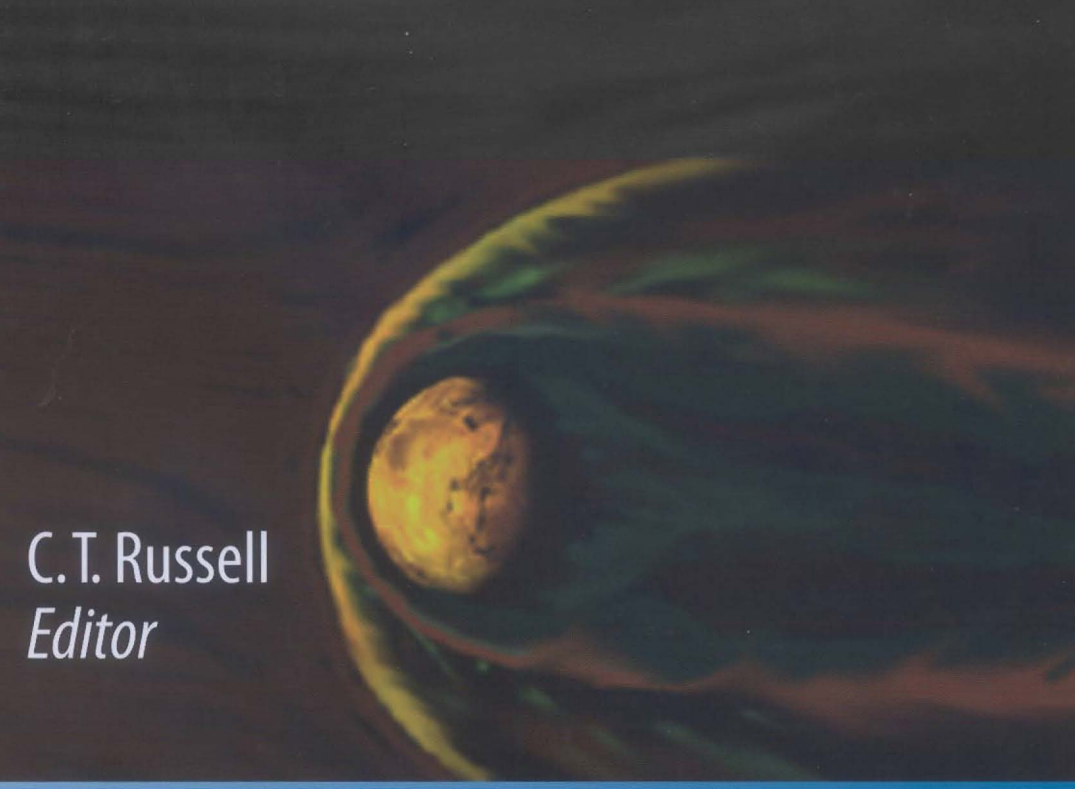

C.T. Russell
Editor

The Mars Plasma Environment

Springer

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FOREWORD

Mars sits very exposed to the solar wind. Ironically Mars possesses the strongest remanent magnetization of any body thus far visited in the solar system, yet the scale size of this magnetization is so small that it provides an insignificant shield against the solar wind. Compared to Venus that is eight times as massive, Mars has but a weak hold on its atmosphere. Mars has been the subject of intense study over the last four decades and we have learned much about its surface and lower atmosphere but studies of the solar wind interaction with its upper atmosphere and ionosphere have been much more rare. Mars 3 and 5 provided the first significant data on the induced magnetosphere, deflection of the solar wind and erosion of the atmosphere. PHOBOS-2 extended these measurements with a magnetometer and a plasma package, ASPERA (Automatic Space Plasma Experiment with a Rotating Analyzer). It increased our understanding of the interactions, but lasted far too short a time. Mars Global Surveyor carried a magnetometer and an electron reflectometer and discovered the martian magnetic anomalies but added only slightly to our understanding of the interplay between the solar wind and the atmosphere.

