

**Year 2 Final
Progress Report for Contract**

NASW-99002

**What is the Relationship between Heavy Ion Outflow and High-
Latitude Energetic Particle Precipitation?**

Prepared for:

National Aeronautics and Space Administration
Goddard Space Flight Center
Headquarters Procurement Office, Code 210.H
Greenbelt, MD 20771

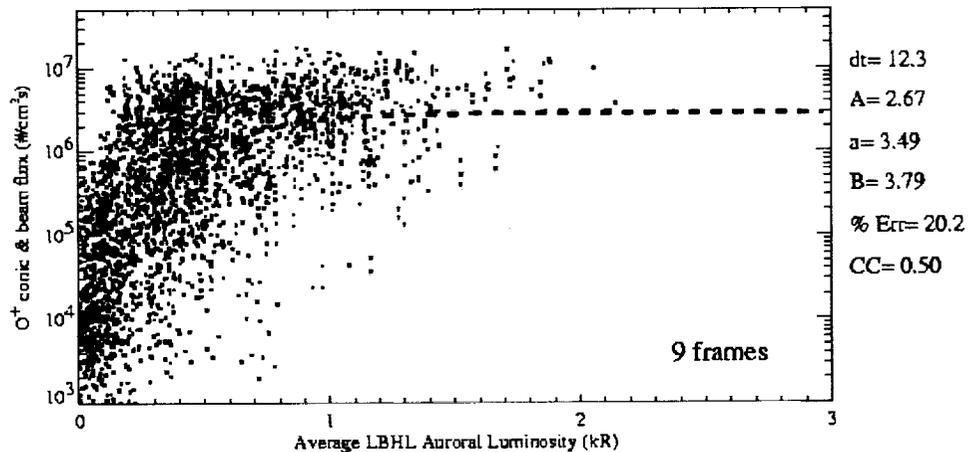
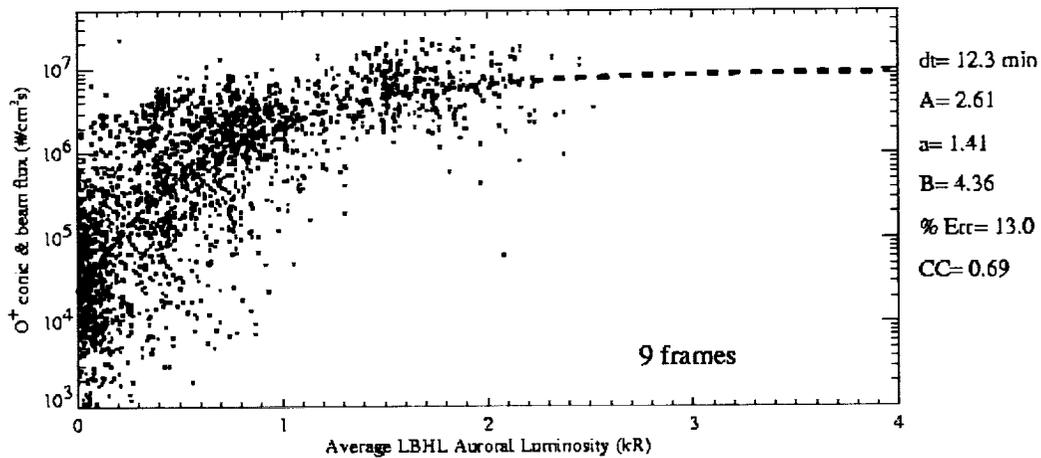
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1. Description of Progress For the Year

Most of the progress made in the last year can be summed up in the following two figures. The first shows TEAMS measured O^+ upflow fluxes from 19 nightside auroral zone passes plotted versus the average auroral luminosity (averaged for about 12 minutes) at the foot point of the magnetic field line where the measurement was made. The 19 passes were from February 7-11, 1997. The second plot was prepared in an identical fashion to the first but for 31 FAST passes from January 25-31, 1997. Both sets of data show the same factor of 400 increase in average O^+ flux with increasing luminosity. Both show the saturation of that flux at high luminosity. One, somewhat puzzling difference between the two is that the January data set has a more rapid rise in the average O^+ flux with increasing luminosity than the February data does.



The above figures were prepared using average luminosities because the O^+ flux has a high correlation with that quantity than any single luminosity value. This strongly suggests that there is a very short time delay of only 5 to 10 minutes between the time

when the electron energy flux into the atmosphere increases and the time when enhanced suprathermal O⁺ fluxes reach 3500-4000 km altitude. This delay is probably nothing more than the travel time need for a ~10 eV O⁺ ion to travel from the topside ionosphere to 4000 km altitude.

The paper submitted to JGR describing these results has been accepted for publication. The paper will appear in a special issue titled "Insights from the POLAR Spacecraft" to be published in two parts in March and August.

We have begun the study of nightside ion outflow as a function of substorm phase and have chosen to use the time interval of 1 December 1996 to 28 February 1997. During this time conditions for the northern-hemisphere auroral zone are fairly constant, being winter and solar minimum ($67 \leq F_{10.7} \leq 86$). The time interval is short enough so that there will be little degradation of the TEAMS instrument over the course of it, meaning that we can readily compare outflow fluxes from different passes. During these three months there were about 380 substorms imaged by UVI. Given the fact that UVI observes the aurora only about 70% of the time this suggests a total of about 540 substorms during the interval, or about one every four hours. Also during these months there were about 900 FAST passes where the TEAMS instrument returned good data. We anticipate that many of the FAST passes will traverse the nightside auroral zone at a time close to a substorm onset (within 30 minutes before to one hour after). On average about 38% of the passes will do this for all substorms or about 26% of the imaged substorms (about 240).

2. Publications and Presentations

Wilson, G. R., D. M. Ober, G. A. Germany, E. J. Lund, The relationship between suprathermal heavy ion outflow and auroral electron energy deposition: Polar/UVI and FAST/TEAMS observations, *J. Geophys. Res.*, in press, 2001.

Wilson, G. R., D. M. Ober, G. A. Germany, E. J. Lund, The Relationship between Suprathermal Ion Outflow and Auroral Electron Energy Deposition: Polar/UVI and FAST/TEAMS Observations, AGU 2000 Spring Meeting, SM22B-06.

3. Current Problems.

At the moment there are no problems hindering the continuation of this project.

4. Work to be performed during the next reporting period.

During the next quarter reporting period (March 3, 2001 – June 3, 2001) we plan to make enough progress on the substorm study to present a paper on the subject at the spring AGU meeting. In addition we will assemble the summer FAST/TEAMS and Polar/UVI data sets.

5. Cost information.

About 72% of the budget for years 1 and 2 has been spent.

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13. ABSTRACT (Maximum 200 words) Fourth quarter progress report for year 2 on contract NAW-99002 "What is the Relationship between heavy ion outflow and high latitude energetic particle precipitation". In this Project we are studying the relationship between the fluxes, mean energies, and field-aligned flow speeds of escaping suprathermal H ⁺ and O ⁺ measured by the TEAMS instrument on FAST and the energy flux of precipitating electrons obtained from the LBHL images taken by the UVI camera on POLAR. We have analyzed data from three time intervals, February 7 – 11, 1997 and January 25 – 31, 1997 and February 1 – 6, 1997. We find that there indeed is a relationship between the O ⁺ escape fluxes and the intensity of the aurora at the foot point of the field line. The time delay between an auroral intensification and the corresponding increase in escape flux is very short, only a few minutes. At low auroral luminosity the relationship between escape flux and luminosity appears to break down due possibly to the lack of sensitivity of the auroral emissions to large fluxes of low energy electrons.				
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