QUARTERLY PROGRESS REPORT

Contract NAS8-33982

PLASMA AND MAGNETOSPHERIC RESEARCH

March 1984 - May 1984

by

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and

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Prepared for

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June 1984

ANALYSIS TECHNIQUES AND SOFTWARE DEVELOPMENT

We have been cooperating with Tom Moore in the development of practical techniques for treating calibration and saturation problems. Low altitude data from 1981 day 314 was analyzed with the RPA analysis program and with the spin curve program to compare with the electrometer data. Both the calibration and saturation problems must be addressed simultaneously since the electrometer is sensitive primarily when saturation is likely to occur. When the program (under development) which incorporates the inline calibration and compensates for the saturation effects is completed, the RPA analysis program must be modified to incorporate the new program in the data preparation part.

In the previous report an apparent enhancement in Z head efficiencies at energies below 1 eV was noted. Based on a study of the construction of the RPA by Alan Biddle, this enhancement has been tentatively ascribed to a "lens focusing effect" at the electrometer aperture.

A computer program has been written to determine particle velocity and size from contamination particulates observed by the Induced Environmental Contamination Monitor (IECM).

We are participating in the development of software for the Space Plasma computer Analysis Network (SPAN) scientific work station. This also includes the development of software facilities for producing and accessing META code graphics files.

Dennis Gallagher is now the chairman of the Software Standards subgroup of the Data System Users Working Group (DSUWG). This group is the formal advisory organization for SPAN, which has been designated a NASA pilot project. SPAN has grown to become the most successful of all NASA

sponsored scientific data analysis networks, joining researchers in space plasma science at 14 institutions throughout the United States, and projected to double in size in the next year.

Dr. Gallagher also continues to serve on the SSL computer committee, acting as one of several advisors regarding the development of SSL computer facilities.

SATELLITE DATA ANALYSIS

In order to look for plasmaspheric field-aligned temperature gradients in the early RIMS data, we have plotted both the high and low altitude parts of the temperature profile together as a function of L (dividing at the minimum L shell). An interesting finding is that during geomagnetically quiet times, the high altitude plasmasphere either is in thermal equilibrium with lower altitudes (inner L shells for local morning) or acts as a heat source for lower altitudes (outer L shells in local morning, all L shells in local evening). During disturbed times, however, this balance shifts so that the high altitude plasmasphere can either be in equilibrium with low altitudes (local evening) or cooler than low altitudes (local morning). Comparisons of the ion temperature profiles indicate that this is not due to heating at low altitudes, but to depressed temperatures at high altitudes during magnetically active periods. This could result from either enhanced cooling or decreased heating at high altitudes during active times. These results have been incorporated into the draft of the paper on DE 1/RIMS ion temperatures (Ref. 1).

The PC-5 paper with Hunter Waite (Ref. 2) has now been sent to all interested parties, prior to submission for publication. Special caution is being used with this paper because our results contradict published

results by Cahill et al. We interpret the combined measurements of RIMS and the PWI static electric field instruments to indicate that a PC-5 wave structure from the dayside magnetossheath passed by the DE 1 spacecraft, rather than DE 1 passing through a stationary wave structure. Some of the amplitude variations are also being interpreted as due to spatial structure in the wave resonance, rather than entirely due to temporal variations in the wave source. The resulting picture of the wave structure in the magnetosphere is very interesting, and we are now trying to have our interpretation rendered in an artist's drawing.

The study of high densities and ion outflows from the polar cap has concentrated on analyzing a single event. Conclusions from studying that event are that there exists a population of 15-20 cm^{-3} of purely convecting H^+, a population of 5-10 cm^{-3} of flowing and convecting H^+ and 20-25 cm^{-3} of flowing and convecting O^+. The flowing ions are highly collimated within a solid angle of ±5 degrees and, including the convection, have a direction of $\sim$135° with respect to the geomagnetic field. These results were presented to the Spring AGU Meeting (Ref. 3) and a paper detailing them is in preparation (Ref. 4). Work on a follow-on study has begun to identify other passes with similar features during the lifetime of HAPI. The second study will focus on statistical information and morphology.

SCATHA measurements of radial electric fields observed during eclipse (at local midnight) have been analyzed for most of the 1979 events. Preliminary results were presented to the Spring AGU Meeting (Ref. 5). A paper on this topic is in the rough draft stage (Ref. 6).

