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Precipitation of solar wind alpha-particles onto the ionospheres of Mars and Venus

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We have found that solar wind particles frequently precipitate onto the atmosphere of Mars. The precipitating particles contribute to the energy and matter flux into the ionosphere. We use ion data from the ASPERA-3 instrument onboard Mars Express to investigate the precipitation patterns and dependence on energy and to estimate the total transfer of energy and matter from the solar wind to the atmosphere. The main reason for the solar-wind precipitation is likely the large gyroradii of hot particles in the magnetosheath compared to the size of the induced magnetosphere/magnetic barrier. We find that the particle penetration depends on the direction of the convection electric field in the solar wind but that the crustal magnetic fields have very little influence. We also believe that the solar wind alpha-particles precipitating into the atmosphere is an important source of the neutral helium in the Martian atmosphere. With a statistical approach we can see how the average flux of down-going alpha-particles around Mars varies with altitude, energy and solar zenith angle.

The situation on Venus is very different. Precipitation of solar wind particles into the atmosphere seems to be very rare on Venus. We use ion data from ASPERA-4 and the magnetometer on Venus Express to investigate the induced magnetospheric boundary (IMB) at Venus and to quantify how often precipitation of alpha-particles occur on Venus. We also highlight the differences between Mars and Venus and suggest possible explanations for the observed differences.