Mercury global full-kinetic plasma simulations in support to BepiColombo

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Résumé

Mercury is the only telluric planet of the solar system, other than Earth, with an intrinsic magnetic field. Thus, the Hermean surface is shielded from the impinging solar wind via the presence of an "Earth-like" magnetosphere. However, this cavity is twenty times smaller than its alike at the Earth. The relatively small extension of the Hermean magnetosphere enables us to model it using global full-kinetic simulation with the aid of modern supercomputers. Such modeling is crucial to interpret, and prepare, future observations of the ongoing joint ESA-JAXA mission BepiColombo.
The goal of this work is to study the global electron dynamics in the Hermean magnetosphere with particular focus on acceleration processes and particle trapping.

The model used in this work is based on three-dimensional, implicit full-PIC simulations

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of the interaction between the solar wind and Mercury's dipole magnetic field. This model includes self-consistently plasma processes from the large planetary scale down to the electron kinetic scale. On top of that, we show comparisons between simulation data and *in-situ* observations by Mariner10 and BepiColombo space missions.
From our simulations we observe accelerated electrons up to tens of keV in the case of southward interplanetary magnetic field (IMF). These electrons are generated by magnetic reconnection in the tail and they are ejected planet-ward in a substorm fashion. These electrons do not form a radiation belt like the one at Earth, but rather remain trapped in the nightside and – eventually – a large fraction of those fall on the planet surface. We suggest that these electrons have been observed by Mariner10/PLS instrument during its first Mercury flyby around and after closest approach. Moreover, our simulations data provide useful insights for the interpretation and planning of ongoing (and future) BepiColombo observations.