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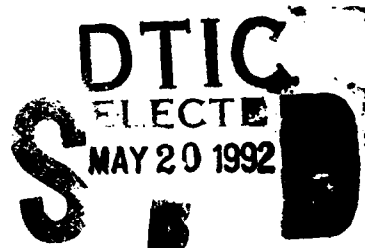
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**THE ELECTRODYNAMICS OF THE DAYSIDE CLEFT REGION
BASED ON A NET OF GROUND OBSERVATIONS IN THE
SVALBARD AREA**

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13. ABSTRACT (Maximum 200 words) Svalbard is the Arctic archipelago between 10° and 35° East and 74° and 81° North. The geomagnetic latitude spans from approximately 71° to 77° north. This makes Svalbard an ideal place for studies of dayside aurora and processes in the magnetospheric boundary regions. Conjugacy to stations in Antarctica makes Svalbard even more attractive. The observatory at Ny-Ålesund is the master station in a network which also includes field stations at Longyearbyen, Hopen, Hornsund, Bjørnøya, and Jan Mayen. International cooperation is essential in this program. Several papers have been presented and many lectures given related to this program. Possible generation mechanisms of dayside cusp auroras including magnetic merging, external pressure pulses and dynamo processes by intruding plasma elements are discussed.				
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1. INTRODUCTION

The Archipelago Svalbard, north of Scandinavia, has an unique location for studies of the boundary regions in the magnetosphere and the connected ionospheric regions, such as the low latitude boundary layer, the cusp, the mantle, and the central polar cap. Furthermore, these islands offer the best places on the Northern Hemisphere for studies of daytime aurora by optical means from the ground.

Svalbard also provides the possibility for carrying out simultaneous, coordinated measurements from two or more places, e.g. at the following sites: Bjørnøya, Hornsund, Longyearbyen, and Ny Alesund, which lies on approximately the same geomagnetic meridian. The separation between the northernmost and the southernmost station is approximately 500 km, and between neighbour stations 110-250 km. In addition, the stations are in the transpolar meridian chain of auroral observatories extending from Alaska into Europe through Scandinavia. This allows simultaneous day and nightside observations on the same meridian plane. Furthermore, these Svalbard stations are magnetically conjugate to Australian and Soviet observatories in the Antarctic. The advanced nets of geophysical and ionospheric stations in Northern Scandinavia - including EISCAT - as well as in the northwestern part of the USSR are also of great value to the Svalbard programme. All the Norwegian magnetic auroral stations are shown in Fig. 1.

The ground based instrumentation on the Svalbard Archipelago is listed in Table 1, while the coordinates for the observational sites, normally used in the Svalbard dayside cusp programme, are given in Table 2.

Table 1: Ground based instrumentation on the Svalbard Archipelago

	Respon- sible	Bjørn- øya	Horn- sund	Longyear byen	Ny- Alesund	Institu- tions
All-sky camera	UT	P	O	X	X	GI
Intensified All-sky (630 nm) camera	UO				X	AFGL
Auroral TV	UO			X	X	GI/GRL
Meridian scanning (4 ch) photometer	UO	P	X	X	X	GI
Auroral spectrometers	UT			X	P	UT
Fabry-Perot spec- trometer	UO			X	P	GI
Dobson spectrometer	UO	P		X	P	
Magnetometer	UT	X	X		X	
Micropulsations	UO	P	X	O	X	GRL
ELF/VLF emission	UO	P	X	O	X	GRL
Riometer/multi-beam	UT	X/P	X		X/X	DI/MPI
Ionosonde	UT	P			P	
Lidar	UT			P/O	P	

Cooperation partners: GI = Geophysical Institute, Alaska, AFGL = Air Force Geophysical Laboratory, Mass., DI = Danish Meteorological Institute, Denmark, MPI = MPAE, Lindau, FRG, GRL = Geophysical Research Laboratory, University of Tokyo together with Research Institute of Atmospherics at Nagoya University, UT = University of Tromsø, UO = University of Oslo, X = in continuous operation, O = ad hoc operation, P = planned to install. In addition to these stations, digital magnetometers are also in operation at Jan Mayen and Hopen and a meridian scanning photometer was installed at Hopen in November 1990.

