The Effects of Hyperbolic Meteoroids from Parker Solar Probe to the Moon

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The zodiacal cloud in the inner solar system undergoes continual evolution, as its dust grains are collisionally ground and sublimated into smaller and smaller sizes. Sufficiently small (~<500 nm) grains known as beta-meteoroids are ejected from the inner solar system on hyperbolic orbits under the influence of solar radiation pressure. These small grains can reach significantly larger speeds than those in the nominal zodiacal cloud and impact the surfaces of airless bodies. Since the discovery of the Moon's asymmetric ejecta cloud, the origin of its sunward-canted density enhancement has not been well understood. We propose impact ejecta from beta-meteoroids that hit the Moon's sunward side could explain this unresolved asymmetry. The proposed hypothesis rests on the fact that beta-meteoroids are one of the few truly asymmetric meteoroid sources in the solar system, as unbound grains always travel away from the Sun and lack a symmetric inbound counterpart. This finding suggests beta-meteoroids may also contribute to the evolution of other airless surfaces in the inner solar system as well as within other exo-zodiacal disks. We will also highlight recent observations from the Parker Solar Probe (PSP) spacecraft, which suggest it is being bombarded by the very same beta-meteoroids. We discuss how observations by PSP, which lacks a dedicated dust detector, can be used to inform the structure and variability of beta-meteoroids in the inner solar system closer to the Sun than ever before.

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