Positions and shapes of the Martian plasma boundaries revisited after Phobos 2 and Mars Global Surveyor observations

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For the purpose of producing updated models of the locations and shapes of both the bow shock and the magnetic pile-up boundary (MPB) of Mars, curve fitting techniques have been applied to the observations of these plasma boundaries by Phobos 2 and Mars Global Surveyor (MGS). The boundary locations used in this study have mainly been identified from the Phobos 2 plasma wave system and the MGS MAG/ER experiment data: a huge amount of 700 shock (127 for Phobos 2 and 573 for MGS) and 901 MPB (41 for Phobos 2 and 860 for MGS) locations have thus been produced for the first time.

The merging of the Phobos 2 and MGS data bases has confirmed that the bow shock models derived previously from separate mission observations are in a quite good agreement with the available observations. Nevertheless, the better accuracy obtained in this study has to be accounted for the larger data sets and the better solar zenith angle coverage because of the far downstream crossings of the Martian bow shock by Phobos 2.

Despite the small number of crossings of the Martian magnetic pile-up boundary (also known as the planetopause, magnetopause, ion-composition boundary, protonopause, ...) by Phobos 2, a quite satisfactory model of the position and shape of this boundary has been produced. Nevertheless, the poor dayside coverage of the Phobos 2 observations did not allow an accurate modelling of the upstream part of the MPB to be done. Conversely, the lack of MPB crossings by MGS far downstream ($x < -4\ R_M$) of the planet was a handicap for a realistic model of the downstream part of the Martian MPB to be produced. Therefore, combining both the Phobos 2 and MGS data sets led to an improved MPB modelling. The new model obtained by fitting a two-conic section to the Phobos 2 and MGS aggregate data sets is indeed a suitable and improved model of the Martian MPB. Two conic sections, one on the dayside and the other on the nightside of Mars, actually well describe the MPB crossing observations close to the planet as well as far downstream down to -16 R_M.