Table 2: Coordinates for the observational sites
normally used in the Svalbard dayside cusp programme.

Sites value	Station coordinates					
	Geographic		Geomagnetic		Magnetic	L-
	Lat.	Long.	Lat.	Long.	midday(UT)	
NYA- Ny-Alesund	78.9	12.0	75.4	131.2	0830	16.5
LYR- Longyearbyen	78.2	15.7	74.4	129.4	0830	14.4
HOR- Hornsund	77.0	15.6	73.4	128.1	0830	13.1
HOP- Hopen	76.5	25.0	71.6	132.5	0830	10.5
BJØ- Bjørnøya	74.5	19.2	71.1	110.5	0900	9.5
JAM- Jan Mayen	70.9	351.3	73.1	96.7	1100	12.8
TOS- Tromsø	69.7	19.0	66.0	105.2	0930	

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OBSERVATION AND RESEARCH PROGRAMME
AT SVALBARD DURING THIS REPORT PERIOD

The observation programme in this joint cooperation between GL/LIS (Coordinator Dr. E. Weber), Hanscom AFB, Bedford, MA and The Group of Cosmical Physics at the University of Oslo, Norway, is concentrated on the dynamics and the optical spectral variation of the dayside cusp aurora. The measurements are carried out with multichannel, meridian scanning photometers and advanced imagers.

During the contract period the following campaigns - where our Svalbard optical observations have been of prime importance - have been carried out:

- a. The GI/LIS airborne auroral observatory over northern Scandinavia in January 90
- b. EISCAT - coordinated campaigns in Dec 89 and Jan 90, and
- c. selected events coordinated with the satellite EXOS D and a rocket launched from Andøya Rocket range to study pulsating aurora.

As seen from the enclosed copy of the Observation Protocol (Appendix I) data from several very interesting dayside cusp events have been collected. These are now studied in detail and coordinated with other relevant space and ground based observations.

The aims of the research programme within this project are outlined in the proposal. Here we will only point out that we will use the optical auroral data as a basis for the study of the dynamics of the magnetopause boundary layer. However, the main features of the aurora may not in all respect point directly to the boundaries and separatrices of importance to the study of the magnetosphere, a careful study of satellite and ground-based data is therefore required to search for more subtle signs of the boundaries we need to observe.

Coordinated ground-based and satellite observations are required in order to study the connection between the dayside forms, the

acceleration regions and the region of plasma entry. The problem of the flux transfer event and its manifestations at different levels in the magnetosphere and in the ionosphere will not be resolved until measurements are obtained simultaneously at the relevant positions on the same field line.

PROGRAM FOR 1991

Observations will continue in the polar night periods in January and November/December 1991. Coordination with EISCAT is planned. Furthermore, the studies will be extended to include nightside phenomena.

We are also continuously working to improve the observation technique and the routines for data reduction. A combined hardware/software system for analysis of TV images has thus been developed. A new data logging system with connection to our laboratories in Oslo will be installed in 1991. This will provide more direct access to the photometer and magnetic data.

EXCHANGE OF SCIENTISTS BETWEEN THE TWO INSTITUTIONS

The program manager for this contract, Dr. Edward J. Weber, GL/LIS visited us in Oslo for one week at the end of January 90. (He also served as an external Ph.d. examiner for a doctor thesis on cusp aurora at the University of Oslo.)

Furthermore, Dr. H. Carlson, the Deputy Division Director at GL/LIS, Hanscom AFB, spent six weeks at the Department of Physics, University of Oslo in March and April 90, in joint discussions of the solar terrestrial electrodynamics of the dayside magnetospheric boundary layers.

The main contractor at the Department of Physics, University of Oslo (A.E.), visited GL/LIS, Hanscom AFB for one week in nov 90.

