



ARM2009

Group Photo

Top row from left

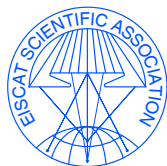
Mr. Roger Jacobsen
Dr. Lisa Baddeley
Dr. Ingemar Häggström
Mr. Arild Stenberg
Mr. Paul Gallop (invited)
Mr. Halvard Boholm
Mr. Peter Bergqvist
Mr. Inge Marttala

Middle row from left

Mr. Toivo Iinatti
Mr. Markku Postila
Dr. Gudmund Wannberg (invited)
Dr. Assar Westman
Mr. Knut Hellvig
Mr. Erlend Danielsen
Mr. Are Haugland
Mr. Gunnar Isberg
Mr. Henrik Andersson

Bottom row from left

Mr. Martin Langteigen
Mr. Espen Helgesen
Ms. Elisabet Goth
Mr. Guttorm Mikalsen
Mr. Lars-Göran Vanhainen
Dr. Esa Turunen
Mr. Jussi Markkanen



Kiruna February 10, 2009

ARM2009

Lapland Hotel Pallas 11 – 13 February 2009

Wednesday 11 February

From 15:00 Check-in
 From 15:00 Coffee and sandwiches
 17:00 Welcome and Director's presentation (ET)
 18:00 End of sessions
 19:00 Dinner

Thursday 12 February

From 07:00 Breakfast
 09:00 Site Reports (HB, LGV; MP, RJ (incl. MTR's), HAN)
 10:15 Coffee break
 10:30 EISCAT operations 2008 and plans 2009 (IH)
 10:50 EISCAT_3D Demonstrator (LGV, PBE, AW)
 11:30 EISCAT_3D overall project report (UGW)
 12:00 Lunch
 13:00 Free time at Pallas
 13:50 *Optional for those not skiing/walking:* Pallas National Park – a presentation
 (in the national park centre)
 14:30 Invited talk (Juha Vierinen)
 15:00 Coffee break
 15:15 Presentation of Vinabili (PG)
 15:30 EISCAT_3D^{ESFRI} and beyond (ET)
 16:00 Heating upgrade (MP, JM)
 16:30 Summary and closing words (ET)
 17:00 End of sessions

 From 18:30 Aperitifs
 19:00 Banquet

Friday 13 February

From 07:00 Breakfast
 09:00 Departure

EISCAT Annual Review meeting 2009 – Lapland Hotel Pallas

(Review accommodation and meals)

Accommodation

Arrival: 11 February 2009
Departure: 13 February 2009 (2 nights) **23 single room**

Arrival: 12 February 2009
Departure: 13 February 2009 (1 night) **1 single room**, Juha Vierinen
(Arrives during the morning)

Meals

Wednesday 11 February

15.00-17.00 Coffee / tea and sandwiches **23 p**

19.00 Dinner **23p**

Menu

- * Forest mushroom soup
- * Sautéed reindeer, mashed potatoes, pickled cucumber, lingonberries
- * Baked Lappish cheese

To drink participants can choose between:
1 glass of *Beringer wine* incl. 1 refill or
1 Beer /Mineral water.

Thursday 12 February

07.00-09.00 Breakfast **23 P**

10.15 Coffee / tea and pastry **24 P**

12.00 Lunch **25 p**

- * Salad and Traditional French Vichy Shôisse (creamy vegetable soup) with bread & water

15.00 Coffee / tea and sandwich **25 p**

18.30 Aperitifs **24 p**

* *Kero* (sparkling wine and cloudberry liqueur)
and some non alcoholic alternative

19.00 Banquet festive dinner **24 p**

Menu:

- * Green salad, grilled chèvre cheese with lemon-herb oil sorbet
- * Roasted Arctic Char, prawn sauce, lemon risotto
- * Hot chocolate cake, cloudberry fool and vanilla ice cream
- * Coffee / tea

To drink:

- * 1 glass of red wine together with the starter (House wine)
- * 1 glass of white wine incl. 1 refill together with the main course (House wine)
- * 1 glass of Cognac or Liqueur (4cl)
 - Cognac Hennessy VSOP
 - Cointreau
 - Saint Brendan's Irish Cream

Friday 13 February

07.00-09.00 Breakfast **24 P**

Additional

*Conference room snacks - incl. fruits, candies, nuts and cookies, available at the conference room on Thursday.

* Bar open during the evening Wednesday and Thursday until 23.00

*Sauna, open daily (16.00-19.00)

There is also a small sauna behind the hotel, by a tiny lake (with the opportunity to go swimming in the icy lake). If we would like to use it we just ask at the hotel when we are there (no advance booking is necessary). No extra charge for the saunas.



PALLAS



Pallas will capture your heart, but you can always come back!

Pallas has some of the most beautiful scenery in Lapland, pleasing to the eye and soul. People who go there often wind up going back year after year. This is a splendid place to enjoy a relaxing holiday and explore nature in every season.

The Lapland Hotel Pallas is a traditional fell hotel built in 1948. Guests can relax in its comfortable lounges and library, which has been enriched by donated books. The weekly programme includes all types of fun activities, from downhill skiing to pancake parties, not to mention cross-country ski trips. The day comes to an agreeable close with stretching and a relaxing sauna in the evening.



Lapland Hotel Pallas / hotel & services

HOTEL: 15 double rooms with shower/WC, clothes drying cabinet. 37 double rooms with shower/WC. In log building: 2 rooms for 4 persons with shower/WC, bunk beds. 1 room for 4 persons with shower/WC, bedroom and living-room. 8 double rooms with WC, shower down the hall. All rooms come with phone and TV.

RESTAURANTS: Log restaurant for 150 persons, bar for 50 persons.

OTHER SERVICES: Fireplace lounge, 2 saunas in the hotel, lakeside sauna, ice pool, 9 ski slopes, 2 ski lifts, ski rentals, ski waxing and storage facilities, ski school, programme services. Slopes and ski tracks right outside the hotel.



