

ONGOING DATA REDUCTION, THEORETICAL  
STUDIES, AND SUPPORTING RESEARCH  
IN MAGNETOSPHERIC PHYSICS

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## 1. INTRODUCTION

We propose to continue the Supporting Research and Technology tasks and the Data Analysis programs presently funded under Contract NASW-3690 awarded in response to TRW Proposal 40789.001 (April 1983). The technical proposal is for a 12-month continuation of NASW-3690, starting on October 1, 1984. The following section summarizes progress made to date on this study. The proposal closes with a work statement and detailed cost estimate for the next year.

2. PROGRESS, OCTOBER 1983 TO APRIL 1984

During this period, there were numerous activities that involved joint data analysis programs, mission definition, and supporting research. Many research papers were written and numerous others were published during the past six months. Since Proposal 40789.001 was submitted in June, 1983, Dr. Scarf and his colleagues completed the following papers related to ISEE-3 (in the solar wind and in the earth's tail), Pioneer Venus Orbiter, and Voyager 1, 2:

MHD Waves and Energetic Protons Associated with a Quasi-Parallel Interplanetary Shock (C. F. Kennel, C. T. Russell, J. Mellott, F. V. Coroniti, K. P. Wensel, T. R. Saunderson, P. Van Nes, J. Scudder, G. K. Parks, E. J. Smith, W. C. Feldman, and J. P. Edmiston; 1st, 2nd, 3rd, 5th, 6th, 7th, 8th, 9th, 10, 11th, 12th, and 13th authors).

Plasma Waves in Space, Proc. of Spring College on Radiation in Plasmas, (Internat'l Centre for Theoretical Physics, Trieste, Italy, May 24 - June 17, 1983).

Planning and Implementing the U.S. IMS Program: A Personal Account, IMS Summary Volume (NAS IMS Panel).

Lightning Measurements from the Pioneer Venus Orbiter (C. T. Russell, 2nd author), Geophys. Res. Lett., 10, 1192, 1983.

Analysis of Chorus Emissions at Jupiter (F. V. Coroniti, C. F. Kennel, and W. S. Kurth; 1st, 3rd, and 4th authors), J. Geophys. Res.

Perspectives on Space and Astrophysical Plasma Physics (C. F. Kennel, J. Arons, R. Blandford, F. V. Coroniti, M. Israel, L. Lanzerotti, A. Lightman, K. Papadopoulos, and R. Rosner; 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, and 9th authors), Proceedings of IAU Symposium No. 107, D. Reidel Publishing Company, Dordrecht, Holland, 1984.

Voyager 1 Evidence for Ion-cyclotron Instability in the Vicinity of the Io Plasma torus (R. M. Thorne, 1st author), submitted Geophys. Res. Lett.

A Summary of Whistlers Observed by Voyager 1 at Jupiter (W. S. Kurth, B. D. Strayer, D. A. Gurnett; 1st, 2nd, and 3rd authors), submitted to J. Geophys. Res.

ISEE-3 Wave Measurements in the Distant Geomagnetic Tail and Boundary Layer (F. V. Coroniti, C. F. Kennel, R. W. Fredricks, D. A. Gurnett, and E. J. Smith; 2nd 3rd, 4th, 5th, and 6th authors), Geophys. Res. Lett.

Continuum Radiation and Electron Plasma Oscillations in the Distant Geomagnetic Tail (F. V. Coroniti, C. F. Kennel, and D. A. Gurnett; 1st, 3rd, and 4th authors), Geophys. Res. Lett.

Distribution of Plasma Fluxes in the Venus Ionosheath (H. Perez-de-Tejada and D. Intriligator, 1st and 2nd authors), J. Geophys. Res.

Substorm Associated Traveling Compression Regions in the Distant Tail: ISEE-3 Geotail Observations (J. A. Slavin, E. J. Smith, B. T. Tsurutani, D. G. Sibeck, G. L. Siscoe, H. J. Singer, D. N. Baker, J. T. Gosling, and E. W. Hones; 1st through 9th authors), Geophys. Res. Lett.

Magnetotail Flux Ropes (D. G. Sibeck, G. L. Siscoe, J. A. Slavin, E. J. Smith, and J. T. Gosling; 1st through 5th authors), Geophys. Res. Lett.