When the European Space Agency embarked on its Mars exploration strategy, it chose to include a comprehensive plasma package, on its pilot mission, Mars Express. In retrospect it should have complemented this package with a magnetometer but it did not. Nevertheless despite this handicap, the Mars Express mission has contributed greatly to the understanding of the Mars plasma environment, with its analyzer of space plasmas and energetic atoms (ASPERA-3).

In early 2006 (Feb 27–March 1) a workshop was convened on "The Solar Wind Interaction and Atmosphere Evolution of Mars" in Kiruna, Sweden by S. Barabash and H. Gunell. On the basis of the presentations at the conference we solicited papers for a special volume. These papers were not restricted to papers from the conference, nor were the papers by authors who attended the conference restricted to the material they presented. The result is a very comprehensive look at the Mars-solar wind interaction and the evolution of its atmosphere.

Herein we document this advance in understanding of the martian plasma environment with a series of articles from theoreticians and modelers, data interpreters and experimentalists. The volume begins with the treatment by B.E.Wood of the ancient sun and solar wind because of the importance of knowing how conditions have evolved over the history of the planet. This review is followed by two hybrid modeling papers by S. H. Brecht and S. A. Ledvina and by E. Kallio and coworkers describing how the solar wind interacts with the presently observed martian atmosphere. This is followed in turn by the discussion of the results of MHD modeling

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by M. W. Liemohn and colleagues, and a paper by D. A. Brain on the MGS measurements of the interaction. These papers set the stage for the main event, the new results from ASPERA-3.

The ASPERA-3 papers are led by the star herself, a description of the instrument by S. Barabash and the ASPERA team. This is followed by a discussion of how the moments of the plasma distribution are calculated, accompanied by a display of those results by M. Fränz. This is followed by a discussion of the plasma morphology at Mars by E. Dubinin *et al.*, and a paper by M. Yamauchi *et al.*, on how the properties of the ion distributions can be used to infer the magnetic field direction. Then begins a series of papers on energetic neutral atoms. A. Galli begins with a paper on energetic hydrogen and oxygen atoms on the night side. A. Grigoriev *et al.*, discusses a subsolar ENA jet. Y. Futaana reports on the Martian response to an interplanetary shock, including the production of ENAs. Next the volume includes four articles on phenomena at lower altitudes. R. Lundin and colleagues discuss auroral acceleration above the magnetic anomalies; H. Nilsson looks at the influence of magnetic anomalies on ion distributions; E. Nielsen and coworkers report on observations by the radar/ionosonde on the top side ionosphere and R. Frahm and colleagues report on photoelectron peaks from the Mars atmosphere. Finally the topic switches to X-rays with a review by K. Dennerl; to the effects of asymmetries in the exosphere on X-rays by M. Holmström; to the exosphere itself with a paper by A. Galli on the results of ASPERA-3's neutral particle detector; and a paper on ENA effects on the martian (and Venusian) exosphere by H. Lichtenegger. This volume documents an impressive leap forward in our comprehension of this complex environment.

The editor wishes to thank first of all the authors themselves who assembled these papers and responded well to the comments of the referees. He also is grateful to the many referees who volunteered to assist in the undertaking by spending their time improving the contents of this volume. These referees include C. Bertucci, D. A. Brain, T. E. Cravens, R. Gladstone, C. Mazelle, D. L. Mitchell, P. C. Brandt, D. G. Mitchell, E. Kallio, D. Hinson, K. Macgregor, J. Linsky, S. Brecht, S. Ledvina, B. Jakosky, Y. Yung, A. Nagy, W. Kazsprazak, H. Wei, G. Delory, R. Strangeway, H. Lammer, J. Leisner, E. Moebius, U. Motschmann, R. Modolo, D. Crider, E. Dubinin, D. Young, R. Goldstein, J. Luhmann, J-A. Sauvaud, V. A. Krasnopolsky, E. Sittler, S. Vennerstrom. The editor also wishes to thank the staff at Springer including Silvia Iviglia, Randy Cruz and Fiona Routley, as well as Marjorie Sowmendran at the University of California, Los Angeles, who handled all the communication with the authors, reviewers and the publisher.

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