Very Small Meteors – A Comparison of Ablation, Deceleration and Detection Theory with Observations,

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In order to determine the mass and velocity distributions of the large flux of very small meteors (< 10 microns) from radar scattering data, it is necessary to model the plasma that is created as these meteors burn up in the upper atmosphere. Although an extensive body of large-aperture radar scattering data has been accumulated in recent years, the essential physics that relates the measured radar cross-section to meteor mass and velocity has only been partially formulated in the limit of long-wavelength scattering from nominally spherical plasmas. In this work we present a set of models of meteor ablation and plasma formation around the meteor head in order to better understand the radar scattering cross-sections. Plasma profiles are determined from first-principles fluid and Monte-Carlo simulations including collision processes and collective fields. The results indicate that the plasma parameters vary widely with altitude, as expected, and hence with the initial meteor mass and velocity. The model outputs include predicted meteor termination altitudes and energy distribution profiles along the meteor track, and those results are compared with recent collections of radar scatter data.