During this period, a number of papers previously mentioned appeared in print. These are:

Plasma and Electric Field Measurements of the PVO in the Venus Inner Ionosheath (H. Perez-de-Tejada and D. S. Intriligator, 1st and 2nd authors), Geophys. Res. Lett., 11, 31, 1984.

The Electrical Activity of the Atmosphere of Venus (L. V. Ksanformality and W. W. L. Taylor, 1st and 3rd authors), Venus, ed. by D. Hunten, L. Colin, T. Donahue, and V. Moroz, p. 565 (University of Arizona Press, Tucson), 1983.

Micron-Size Particles Detected Near Saturn by the Voyager Plasma Wave Instrument (D. A. Gurnett, E. Grun, D. Gallagher, and W. S. Kurth; 1st, 2nd, 3rd, and 4th authors), ICARUS, 53, 236, 1983.

- A Search for Saturn Electrostatic Discharges in the Voyager Plasma Wave Data (W. S. Kurth and D. A. Gurnett, 1st and 2nd authors), ICARUS, 53, 255, 1983.
- Narrowband Electromagnetic Emissions from Jupiter's Magnetosphere (D. A. Gurnett and W. S. Kurth, 1st and 2nd authors), Nature, 302, 385, 1983.
- Voyager Plasma Wave Measurements at Saturn (D. A. Gurnett, W. S. Kurth, and R. L. Poynter; 2nd, 3rd, and 4th authors), J. Geophys. Res., 88, 8971, 1983.
- A Survey of Electrostatic Waves in Saturn's Magnetosphere (W. S. Kurth, D. A. Gurnett, and D. D. Barbosa; 1st, 3rd, and 4th authors), J. Geophys. Res., 88, 8959, 1983.
- Science Return from ISEE-3 at Comet Giacobini-Zinner (E. J. Smith and R. W. Farquhar, 2nd and 3rd authors), Cometary Exploration II (Proc. of International Conf. on Cometary Exploration, Budapest, November 1982), 225, 1983.
- Wave-Particle Interactions in the Venus Wake and Tail (D. Intriligator, 1st author), J. Geophys. Res., 89, 47, 1984.
- The Interplanetary Shock Event of November 11/12, 1978 -- A Comprehensive Test of Acceleration Theory (K. P. Wenzel, T. R. Saunderson, P. Van Nes, C. F. Kennel, F. V. Coroniti, C. T. Russell, G. K. Parks, E. J. Smith, and W. C. Feldman; 1st, 2nd, 3rd, 4th, 6th, 7th, 8th, 9th, and 10th authors), in Proceedings of the 18th International Cosmic Ray Conference, Bangalore, India, August 1983), 131, 1983.

We are still awaiting publication of:

Observations of Lower Hybrid Noise in the Io Plasma Torus and Anomalous Plasma Heating Rates (D. D. Barbosa, F. V. Coroniti, and W. S. Kurth, 1st, 2nd, and 3rd authors), J. Geophys. Res.

Plasma and Energetic Particle Structure of a Collisionless Quasi-Parallel Shock (C. F. Kennel, F. V. Coroniti, C. T. Russell, K. P. Wenzel, T. R. Saunderson, P. Van Nes, W. C. Feldman, G. K. Parks, E. J. Smith, B. Tsurutani, F. S. Mozer, M. Temerin, R. R. Anderson, J. Scudder, and J. P. Edmiston; 1st, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, and 16th authors), J. Geophys. Res.

Measurements of Plasma Waves and Suprathermal Charged Particles in Saturn's Inner Magnetosphere (L. A. Frank, D. A. Gurnett, L. J. Lanzerotti, A. Lazarus, R. Lepping, and E. C. Sittler, Jr.; 2nd, 3rd, 4th, 5th, 6th, and 7th authors), in Saturn, ed. by T. Gehrels, p. (University of Arizona Press, Tucson), 198 .

This large effort involves space plasma physics problems, applications and concepts that go beyond the boundary of any given spacecraft wave investigation or even any given planetary or interplanetary environment, and hence all of the research is correctly reported under this general support contract.