99330 Pallastunturi, Finland
tel. +358 (0)16 323 355
fax +358 (0)16 532 741
pallas@laplandhotels.com

Welcome!

ACCOMMODATION CAPACITY: total 63 rooms.

DISTANCES: Airport (Kittilä) 45 min,
railway station (Kolari) 1.5 h.

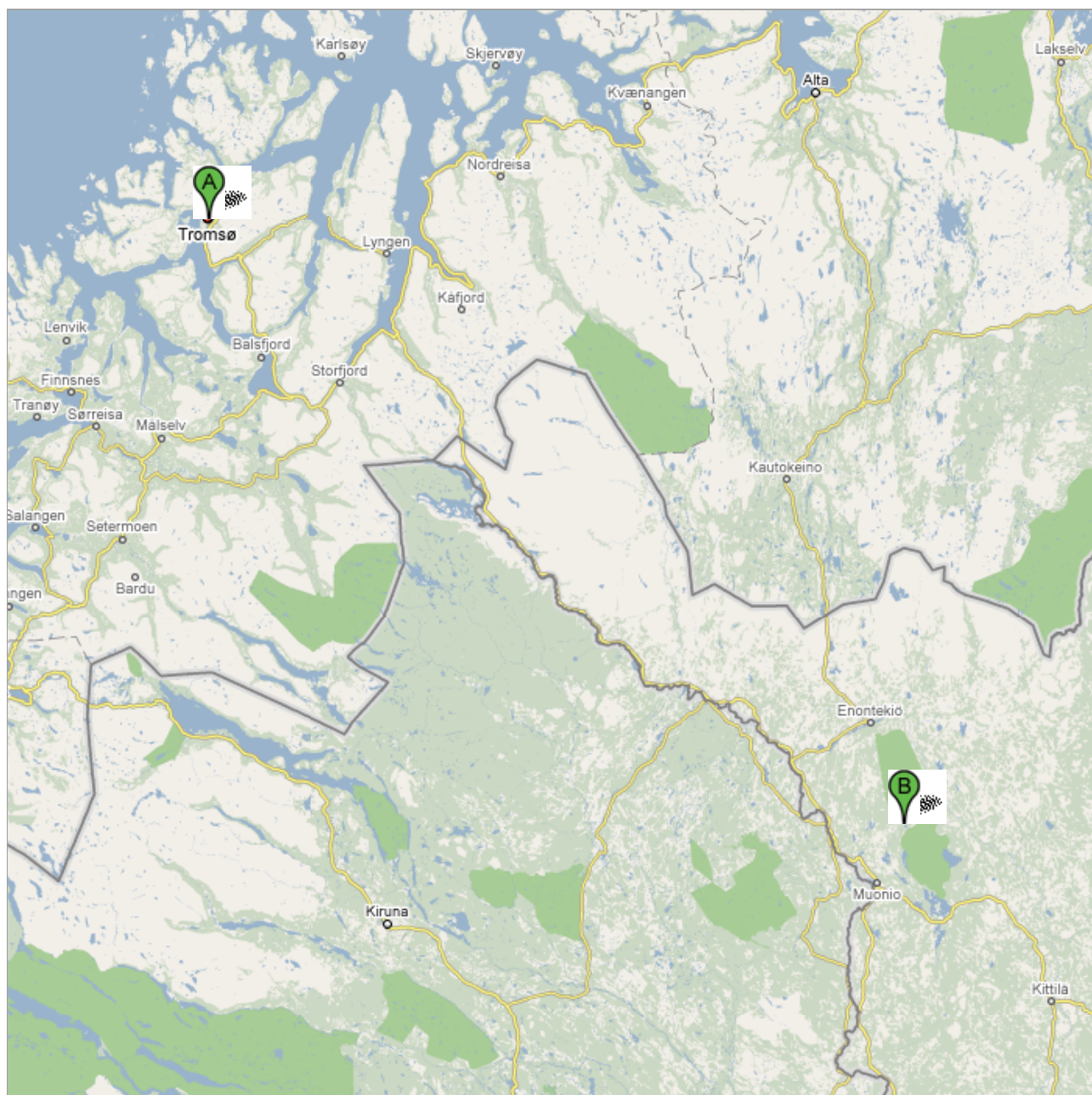


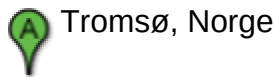




Vägbeskrivning till Pallas-Ounastunturin Kansallispuisto

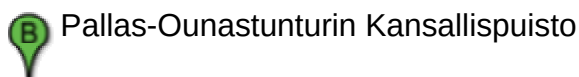
375 km – cirka 5 timmar 38 min





Tromsø, Norge

	1. Kör i riktning syd på Conrad Holmboes veg mot Maristuen Ungefär 2 min	åk 0,7 km totalt 0,7 km
	2. Svag sväng vänster vid Th Øiens gate Ungefär 1 min	åk 0,2 km totalt 0,9 km
	3. Sväng höger vid Petersborggata	åk 0,1 km totalt 1,0 km
	4. Sväng vänster mot Skanckesmuget	åk 94 m totalt 1,1 km
	5. Sväng vänster mot Skanckesmuget	åk 67 m totalt 1,2 km
	6. Sväng höger vid Skanckesmuget	åk 0,1 km totalt 1,3 km
	7. Sväng vänster vid Vestregata	åk 65 m totalt 1,4 km
	8. Sväng höger vid Bispegata Ungefär 1 min	åk 0,2 km totalt 1,5 km
	9. Sväng vänster vid Skippergata Ungefär 1 min	åk 0,3 km totalt 1,8 km
	10. Svag sväng höger vid 862 Ungefär 3 min	åk 1,7 km totalt 3,6 km
	11. I rondellen tar du 1:a avfarten in på E8 Ungefär 55 min	åk 68,3 km totalt 71,8 km
	12. Svag sväng höger vid E6	åk 8 m totalt 71,8 km
	13. Sväng vänster vid E6/E8 Ungefär 1 min	åk 11 m totalt 71,8 km
	14. Sväng höger för att stanna kvar på E6/E8 Ungefär 39 min	åk 43,6 km totalt 115 km
	15. Svag sväng höger vid E8 Du är i Finland Ungefär 32 min	åk 38,4 km totalt 154 km
	16. Fortsätt på E8/Käsivarrentie Fortsätt att följa E8 Ungefär 2 timmar 46 min	åk 202 km totalt 355 km
	17. Sväng vänster vid Kerässiepintie Ungefär 34 min	åk 19,3 km totalt 375 km
	18. Sväng höger vid lisakinpolku	åk 0,1 km totalt 375 km
	19. Svag sväng höger för att stanna kvar på lisakinpolku	åk 0,3 km totalt 375 km



