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Computational modelling of planetary magnetospheres in application to exoplanets

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Abstract

The Solar System objects provides "archetypes" of how flowing supermagnetosonic plasma interacts with a planetary object.

- In the *Earth-like interaction* an object has a strong intrinsic magnetic field and a magnetosphere is formed around the object.
- In the *Venus-like interaction* an object does not have a noticeable global intrinsic magnetic field but it has a dense atmosphere which upper layer is ionized by solar EUV radiation. This tenuous ionized upper layer deviates the flow of plasma around an object.
- In the *moon-like interaction* an object does not have an intrinsic magnetic field neither an atmosphere. In such a situation the solar wind interacts directly with the surface of an object.
- In the *comet-like interaction* an extended expanding ion cloud is formed around an object which mass load the solar wind with newly born cometary ions.
- Moreover, although all planets in our solar system are in a supermagnetosonic solar wind, planetary moons, such as Saturnian Moon Titan, provides environments where the flowing plasma is *subsonic and/or subalfvenic*.

Our knowledge about these environments has increased remarkably during the last 40-50 years due to *in situ* measurements. In addition, the increase of the computer capacity has made it possible to study these different plasma environments with global three dimensional self-consistent numerical hybrid and magnetohydrodynamic (MHD) models.

In this presentation we summarize the basic characteristics of aforementioned Solar System objects based on new in situ observations and global computer simulations. We also discuss about what are the main lessons for the new are of space physics, *exomagnetosphere physics*, which objectives are magnetospheres in the Solar System and beyond.