Coherent Large Amplitude ULF Waves in the Martian Plasma Environment

E. Dubinin[(1)], M. Fraenz [(1)], C. Mazelle[(2)], and S. Barabash[(3)]
(1) Max-Planck-Institute for Solar System Research, 37077 Göttingen, Germany, http://mps.mpg.de
(2) Institut de Recherche en Astrophusique et Planetologie, Toulouse, France
(3) Swedish Institute of Space Physics, Kiruna, Sweden

The measurements made by Mars Global Surveyor and Mars Express spacecraft provided us with new data about the characteristics of the ULF waves near Mars. The existence of a neutral hydrogen exosphere extending beyond the bow shock into the solar wind at Mars is responsible for the mechanisms of wave generation with which we already met when studying the solar wind interaction with the comets. A typical feature is the observation of large-amplitude coherent waves with frequencies determined by the local proton gyrofrequency. Often the waves consist of periodic compressive pulses and resemble '30-s' – compressive waves observed in the Earth's foreshock. Closer to the planet oxygen ions of the ionospheric origin begin to dominate and multi-ion effects become important.

Another unique feature of is the large curvature of their bow shocks as compared to the Earth bow shock, and a small width of the magnetosheath. As a result, the coherent wave structures often fill the whole Martian magnetosheath raising the question whether a shock or shocklet description of the solar wind-Mars interaction is appropriate. Although the magnetic field fluctuations are strongly attenuated in the ionosphere of Mars, large-amplitude density oscillations driven either by local processes (e.g. by the Kelvin-Helmholz or Raleigh-Taylor instabilities) or by the external pressure pulses are typical for the upper ionosphere.

At the nightside and in the tails of Mars we often observe periodic (1-2 min) pulses of planetary ions ejected tailward. Similar periodic structures observed in different regions from the solar wind/foreshock down to the tail raise the question whether these pulsations have a unified origin. The results suggest a need for more extensive observational studies, data analysis and further theoretical examination.