PUBLICATIONS/REPORTS

The following papers/reports, pertinent to this contract, have been published during the contract period:

Egeland, A., Present and future research at Svalbard, Proceedings GEM Workshop, Maryland Univ. (T. Rosenberg, ed.).

Sandholt, P.E., M. Lockwood, B. Lybekk, and A.D. Farmeri, J.G.R., vol 95, pp. 21095-21.11.

Sandholt, P.E., T. Oguti, S.U.K. Cowley, K. Freeman, B. Lybekk and D.M. Willis: J.G.R. vol 95, pp. 1039-1060 ct also J.G.R. vol 94, pp. 6713-6722.

and the recent monograph:

Electromagnetic coupling the polar clefts and caps, edited by P.E. Sandholt and A. Egeland, Klüver Academic Publishers, Dordrecht, the Netherlands. 1989.

CONFERENCE CONTRIBUTIONS

Both at the annual meeting of the European Geophysical Society and at the spring meeting of the American Geophysical Union, papers based on the observations covered by the present contract were presented.

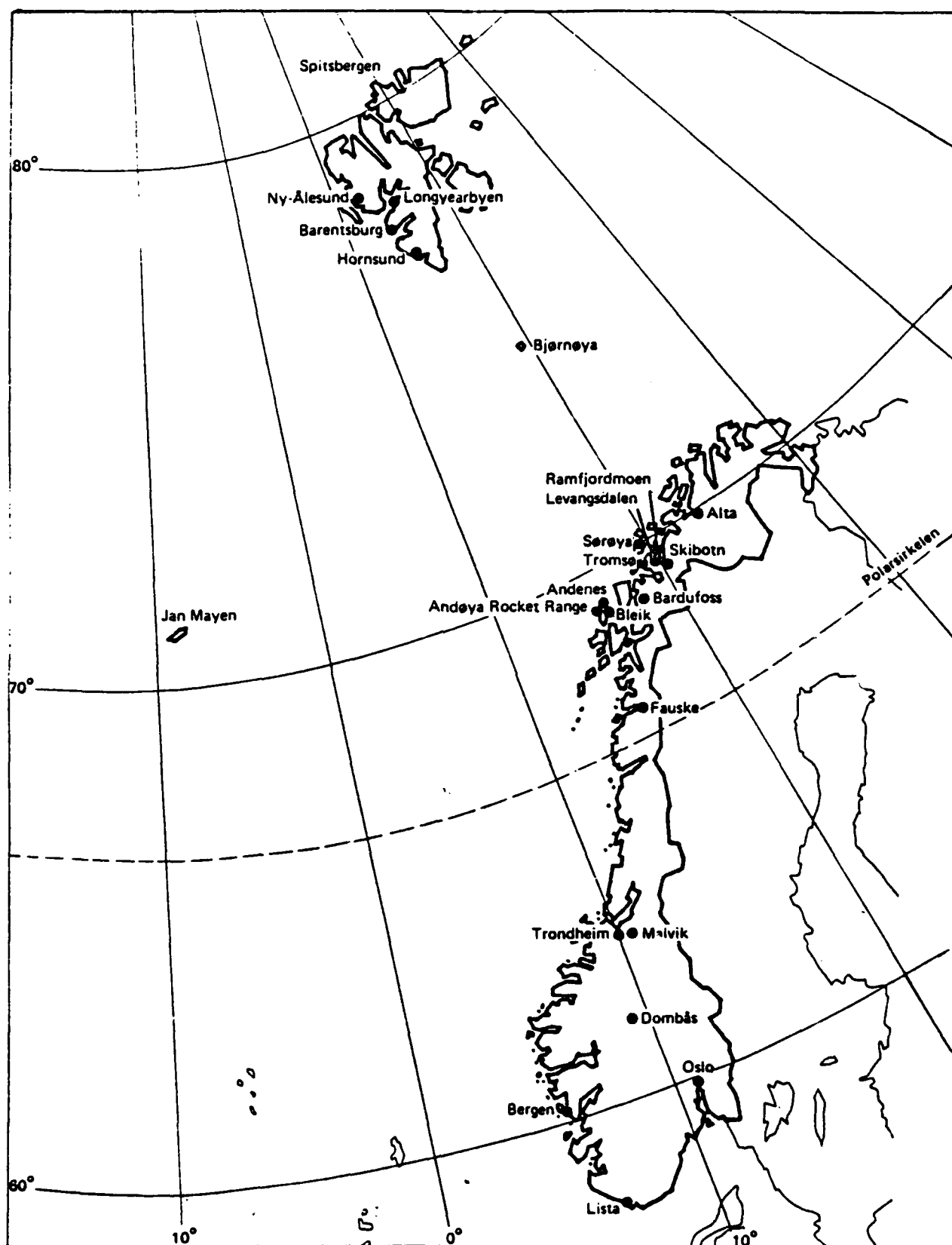


Figure 1: Norwegian magnetic stations.

APPENDIX I: OBSERVATION PERIODS

NY ALESUND OBSERVATIONS NOVEMBER 1989 - JANUARY 1990

All time are in UT.

Instruments: Meridian scanning photometer (MSP)
Image intensified all-sky camera (ASC)
ISIT video camera (ISIT)
CCD video camera (CCD)

November 24, 1989 - December 5, 1989

Operators: Bjørn Lybekk and Dagfinn Opsvik

<u>Date</u>	<u>Instrument</u>	<u>Start</u>	<u>Stop</u>	<u>Comments</u>
Nov. 24	ISIT	1437	2000	Clouds in the morning
	MSP	1455	2030	
Nov. 25	MSP	0613	0843	Clouds after 0630
	ISIT	0615	0642	
Nov. 26	MSP	1125	1735	Clouds in the morning
	CCD	1126	1500	
	ISIT	1345	1422	Clouds after 1600
Nov. 27	MSP	0509	1000	Clouds after 0930