Pallas-Ounastunturin Kansallispuisto

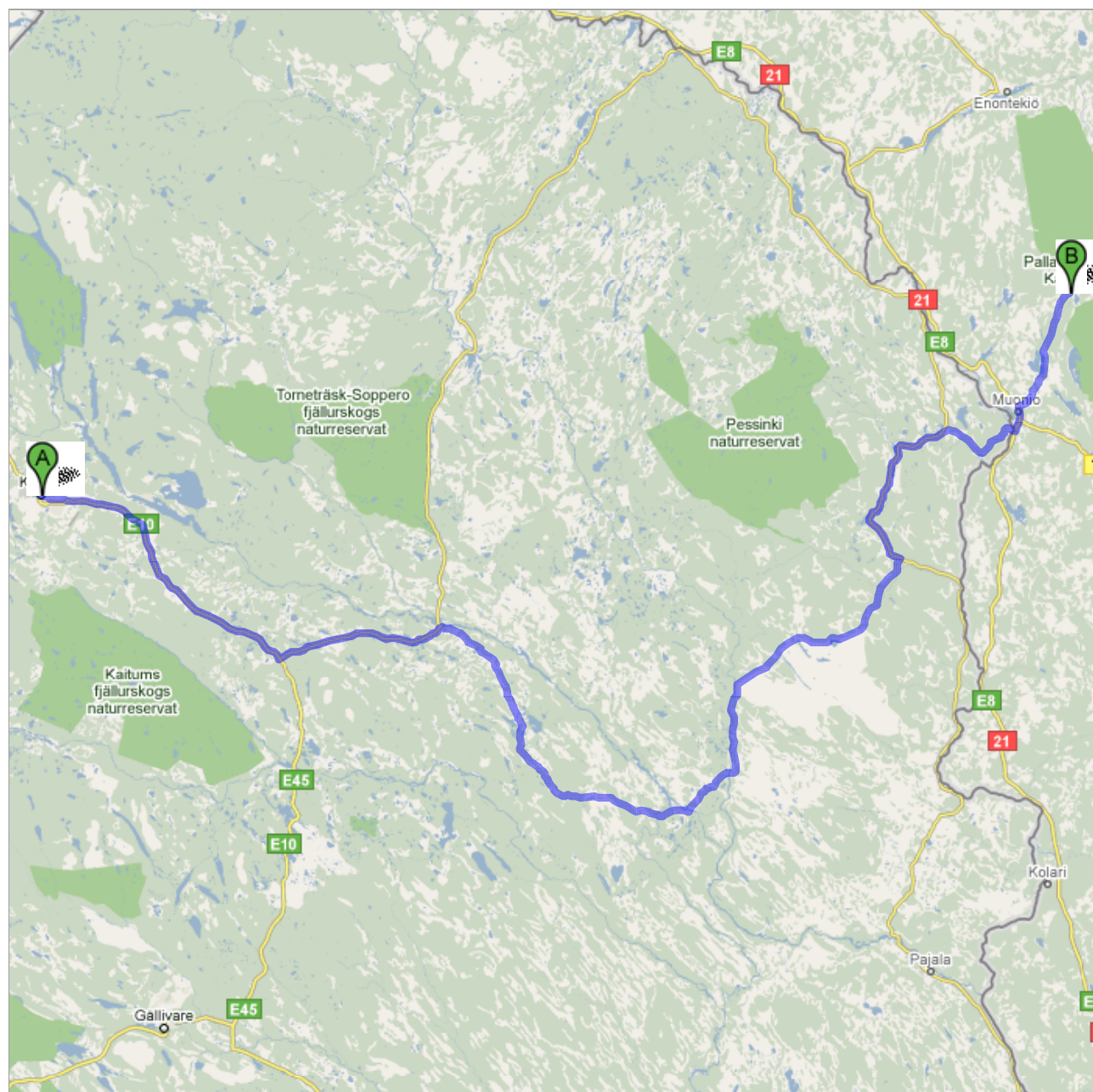
De här anvisningarna är endast till för planering. I verkligheten kan vägbyggen, trafik, vädret eller annat göra att omständigheterna skiljer sig från våra resultat, och du bör planera din rutt efter det. Var uppmärksam på alla skyltar eller meddelanden som rör din rutt.

