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Numerical Simulation of Gas Expansion from Meteoroid Impact Vaporization on Mercury

Meteoroid impacts on Mercury's surface produce transient vapor plumes by releasing volatile species from surface materials. Observations by NASA's MESSENGER spacecraft have detected significant transient Na enhancements in Mercury's nightside exosphere, attributed to large-scale meteoroid impact events (Cassidy et al., 2021). Furthermore, superthermal (>50,000) Ca atoms also has been detected, indicating that these atoms could not result only from the initial impact processes. Instead, these superthermal Ca atoms are believed to originate from an additional energetic mechanism, such as the photodissociation of calcium-bearing molecules released during impacts (Killen et al., 2015). To investigate the dynamics of impact-generated gas expansion on Mercury, we will show a time-dependent Monte Carlo model. The model incorporates multiple volatile species, such as Na and CaO, and accounts for photolysis reactions. This approach aims to characterize the spatial distribution and temporal evolution of impact-generated, aiding future observations by the BepiColombo mission.

Section

Solar System/Exoplanets

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