CASI

Project Title: A Co-Investigator Project for the Cornell University Cleft Accelerated Plasma Experimental Rocket - CAPER.

Code Name: CAPER

Principal Investigator: Dr. Charles S. Deehr

Geophysical Institute
University of Alaska Fairbanks
903 Koyukuk Ave N
Fairbanks, Alaska 99775-7320

Grant Duration: June 30, 1996 to June 30,1999

NASA Grant Number: NAG5-5097

THE CAPER PROJECT

The CAPER rocket campaign was to follow the SCIFER experiment as a detailed study of the ion acceleration processes in the Cleft Ion Fountain (CIF) above 1000 km altitude. The SCIFER rocket demonstrated that the experiment was feasible and that the CIF acceleration processes on the dayside are different from those observed in the discrete aurora on the nightside. The responsibility of the GI/UAF co-investigator project was to provide the real-time acquisition and display of large-and small-scale ground observations, and satellite solar wind data data at the launch control center at Longyearbyen, Svalbard for the determination of the launch conditions and the later interpretation of the rocket observations. The rocket campaign was proposed for January of 1998, but was slipped to January of 1999. The rocket was launched on January 21, 1999 at 06 h 13 m 30 s UT. All of the GI/UAF co-investigator systems functioned well, except the narrow-field TV camera which was to follow the 140 km conjugate point of the payload on command from GPS tracking data sent from Andoya. The data were not available during the flight, and the camera tracked the nominal conjugate. Unfortunately, the trajectory was well west of nominal, so no useful narrow-field conjugate data were acquired. In addition, the payload missed the region of more intense precipitation, brighter aurora, stronger currents, and likely large fluxes of transverse ion acceleration. On the other hand, good data were acquired across a region of the ionosphere that appears to have had a double convection boundary because of the IMF switching its z component shortly before launch. These data are important for understanding the reaction of the magnetosphere and ionosphere to changes in the IMF.

SCIENTIFIC PERSONNEL

C. S. Deehr, R.W. Smith, H.C.S-. Nielsen, Geophysical Institute, R. L. Arnoldy, Center for Space Science, University of New Hampshire, P. Kintner, School of Electrical Engineering, Cornell University, C. Pollack, T.Moore, Marshall Space Flight Center, D. Lorentzen, J. Moen, University Studies on Svalbard, Jan Holtet, University of Oslo, D.A.R. Simmons, Milngavie, Scotland.

CAMPAIGN SLIP

The CAPER campaign was originally scheduled for January, 1998. Construction delays resulted in a slip to January, 1999. Because this part of the project had been invested in the ground-based campaign prior to the decision to slip, it was necessary to apply for further funding. The appeal (attached here as appendix one) was granted in the amount of $20k.

LAUNCH SCENARIO:

The campaign began in early January, 1999, at Longyearbyen Svalbard. The schedule of observations and the launch conditions are attached here as appendix two.

The window opened at the nominal start time of 0400 UT on January 21. Auroral conditions were moderately active overnight. The solar wind magnetic field was mostly southward and the solar wind speed was faster at 420-460 km/s. The winds at Andoya Rocket Range were acceptable. The weather at Longyearbyen was Ny Alesund was clear with occasional low clouds. Magnetic activity was moderate during the window and Kp was 2. Launch conditions from the viewpoint of geomagnetic activity became favorable at about 0530 UT. At that time the decision to raise the payload to vertical was made and the count was advanced to T-8min.

The decision to launch was taken at the auroral station at 0555 UT and after a brief pause for the departure of fishing boats from the booster impact area, CAPER was launched at 6:13:30 UT. All instruments on the payload functioned nominally and the initial data analysis indicated that the payload encountered multiple auroral arcs, regions of accelerated ions, and strong electric field activity. The CAPER apogee was 1360 km, about 20 km higher than predicted. EISCAT Svalbard operated in the field-aligned mode. EISCAT in Tromso operated the VHF radar in the split beam mode looking northward. Polar UVI and VIS data were acquired during launch. The launch decision was also aided by the ACE real time solar wind data and the NOAA Space Environment Center real time space weather data, especially GOES data.

RESULTS

The trajectory, particle data, and wave data have been reduced, along with most of the ground-based observations. In addition to these data, the main rocket contribution to this study will be to provide the electric field and flow velocities. This requires a rather painful process of first determining the rocket attitude. This task was assigned to Eric Klatt of Cornell. This task was completed by the spring of 2000, and the data will now be assembled for analysis by the members of the team.

ACKNOWLEDGEMENTS
We wish to thank all of the many dedicated and talented individuals who contributed to the CAPER project and it success. CAPER was funded by NASA and launched in collaboration with the Norwegian Space Agency, Andoya Rocket Range, UNIS, and our gracious Norwegian hosts. The GSFC/Wallop Flight Facility project manager was Dave Moltedo.

