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3-D features of the Mars-solar wind interaction: ASPERA-3 observations and their global modelling

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Mars does not have a strong global intrinsic magnetic field and therefore the solar wind can flow close to the planets in high neutral density regions. Because of the formed direct interaction between the atmosphere/exosphere and the solar wind, the ionized atmospheric contents can be picked up and accelerated by the solar wind. Charge exchange between solar wind protons and planetary neutrals, instead, produce energetic neutral hydrogen atoms which are the manifestation of the direct interaction between the solar wind and planetary neutrals. Picked-up planetary ions in turn form energetic neutral atoms via charge exchange process. The ion and energized neutral escape forms the total loss flow from the planet.

In this paper we are concentrating only on the ion losses which are measured by ion mass analyzer IMA (ASPERA-3 experiment) onboard of Mars Express. This sensor provides 3-D measurements of both solar wind ions and planetary ones from the beginning of 2004. We use self-consistent 3-D quasi-neutral hybrid (electrons a fluid, ions are particles) model to study 3-D features of the observed planetary ion escape and its correlation to the 3-D morphology of the magnetic field. Finally, 3-D features of the overall Mars-solar wind interaction and the possibility to observe these features by ASPERA-3 will be discussed.