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The contribution of impulsive meteoritic impact vaporization to the Hermean exosphere

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The exosphere of Mercury has been the object of many investigations and speculations regarding its composition, formation, depletion and dynamics. While vaporization of Mercurian surface materials by meteorite impacts has been often considered to be a less important contributor to the exosphere than other potential processes, larger objects coming from the Main Asteroid Belt could cause high local and transient enhancements in the density of the exosphere. Vaporization by such impacts is an almost stoichiometric process, and thus would contain valuable information about the surface composition. We investigate some exospheric effects of impact vaporization for meteorites with radii of 1 cm, 10 cm,and 1 m, with particular reference to the missions that will explore Mercury during the next decade (MESSENGER and BepiColombo). Because of their higher probabilities, impacts of objects in the two smaller size ranges will surely occur during the lifetimes of the two missions. The enhancement of the exospheric density on the dayside of Mercury would be appreciable for the 10-cmand 1-m meteorites (some orders of magnitude, especially for Al, Mg, Si, and Ca). Such events could allow detection, for the first time, of refractory species like Al, Mg, and Si, which are expected to exist on the surface but have not yet been detected in the exosphere. Ca could be detectable in all cases, even if produced by impacting objects as small as 1 cm in radius. The lower exospheric background on the night side should allow easier identification of Na and K produced by impulsive events, even if their generally high background values make this eventuality less likely.