	ISIT	0512	0902	
	CCD	0520	1000	
	MSP	1320	2035	Clear sky
	ISIT	1642	1800	
Nov. 28	Snow, no observations			
Nov. 29	Snow, no observations			
Nov. 30	MSP	0558	2033	Some clouds between
	ISIT	0600	2033	and 1000
	CCD	0627	1402	
Dec. 01	Snow, no observations			
Dec. 02	CCD	0527	1600	Clear sky, aurora inzenith
	ISIT	0527	2150	
	MSP	0549	2150	
Dec. 03	MSP	0508	1256	Clouds between 0900 and 0900
	ISIT	0510	1131	Clouds between 1000 and 1100
	CCD	0531	1256	
Dec. 04	CCD	0744	1553	Clouds before 0740
	MSP	0800	1411	
	ISIT	0906	1411	

NY ALESUND ALL-SKY CAMERA OBSERVATIONS JANUARY - FEBRUARY 1990

Due to certain shipping problems, the image intensified ASC was installed in Ny Alesund as late as Jan. 19, 1990.

After installation, it became clear that the filter wheel did not match the control unit setting. Thus, the filter number shown on the film is wrong, and the correct filter number is found in the following table:

Filter number shown on film	Actual filter number
Filter #1	Filter #2
Filter #2	Filter #3
Filter #3	Filter #4
Filter #4	Filter #1

However, running the original timer programs now gave wrong combinations of exposure time and filter. In addition, Filter #1 (630.0 nm), monitoring the most important dayside emissions, was not used in this setup. Therefore, a new timer program was made, taking into account the mismatches given in the table. This program should select the actual Filter #1 (630.0 nm), #2 (557.7 nm) and #3 (427.8 nm). This program was run in the period February 20-27, 1990, replacing the old Program #1.

January 19 - 30, 1990

All times are in UT.

Operators: Bjørn Jacobsen, Tone Bergholt and Arnulf Rudland.

