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A hybrid model family to study flowing plasma-Solar System object interactions

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Abstract

The Solar System contains various Earth-size or smaller objects which interact with the flowing plasma. Some of these objects have an intrinsic magnetic field but not an atmosphere (Mercury), some objects do not have a noticeable global intrinsic magnetic field but have an atmosphere (Venus, Mars, Titan) while some have neither an atmosphere nor an intrinsic magnetic field (e.g. the Moon and asteroids). All these objects are currently investigated by several space missions (Messenger, Venus Express, Chandrayaan-1, Mars Express, Cassini) by magnetic field and plasma instruments (e.g. ASPERA-3/ Mars Express, ASPERA-4/ Venus Express).

The Finnish Meteorological Institute (Helsinki, Finland) has developed a global self-consistent plasma model to study these Solar System objects. The self-consistent model, HYB, is a quasi-neutral hybrid model where ions are modeled as particles and electrons as a massless charge neutralizing fluid. During the last ten years the model has been used to study the plasma environment of Mercury (HYB-Mercury [1]), Venus (HYB-Venus [2]), the Moon (HYB-Moon [3]), Mars (HYB-Mars [4]), Titan (HYB-Titan [5]) and a non-magnetized asteroid (HYB-Ceres [6]).

In this presentation we describe briefly the basic properties of the HYB model and illustrate how it can be used in space plasma physics research. Finally, we discuss a vision where the simulation results would be made easily available to the scientific community by developing HYB-WWW, a hybrid model library, which can be accessed interactively through a Web interface or integrated into the Europlanet data system.

References

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