During this time an appreciable effort by Mr. Greenstadt went into editing the report combining the contributions of Working Group (WG) 10 on Collisionless Shock Waves in the Solar Terrestrial Environment for the Solar Terrestrial Workshop organized by NASA and held in Berkeley Springs, West Virginia, last June (1983). The Working Group's report

will appear as Chapter 10 in a book documenting the whole conference, now in press. The deliberations of WG 10, of which Mr. Greenstadt was chairman, seem to have served well their intended purpose of stimulating cooperation and exchange between theoretical and observational investigators; so much so that the final proof of the Chapter is already dated in some areas as a result of investigations inspired or accelerated by discussions held in Berkeley Springs. Indeed, an AGU Chapman Conference on Collisionless Shock Waves in the Heliosphere, held in February 1984, included many papers whose results could easily be seen by Working Group members to have developed through the proceedings in West Virginia.

Mr. Greenstadt prepared and presented an invited review on the morphology of quasi-parallel shock at the Chapman Conference mentioned in the preceding paragraph. The review attempted to interrelate various measurements and computations involving the q-parallel structure and foreshock elements connected to it, and included, as a logical extension, a computation of instantaneous local field-normal angle that may reconcile some coexisting q-parallel features. A tentative new classification scheme for q-parallel morphology was suggested. The review is being drafted for publication in a Conference Proceedings.

The distinction between magnetic and particle shock thickness scales in q-parallel shocks was documented for the first time and submitted for publication (Scudder et al., below).

An extensive study of all available "laminar" shocks found by ISEE-1 and -2 revealed clearly the distinction between profiles dominated by dispersion and resistive dissipation; a report is in press following revision to accommodate referee comments (Mellott and Greenstadt, below).

A study of the predictability of local shock macro-structure at ISEE-1, at the earth's bow shock, from solar wind measurements made upstream by ISEE-3, was conducted, using computer-graphic format supported by other sources.

Mr. Greenstadt is representing Division III (Magnetosphere) of the International Association of Geophysics and Aeronomy (IAGA) in organizing sessions on shocks for the IAGA meeting in Prague to be held in August, 1985. Mr. Greenstadt's reports in preparation or in press include:

Collisionless Shock Waves in the Solar Terrestrial Environment, Chapter 10, contribution of Working Group 10 (E. W. Greenstadt, chairman) to the Solar Terrestrial Physics Workshop, Berkeley Springs, West Virginia, June, 1983; to be published in Solar Terrestrial Physics - Present and Future, 1984, in press, NASA.

Scale Lengths in Quasi-Parallel Shocks, by J. D. Scudder, L. F. Burlaga, and E. W. Greenstadt, in press, J. Geophys. Res., 1984.

The Structure of Oblique Subcritical Bow Shocks: ISEE-1 and -2 Observations, by M. M. Mellott, and E. W. Greenstadt, in press, J. Geophys. Res., 1984.

Oblique, Quasi-Parallel, and Parallel Morphology, by E. W. Greenstadt, to be submitted to Proceedings of Chapman Conference on Collisionless Shocks in the Heliosphere, Napa, California, 1984.

During the period since Proposal 40789.001 was submitted, the investigators have also participated in many professional science meetings and many NASA and National Academy of Sciences planning meetings. Dr. Scarf served as a member of the following NASA committees:

1. The Space and Earth Science Advisory Committee;
2. The Solar System Exploration Committee;
3. The Solar System Exploration Management Council;
4. The Comet Rendezvous Science Working Group; and
5. The Ad Hoc Committee on OAST Support for Planetary Programs.

In addition, Dr. Scarf was a member of the NASA Delegation to the Third Meeting of the Interagency (NASA-ESA-ISAS-Intercosmos) Consultative Group. Dr. Scarf also participated in many planning meetings for ISTP (here and in Japan) and he journeyed to Washington for several meetings concerned with the future of Solar Terrestrial Research within NASA. In addition to all of this, Dr. Scarf participated in Science Team meetings for ISEE, Voyager, Pioneer-Venus, Galileo and AMPTE, and he spoke at the Fall AGU meeting, at the IAGA Assembly, and at the Spring College for Plasma Physics.

As mentioned above, Mr. Greenstadt participated in the Solar Terrestrial Workshop, and he also is a member of the Data Systems Users Working Group. He spoke at the AGU Chapman Conference at Napa, and at both 1983 AGU meetings.

Dr. Fredricks has been serving as a member of the NAS Committee on Solar and Space Physics and as a member of the joint U.S. - Italy Tether Science Working Team. As Principal Investigator for WISP, Dr. Fredricks also has extensive involvements with Space Plasma Lab. and Dr. Taylor has been extremely busy with planning and analysis activities for LDEF, SEPAC and WISP.