An effort is being made to analyze a substantial portion of the available plasmasphere data for temperatures and densities for the period when the RIMS radial RPA was functioning properly. All available data for

the period of only H^+ and He^+ observations (Day 280 to Day 290, 1981) have been analyzed. Data files containing temperatures, densities and spacecraft potentials are being stored on a PDP disk to serve as a data base for future studies. Selected sets of data are being plotted versus invariant latitude for correlation with Brace's DE 2/LANG ionospheric electron densities and temperatures. Other data sets are being used to examine plasmasphere structure and its relation to local time and magnetic activity history.

A study has been initiated to determine substorm characteristics, primarily rise and fall time constants, for steady IMF intervals.

We have participated in analysis of data obtained during the STS-3 space shuttle mission. Some results of this analysis will be reported in a paper being prepared for submission to GRL (Ref. 7).

The study on the relationship of the dusk sector electric field to electron energy dispersion was completed. Results were presented to the Spring AGU Meeting (Ref. 8) and submitted for publication (Ref. 9). The initial study of a period of plasmasphere filling was also concluded, and the results submitted for publication (Ref. 10). Work on the heavy ion enhancement study with Tom Roberts, has continued.

Data for 1981 Days 295 and 296 was analyzed and densities and temperatures were sent to Janet Kozyra for her study of SAR arcs and ring current decay. The periods were times of ion cyclotron events reported by Don Gurnett at the last DE meeting.

SPACECRAFT SHEATH EFFECTS

The distribution function technique has been applied to a number of eclipse passages in the 1982 eclipse season in order to determine the shift in spacecraft potential as a function of plasma density. Potential shifts of about 0.5 V typically correspond to densities near 200 cm^{-3}, with larger shifts found for lower densities. These transitions have also been examined using spin curve techniques. The combination of the RPA curves from the end heads and the spin curves from the radial detectors provides the opportunity to obtain absolute potentials, as well as the shift. Preliminary results show the same shift in potential, but disagreement on the potentials of the different detector assemblies. During this period, the radial detector appears to be 0.5 to 1.0 V less positive than the -Z detector, with the +Z detector maintaining its 2 V negative bias with respect to the -Z detector.

LABORATORY PLASMA FLOW STUDIES

A new Langmuir probe has been constructed and is to be mated with an electronic circuit to accommodate fast voltage sweeps. Following correction of problems with circuit components, the electronics for this probe will be tested with another Langmuir probe. Once successful testing has been completed, the new probe should provide satisfactory measurements of electron and ion temperatures for the plasma flow experiments.

Results of previous experiments on the plasma expansion process are being reported in several forums. Some of these experimental results will be reported by Uri Samir in a poster paper at the 1984 International Conference on Plasma Physics, with a summary paper to be published in the conference proceedings (Ref. 11). The final draft of the paper on the

plasma wake experiments is being completed for submission to JGR (Ref. 12). A paper on the expansion of space plasmas into a vacuum will also be presented to the URSI meeting (Ref. 13).

REMOTE OBSERVATIONS

John Bird travelled to College, Alaska to work with Gary Swenson in obtaining data to provide thermospheric temperatures and winds, using the Fabrey-Perot interferometer. Modifications to the instrument were successful, and a considerable amount of data was taken. Programs to analyze the data are being developed.

INSTRUMENT DEVELOPMENT

A number of test fixtures were designed and built for the large vacuum chamber. Parts were fabricated for Differential Ion Flux Probe (DIFP) heads. A substantial part of the design and fabrication of the dual ion source was completed.

PRESENTATIONS AND PUBLICATIONS

Drs. Gallagher, Horwitz, and Olsen travelled to the Spring AGU Meeting in Cincinnati, OH, where they presented papers (Refs. 3, 8, 14). In addition to those, a paper on the plasmaspheric bulge region was presented by Pierette Decreau (Ref. 15). Dr. Olsen will present a paper to the URSI meeting in Italy (Ref. 16).

In addition to the papers noted above, the following are at the indicated stage of the publication cycle.

Papers published: a report of the plasmapause meeting (Ref. 17); the initial report on the dusk sector relation between electric field and

electron energy dispersion (Ref. 18); the paper on diffusive equilibrium distributions of He^+ in the plasmasphere (Ref. 19); and the Finland Workshop paper (Ref. 20).

Papers accepted and in press: a study on the implications of solar flares for substorms (Ref. 21); a paper on residence time heating effects on auroral conic generation (Ref. 22); the paper on magnetospheric plasma dynamics (Ref. 23); the supersonic polar wind paper (Ref. 24).

Papers submitted and under review: the paper on magnetosheath electrostatic waves (Ref. 25).

Papers in preparation: the equatorial heating paper (Ref. 26); the plasmapause review paper (Ref. 27).

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FINANCIAL DATA

NAS8-33982

Amount of Contract

Expenditures through May 31, 1984

Balance Remaining

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