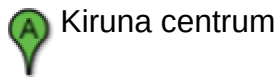
Kartdata ©2009 Tele Atlas



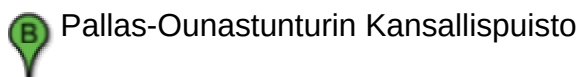
Vägbeskrivning till Pallas-Ounastunturin Kansallispuisto

250 km – cirka 4 timmar 15 min





	1. Kör i riktning öst på Mangigatan mot Geologgatan Ungefär 1 min	åk 0,2 km totalt 0,2 km
	2. Sväng höger vid Adolf Hedinsvägen Ungefär 2 min	åk 0,8 km totalt 1,0 km
	3. Fortsätt på Växlaregatan Åk igenom 1 rondell Ungefär 1 min	åk 0,5 km totalt 1,5 km
	4. Sväng vänster vid Malmvägen Ungefär 4 min	åk 2,6 km totalt 4,1 km
	5. Sväng höger vid Tuolluvaaravägen	åk 60 m totalt 4,1 km
	6. I rondellen tar du 4:e avfarten in på E10 Ungefär 32 min	åk 42,8 km totalt 46,9 km
	7. Sväng vänster vid E45 Ungefär 23 min	åk 26,0 km totalt 72,9 km
	8. Sväng höger vid 395/Centralvägen Fortsätt att följa 395 Ungefär 54 min	åk 54,1 km totalt 127 km
	9. Sväng vänster vid Kangosvägen Ungefär 10 min	åk 9,0 km totalt 136 km
	10. Fortsätt på Keräntöjärvivägen Ungefär 48 min	åk 49,1 km totalt 185 km
	11. Sväng vänster vid 99 Ungefär 27 min	åk 27,4 km totalt 212 km
	12. Sväng höger vid 404/Vuomatie Fortsätt att följa 404 Du är i Finland Ungefär 13 min	åk 13,7 km totalt 226 km
	13. Fortsätt på 404/Tullitie	åk 0,2 km totalt 226 km
	14. Sväng vänster vid E8/Torniontie Fortsätt att följa E8 Ungefär 6 min	åk 4,0 km totalt 230 km
	15. Sväng höger vid Kerässiepiintie Ungefär 33 min	åk 19,3 km totalt 250 km
	16. Sväng höger vid lisakinpolku	åk 0,1 km totalt 250 km
	17. Svag sväng höger för att stanna kvar på lisakinpolku	åk 0,3 km totalt 250 km



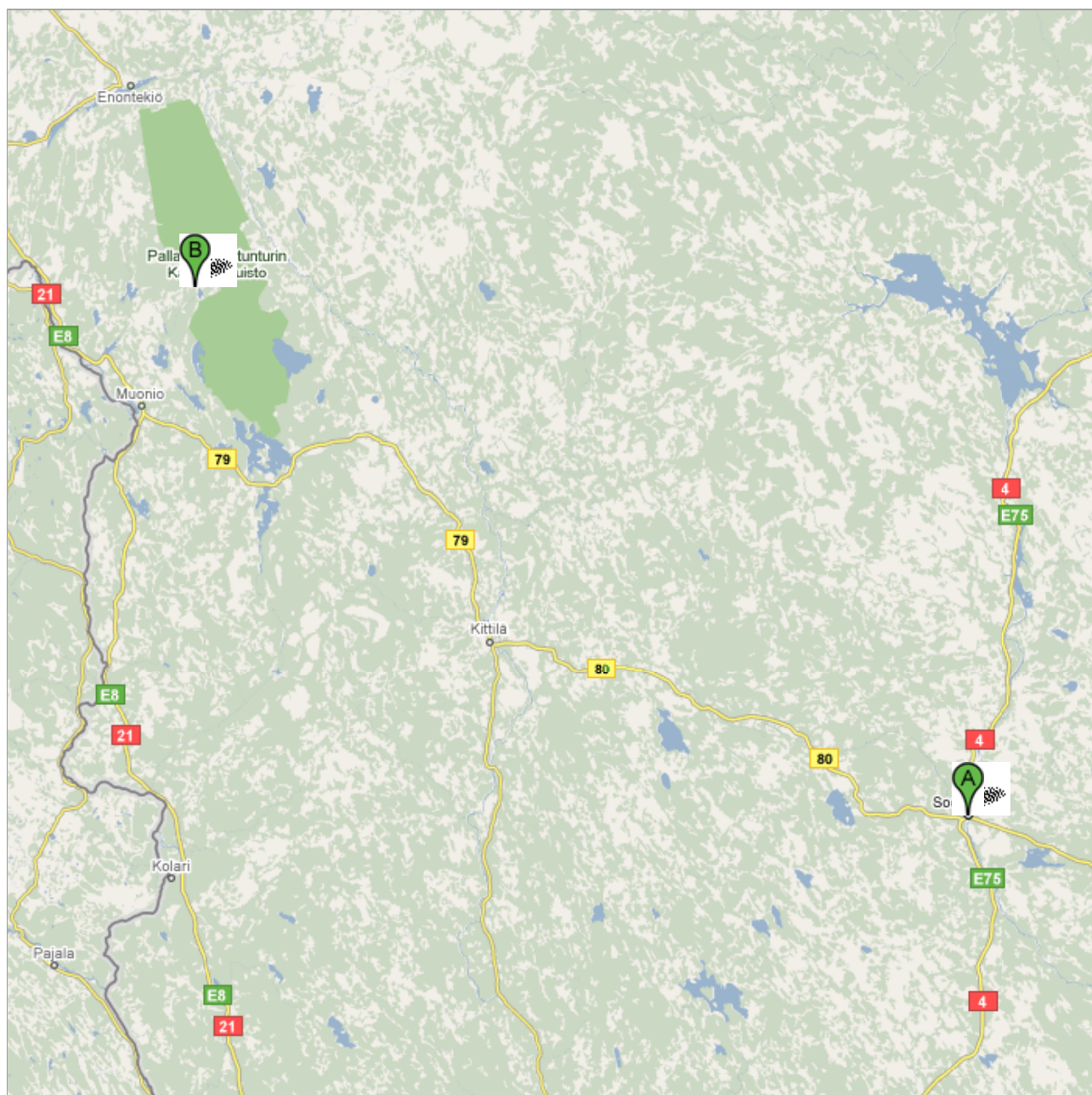
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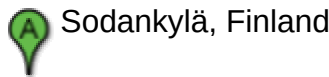
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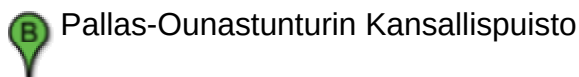
Vägbeskrivning till Pallas-Ounastunturin Kansallispuisto