APPENDIX ONE

Letter to NASA requesting additional funding for the subject Co-investigator grant.

Feb. 2, 1998

Dr. Mary Mellott
Suborbital MITM Physics Program
Space Physics Division
Code SS
NASA Headquarters
Washington, DC 20546-0001

Subject: Cleft Accelerated Plasma Experimental Rocket (CAPER) NRA-95-MITM-012C
"University of Alaska Ground-Based Observations" NAG 5-5097

Dear Mary,

As you know, the CAPER rocket campaign (40.012 IE), scheduled for January, 1998, was cancelled in early December. I understand that the PI, Paul Kintner has requested that it be flown in January of 1999, and they would expect no further funding, since their foreign travel has not been used.

Our situation is somewhat different, since we used the lion's share of our salary and travel money to establish the ground stations on Svalbard in early November. Deployment before Christmas and New Year vacations was necessary, because there was not enough time in January before the window opened on the 16th for shipping, installation, testing and possible repair. A second incentive was the Maynard-Pfaff launches from Svalbard (36.152 and 153 IE) during the dark of the moon at the end of November, 1997. Maynard launched into an overcast sky on Svalbard, but we acquired an excellent set of data in support of Pfaff's launch.

In addition to the expenditure of foreign travel funds, we will be forced to spend more engineering time than budgeted. It is necessary for us to calculate the payload trajectory in the first 2 minutes after burnout in order to derive pointing angles for the cameras on Svalbard as the payload passes over the region of interest. We had requested the same radar position data as we receive for this purpose at Poker Flat (10 positions per sec).

In October, we were told that the position data available to us would be only 1 position per 2 sec, which would not suffice at the noise levels we have experienced in the past. Another possibility is the GPS signal at a low rate, but more accurate and less noisy than the radar data. In any case, Hans Nielsen and Ed Hoch will have to reprogram the calculation to accommodate whatever choice is made, and we will have to test the system, using output from previous flights. We have requested all of this information, but it is still not clear what position data format will be made available, nor have we received any test data.

This is therefore a request for additional funds on CAPER to cover reprogramming and testing of the pointing angle programs and the travel and deployment of instrumentation necessary to support CAPER for the January window next year. I took the liberty of assembling a statement of work and a budget, enclosed herewith, in the hope that you could see your way clear to help us in this matter.

I think our record with SCIFER in January of 1995 shows the importance of the ground observations to the success of the rocket campaign. In that effort, we were not only able to provide continuous, real-time input to the launch criteria, but the interpretation of the combination of the rocket and ground-based data established the previously unknown spatial relationships between pulsating aurora, Pc5 pulsations, and travelling magnetic vortices; all relative to the particular incoming particle spectra, the dayside convection reversal, and discrete auroral forms. All of that came in addition to the fundamental plasma physics regarding ion acceleration which was accomplished at the payload.

Yours truly,
Charles S Deehr

APPENDIX TWO
CAMPAIGN COUNTDOWN

CAPER Campaign
Longyearbyen Auroral Station (78.20187 N Lat. 15.83325 E Long.)
Countdown Schedule
January 12-26, 1999
Prof. Paul Kintner, PI

Launch Criteria:

14.5 min to apogee from T-2.5 min hold.
Vsw>400 km/s
Bz<5nT>20min
By<5nT
Green arcs in red background
0900<MLT<1045.
Magnetic pulsations present.

Local	UT	MLT	T	Countdown	Action
0230	0130	0500		Leave town	Pick up crew at various housing
0300	0200	0530	T-2hr	On Station	Call ARR, NYA,EISCAT.
0330	0230	0600		Establish external support	ACE,LASCO,etc., set clocks, contact payload GPS.
0400	0300	0630		Instrument checks	ASTV, NFTV, MAG, IND MAG, SPEC.,EISCAT.
0430	0330	0700		Report Conditions. ACE obs. arrive at Earth.	Aurora Lat, Intensity, Mag activity, Vsw, IMF, Ne.
0500	0400	0730	T-15m	Launch window opens.	Repeat above report each ½ hr.
0530	0430	0800			
0600	0500	0830			
0630	0530	0900	T- 8m	Prime window opens. Begin average cleft.	
0700	0600	0930	T-2.5m		
0730	0630	1000			Time of SCIFER launch.
0800	0700	1030			
0830	0730	1100		Prime window closes. End of average cleft.	
0900	0800	1130		Begin average cusp.	
0930	0830	1200		Magnetic Noon middle of average cusp.	
1000	0900	1230		Launch Window closes.	ASTV, NFTV off due to sky brightness.
1030	0930	1300		Leave station.	Middags