Date	Instrument	Start	Stop	Comments
Jan. 19	ASC	2025	cont.	Clear sky, no aurora New film #1.
Jan. 20	ASC	cont.	1000	Some clouds, strong aurora
	ASC	1316	cont.	Mostly clear sky, no aurora
Jan. 21	ASC	cont.	0845	Mostly overcast
Jan. 22	ASC	0455	0940	Mostly overcast
Jan. 23	ASC	0636	0905	Mostly overcast, some aurora
Jan. 24	ASC	0732	0901	Partly cloudy, some aurora Camera focused 1300
	ASC	1628	cont.	Partly cloudy, substorms
Jan. 25	ASC	cont.	0906	Clear sky, nice aurora
	ASC	1623	cont.	New film #2 started 1825
Jan. 26	ASC	cont.	0850	Clear sky, active aurora
	ASC	1400	cont.	
Jan. 27	ASC	cont.	0851	Clear sky, quiet aurora

	ASC	1408	cont.	
Jan. 28	ASC	cont.	0837	Light clouds, quiet aurora
	ASC	1415	cont.	
Jan. 29	ASC	cont.	0811	Overcast, snow
	ASC	1612	cont.	Clear sky. New film #3.
Jan. 30	ASC	cont.	0800	Clear sky, nice aurora

During the second observation period, Feb. 20-27, 1990, the camera was operated by station engineers. Film #3 was used, and the new program #4 was run (described earlier).

Feb. 20	ASC	2100	cont.	Light clouds
Feb. 21	ASC	cont.	0300	Partly cloudy
		2128	cont.	Clear sky
Feb. 22	ASC	cont.	0300	Clear sky
		2100	cont.	Clear sky
Feb. 23	ASC	cont.	0300	Some clouds
		2317	cont.	Light clouds
Feb. 24	ASC	cont.	0300	Light clouds
		2100	cont.	Clear sky
Feb. 25	ASC	cont.	0300	Clear sky
		2100	cont.	Clear sky
Feb. 26	ASC	cont.	0300	Clear sky
		2100	cont.	Clear sky
Feb. 27	ASC	cont.	0300	Light haze
		2105	cont.	Light haze at horizon, clear in zenith.
Feb. 28	ASC	cont.	0300	Clear sky.

NY ALESUND ALL-SKY CAMERA OBSERVATIONS DECEMBER 1990

As described in the all-sky camera log for January 1990, the filter wheel did not match the control unit setting. In an attempt to resolve this problem in December 1990, the filter wheel control hardware was partly damaged. The camera will be shipped to Geophysics Laboratory in spring 1991. Meanwhile, the camera was operated with fixed filter wheel, i.e., only the 630 nm filter was used. Two timer programs were run : Program #01 (nighttime program) means 8 sec exposure, one frame per min., while Program #02 (daytime program) means 4 sec exposure and one frame per min.

December 11 - 23, 1990

All times are in UT.

Operators: 11-18 Dec.: Bjørn Jacobsen and Dagfinn Opsvik,
19-23 Dec.: Lars Inge Sæther (station engineer).

<u>Date</u>	<u>Start</u>	<u>Stop</u>	<u>Comments</u>
Dec. 11	0910	1417	Clear sky --> Cloudy New film #1.
	1733	cont.	Clear sky, no aurora
Dec. 12	cont.	cont.	Clear sky --> Cloudy
Dec. 13	cont.	1341	Partly cloudy --> Overcast
Dec. 14	No observations		Snowing
Dec. 15	1445	cont.	Clear sky
Dec. 16	cont.	1221	Clear sky --> Overcast
Dec. 17	1355	1929	Clear sky --> Overcast
Dec. 18	0717	1400	Clear sky. Power failures, camera clock displays 0400 instead of 1400
	1451	cont.	Clear sky. New film #2.
Dec. 19	cont. 1605	1413 cont.	Clear sky --> Overcast Clear sky
Dec. 20	cont.	cont.	Clear sky
Dec. 21	cont.	1125	Partly cloudy --> Overcast Power failures.
Dec. 22	0457 1508	1013 cont.	Clear sky --> Overcast Clear sky
Dec. 23	cont.	0122	Snowing.