187 km – cirka 3 timmar 2 min





	1. Kör i riktning väst på Sompiontie mot Jäämerentie	åk 49 m totalt 49 m
	2. Sväng vänster vid Jäämerentie Ungefär 2 min	åk 0,4 km totalt 0,4 km
	3. Svag sväng vänster vid E75/Sodankyläntie	åk 23 m totalt 0,5 km
	4. Svag sväng vänster för att stanna kvar på E75/Sodankyläntie Fortsätt att följa E75 Ungefär 2 min	åk 0,6 km totalt 1,1 km
	5. Sväng höger vid 80/Kittiläntie Fortsätt att följa 80 Ungefär 1 tim 11 min	åk 84,3 km totalt 85,4 km
	6. Sväng höger vid 79/Valtatie Fortsätt att följa 79 Åk igenom 1 rondell Ungefär 1 tim 11 min	åk 80,2 km totalt 166 km
	7. Sväng höger vid E8/Kilpisjärventie Ungefär 3 min	åk 2,0 km totalt 168 km
	8. Sväng höger vid Kerässiepiäntie Ungefär 33 min	åk 19,3 km totalt 187 km
	9. Sväng höger vid lisakinpolku	åk 0,1 km totalt 187 km
	10. Svag sväng höger för att stanna kvar på lisakinpolku	åk 0,3 km totalt 187 km



De här anvisningarna är endast till för planering. I verkligheten kan vägbyggen, trafik, vädret eller annat göra att omständigheterna skiljer sig från våra resultat, och du bör planera din rutt efter det. Var uppmärksam på alla skyltar eller meddelanden som rör din rutt.

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ESR SITE REPORT 2009.02.09.

EISCAT SVALBARD RADAR, 10.FEB.2009 HB

STAFF

Assar Westman moved back to Headquarter at May 30.

32M ANTENNA

At July 25. the antenna stopped because a motor interlock turns on at azimuth motor nr.4. It was found a broken control card and the motor was disconnected so the antenna could be moved.

A broken panel in the dish at row 8 was repaired during last week of August.

EXCITER

One of the DDS (Direct Digital Synthesis) card in the exciter unit failed in December and we will get a new card from Kiruna site.

RECEIVER PROTECTOR

The experiment at February 1. and 2. had to be cancelled because we went into problem with voltage confirm and current monitor interlock. The fault was inside the RX protector unit and the current through the pin diodes was not inside the limit window.

TRANSMITTER

In April we discovered strong noise into the receiver when transmitting. After some time we found that the noise came from klystron 3B, and we had to replace it.

In July a dummy load to transmitter 1 – 4 was partly broken since it was measured to 1K ohm. Both was replaced by new 50 ohm loads.

FIRE ALARM

The new aspirator type fire alarm we installed in the transmitter hall is very sensitive and had some running-in problem. At Saturday Sept.6., the fire alarm turn on and the fire brigade rushed to the site. The door was locked, the firemen have got a key, but could not find it, so they smashed the window and went in. It was a false alarm from transmitter 1 and 2. The detector has now been replaced.

ESR KLYSTRON STATUS 30.01.2009

TYPE		SERIAL	BEAM	HEATER		
K3672	529	34201	6443	6730	TX3A	1
K3672	554	9415	20920	22152	SPARE TUBE	2
K3672	543	9248	20932	22165	"NOISY TUBE"	3
K3672	544	9351	2888	3153	"NOISY TUBE"	4
YK1265		55109	10947	11173	TX1B	5
YK1265		34305	14651	15288	SPARE 70% output	6
YK1265		25105	21993	22379	TX7B	7
YK1265		34303	22946	23641	TX2A	8
YK1265		64210	22946	23641	TX2B	9
YK1265		54508	19122	19619	TX5A	10
YK1265		65005	18093	18336	TX3B	11
YK1265	529	9330	22068	23068	TX4A	12
YK1265		64604	21894	22299	TX6A	13
YK1265		64103	21894	22299	TX6B	14
YK1265		64603	21993	22379	TX7A	15
YK1265		55116	6787	7038	SPARE TUBE	16
YK1265		64805	22115	22482	TX8B	17
YK1265		64907	22115	22482	TX8A	18
K3672	1014	144	16764	16976	TX5B NEW 03-02	19
K3672	1019	150	8279	8415	Body 200mA/Fil.conn.def.	20
K3672	1127	540	8310	8348	TX1A NEW 11-06	21
K3672	1143	620	6113	6149	TX4B NEW 11-06	22

Kiruna site status, 12 February 2009

Staff.

Peter Bergqvist - Electronic engineer / Computer system administration

Inge Marttala - Electronic engineer

Lars-Göran Vanhainen - Site manager

Operation.

- Operating hours 2008 (recorded):

UHF experiments:	1059
Passive (scinti):	93
Total:	1152 hours
- The National Post and Telecom Agency (PTS) in Sweden have released a draft decision for the GSM900-band usage. This follows an agreement by the EU telecom ministers to open up the GSM spectrum for other services (UMTS900).

In the new frequency allocation plan, the telecom operator Hi3G is allotted the frequency band 925 – 930 MHz, and Swefour 930 - 935 MHz.

The present EISCAT UHF frequency band is 926 – 931 MHz.

The new frequency allocation plan will be valid 12 months after decision in the PTS board, which will be taken in the middle of March. Any objection to the draft decision must be in writing, and before March 4.

This decision will set out the end date for UHF radar operation in Kiruna, to March 2010.

