PREFACE

Significant results returning from analysis of data from the International Solar Terrestrial Program (ISTP) satellites are changing our views on how the Solar Wind interacts with Earth's geospace environment. A recurring theme in this new phenomenological picture is the importance that small scale phenomena have for the large scale evolution of the magnetospheric system. The emphasis on microphysics in the previous decade that has resulted in sophisticated, comprehensive instruments and large spacecraft, is now accompanied by the equally strong desire to place in situ observations in the context of the local topology. This desire is fundamentally different from ISTP's. While ISTP strives to understand local microphysics in response to the external driver, the quest in the post-ISTP era is to understand the electrodynamic coupling between microphysical processes through a variety of distances, propagation speeds and synergistic behaviors. The questions center around the need to explore a virtually untapped domain of study of the geophysical plasma: the domain of wavenumber space. Even rudimentary observations, when taken in many spatially distributed points, promise to bridge the existing observational gap between the local microphysics and global evolution. This represents a new approach to the exploration of the closest astrophysical laboratory, which is also expected to resolve spatiotemporal ambiguities and reveal cause-and-effect relationships. Furthermore, it will provide an unprecedented perspective towards data sets (and results) from previous missions that were equipped with more comprehensive instrumentation.

Whether imaging, or measuring *in situ* the space plasma in the new observational mode, large numbers of observational points are necessary. Since launch costs represent a significant fraction of the total mission expenditures, keeping such costs at bay necessitates careful consideration of instrument and spacecraft component miniaturization. This, in turn, promises to spur development of leaner and more efficient technologies, with spin-offs in planetary and solar exploration.

In recognition of the above scientific and technical challenges, NASA solicited proposals (NRA 96-OSS 03) and has funded studies of future mission concepts. In addition, it assembled a science definition team (SDT) on "geospace multiprobes". The team, chaired by R. Heelis, concluded its work in the summer of 1997. A study report was generated and was released to the science community in August 1997. The "Heelis" report concludes that future "multiprobe" missions in the magnetosphere are the next step towards final understanding and development of predictive capability of geospace processes. The report coined the term "Magnetospheric Constellation" to denote the mission that would address questions on magnetospheric phenomenology with a large number of observational platforms. NASA studies of proposed mission implementations of SDT-defined science goals have come up with numbers suggesting that at least some versions of the proposed missions can be accomplished under the Solar Terrestrial Probe Line budgetary constraints ($120M) and launch vehicle lift capability (Delta 7920). The encouraging results of the Heelis report necessitated a wider community feedback for better definition and prioritization of the goals of the field in the post-ISTP era. During the Fall of 1997 Assembly of the American Geophysical Union, a special session titled: "Science closure and enabling technologies for constellation missions" was arranged to solicit such wider community feedback. Forty papers were presented in that session. The large attendance, and the lively corridor discussions on the subject during and after the session reinforced the interest of the community on this mission. During those discussions it became clear that a series of highly complementary missions, rather than a single mission, might better serve the scientific objectives set forth by the SDT. "Constellation class" missions share a common overarching goal: to probe the instantaneous realizations of the magnetospheric system and their evolution in response to its drivers. Each component-mission, however, should target with surgical precision a specific geophysical region and flight-prove only a small set of new technologies, preferably ones that can benefit its descendants. With that in mind it is clear that the large number of scientific quests, implementation schemes and technology development directions proposed is not an indication of division or confusion but of assertiveness and vigor. While a vibrant magnetospheric community is attempting to usher a new era of plasma-physical understanding of the geospace environment, NASA/HQ and NASA/GSFC are facilitating this process in several ways: First, by forming a special science definition team on the Constellation mission, starting in early 1999. Second, by funding advanced technology development for future NASA missions (e.g., NRA 98-OSS-10, NRA 99-OSS-TBD). Third, by continuing to support a series of special sessions on future multiprobe missions at assemblies of the American Geophysical Union. Finally, by supporting much needed publications on the subject, such as the present volume, that act as a forum for assembly and dissemination of the fruits of the community's labor.

This volume is primarily comprised of material that was presented in the related session in the Fall 1997 AGU meeting. The volume was deemed necessary and timely: Necessary, because no other forum for cross-fertilization between science and technology for magnetospheric missions exists. Timely, because with the excitement from the new results from ISTP, with the current technological drive for cheaper, smaller, faster missions, and with the aforementioned plans of NASA under the Solar Terrestrial Probe Line providing a tangible near-term implementation framework, scientists and engineers alike are keen on discussing the new wave of the future. Given the expected time required for the missions to mature, and given the surrounding technology and science issues that can benefit a wider discipline, the publication is expected to be a valuable reference for future missions, be they of the Constellation class or not.

To avoid publication delays while ensuring a volume as representative of the community as possible we decided to forgo the formal review process. The papers were informally reviewed by the editors. We wish to express our appreciation for the diligent efforts of the administrative staff of the Space Physics Research Group at the Space Sciences Laboratory at UC Berkeley during the editing process. Most notably, the editorial assistance of P. Dunn at SSL/UCB was critical for ensuring the timely and professional production of the volume.

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