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Hybrid Modeling of Hydrogen Energetic Neutral Atoms from Mars: Emission from Subsolar Magnetosheath

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We simulated the hydrogen energetic neutral atom (ENA) emission from the subsolar magnetosheath of Mars using a hybrid scheme in order to reproduce multiple features of the statistical features obtained from statistical observations of the Neutral Particle Detectors on the Mars Express spacecraft. We track the charge exchange reaction between the ions produced by the hybrid plasma model under a Martian neutral exosphere model. The simulation exhibits a directional emission of hydrogen ENAs from dayside magnetosheath. Particularly, the stronger ENA emission in the opposite direction of the solar wind convection electric field is reproduced, being consistent with the observations, by a corresponding asymmetry in the proton flux at the lower magnetosheath. This proton flux asymmetry is caused by the mass loading of ionospheric heavy ions in the direction of the convection electric field. We also investigate the influences of the upstream solar wind dynamic pressure. We demonstrate that higher dynamic pressure causes stronger and more anisotropic ENA emission, besides the influence of the proton flux. This dependence suggests that the induced magnetic boundary is lower during higher dynamic pressure, where the sheath protons can access to a denser exosphere and thus the charge exchange rate is higher.