Frequency allocation in the 900 MHz band

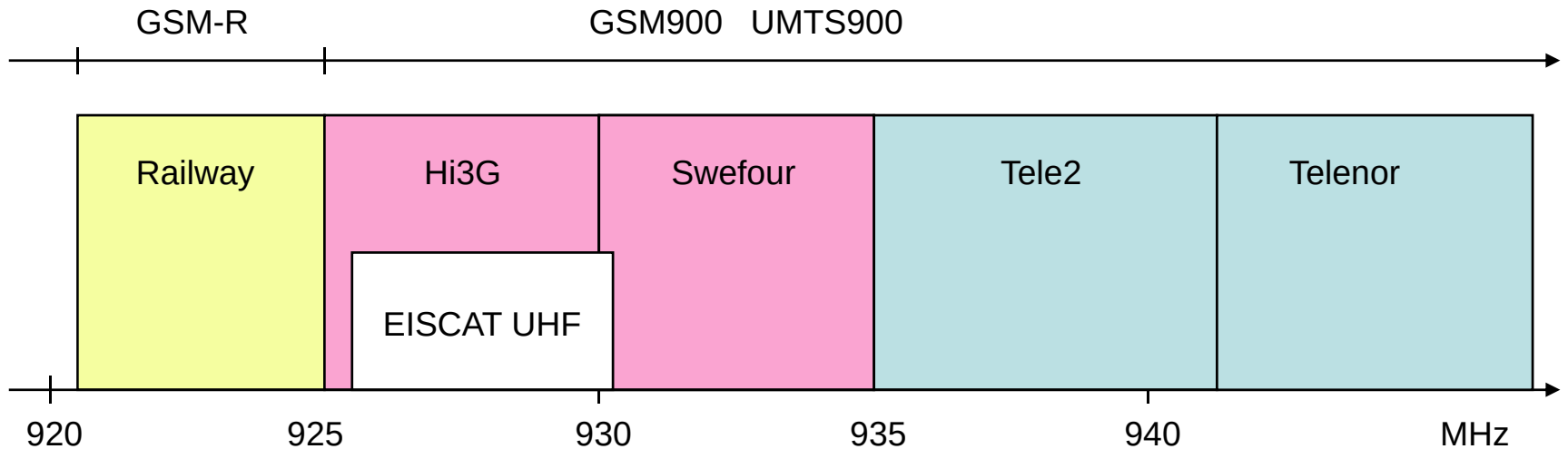
(Draft decision from PTS, February 4.)

(GSM = Global System of Mobile communication)

(UMTS = Universal Mobile Telecommunication System)

GSM-R 921 – 925 MHz (GSM Railway)

GSM900/UMTS900 925 – 960 MHz



EISCAT UHF band 926 – 930,5 MHz

Computers/Software.

- Data archive status: An extension of the disc array is planned for this year. The present Raid disc system, 2 x 22 TB, is expected to be full during the autumn. The work of copying old DAT, Exabyte, DLT and Reel tapes to the data archive will continue this summer.
- Eros5 installed
- Paul Gallop has installed the RAL computer system, for data analysis.

UHF Antenna/Receiver.

- One azimuth wheel bearing was replaced last year, after it had started to produce noise. The repair work was done by a local contractor with the assistance from the site staff.
- A synchro transducer in the antenna positioning system failed and was replaced with a spare unit from Tromsö.

EISCAT_3D.

- WP 12: high speed serial data transfer, for the Demonstrator array.
- We installed the receiver for the Demonstrator array in October together with Sodankylä site staff and the Luleå group. Extensive test work followed the installation and is still ongoing.
- Design work and simulations on the active elements (TX antenna) by Toralf Renkvitz
- Design and prototyping of power amplifier and Tx antenna by Ingemar Wolf

Lars-Göran Vanhainen





Sodankylä site status (March 2008- ARM 2009)

- Personnel
- Antenna
- Interference
- SD-activities
- E_3D
- Heating upgrade
- Eros
- Other matters

Personnel

- 3.5 persons working at Sodankylä site 2008 (Tarmo part-time pension 50/50)

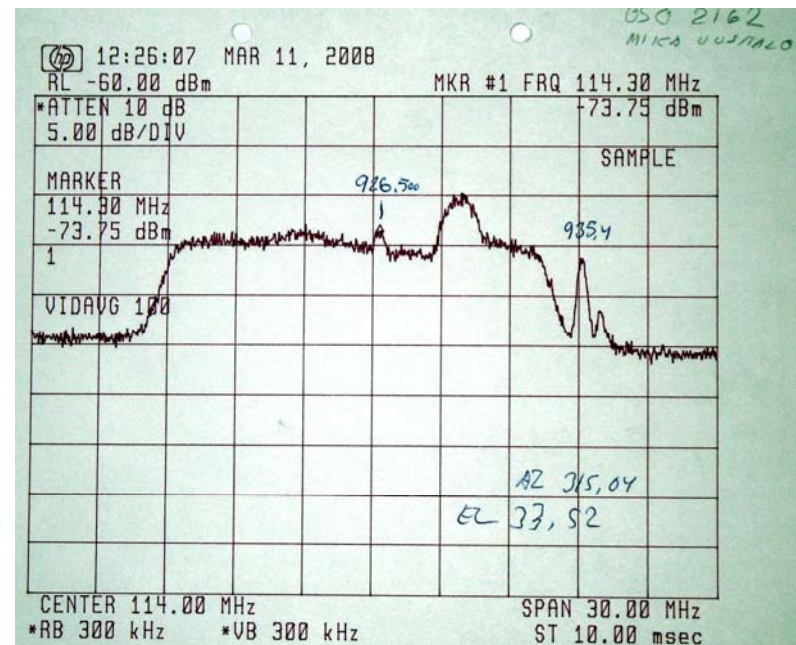
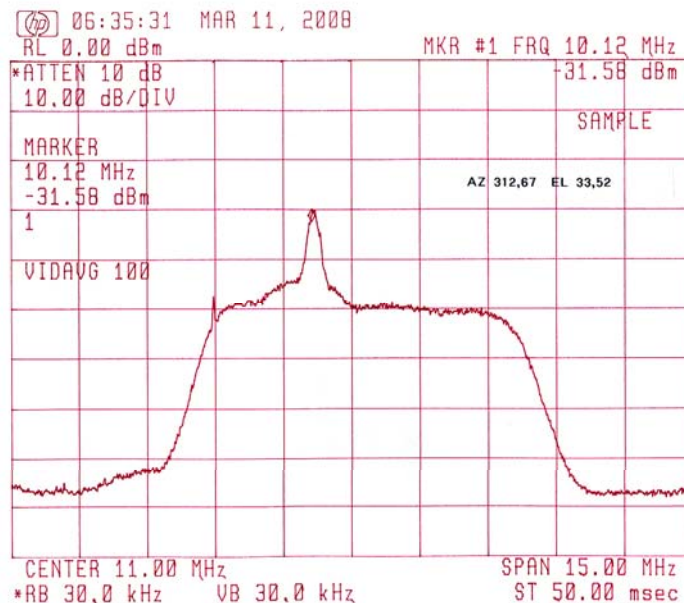
Antenna

- Elevaton motor I failure (28.3)
 - original motor (lasted almost 30 years!!)
 - Spare motor fetched from the Kiruna site
- Bolt tightening of the antenna's panel
- Tromsö UHF antenna maintenance (T. linatti 17.4, 3-9.8)
 - changing UHF antenna's elevation brake
 - elevation motor change
 - thyristor bridge change
 - greasing bearings

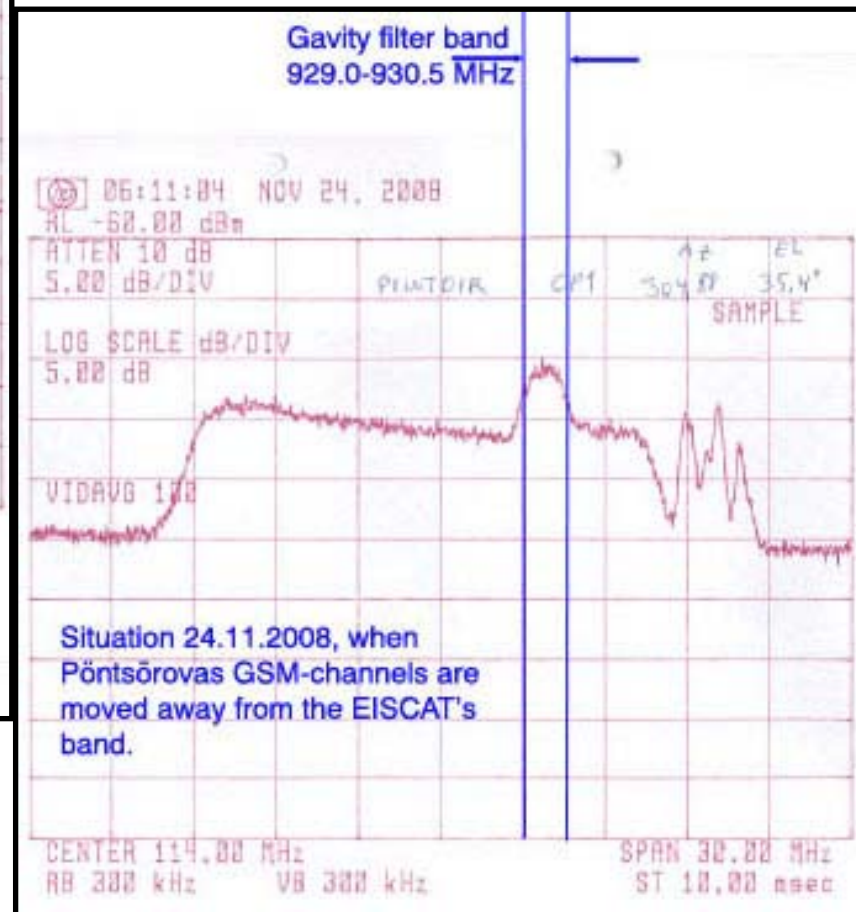
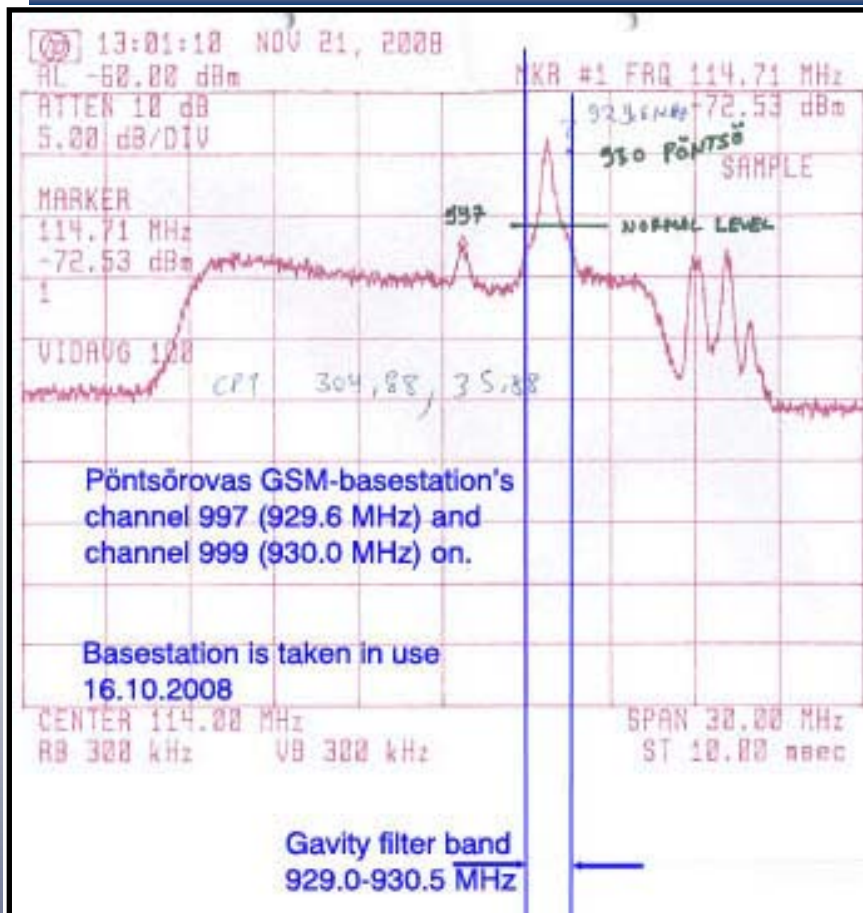


Interference 11.3. and 24.4.2008

- GSM base station has been taken in use near Sodankylä village (930 MHz frequency was used)
- Pyhätunturi's GSM base station (about 50 km south from our site) has been added more channels (again, 930 MHz frequency was used)
- on request operator moved channels away from our band => 17.3. and 25.4. we saw a signal again



Interference 21.11.2008



SD-activities

- participating and giving presentation in "IPY Cluster63 mid-term review"-meeting, Bergen (2.4)
- running SD-experiment 28-30.10 (ESR)
 - updating plotting program
 - analyzing SD-data
- Fifth European Conference on Space Debris 30.3-2.4.2009, Darmstadt, Germany

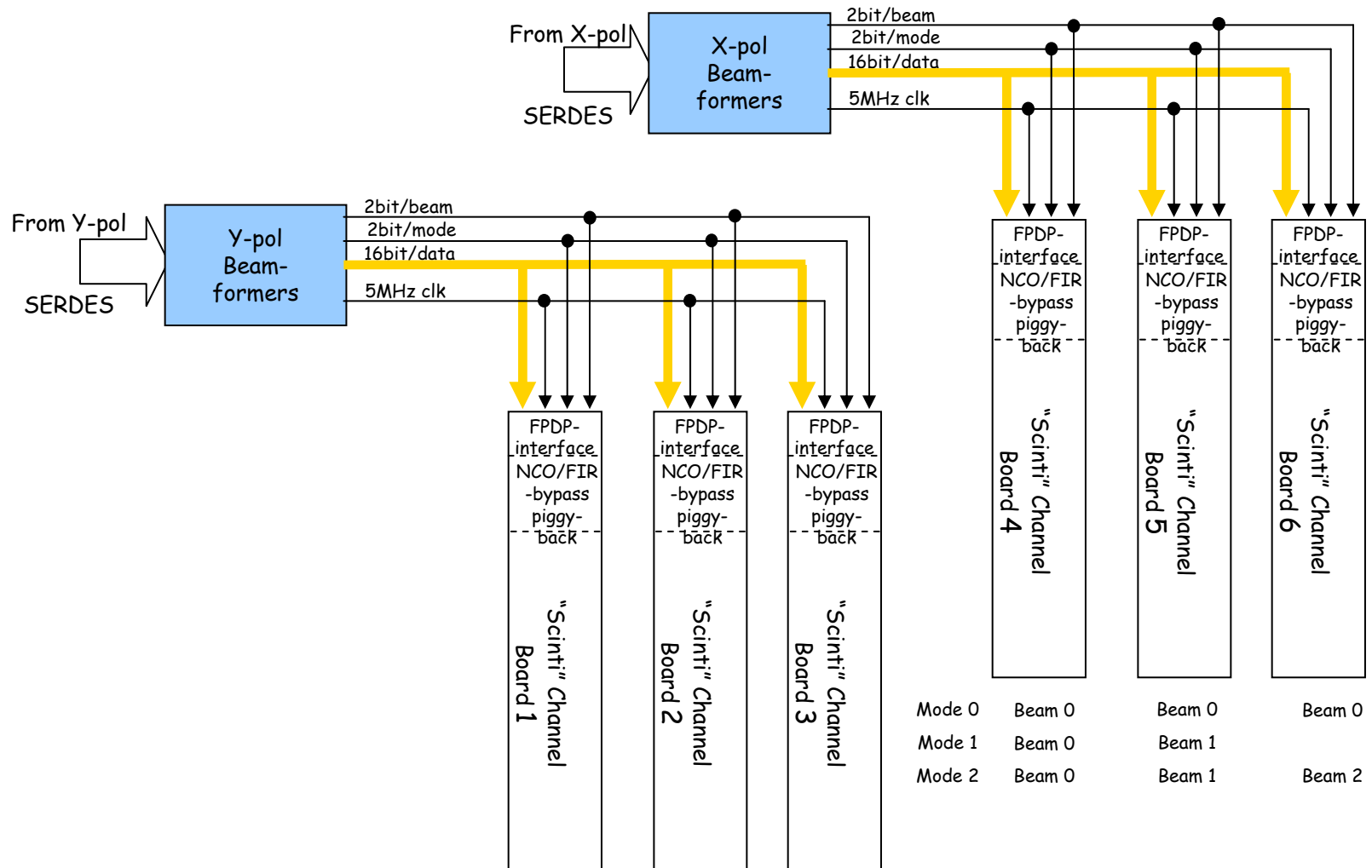
E_3D

- WP1 Management of Design
 - Steering Group's extra ordinary meeting 4.4.
 - All-hands meeting 16-17.9
 - SG8 meeting 17.9 and SG9 meeting 14.1
 - SG-demo teleconference meetings 3.10, 23.10, 19.11, 17.12, 21.1 and 4.2
 - work with the deliverables
- WP7 Control and Monitoring
 - EROS inspecting/developing work

E_3D

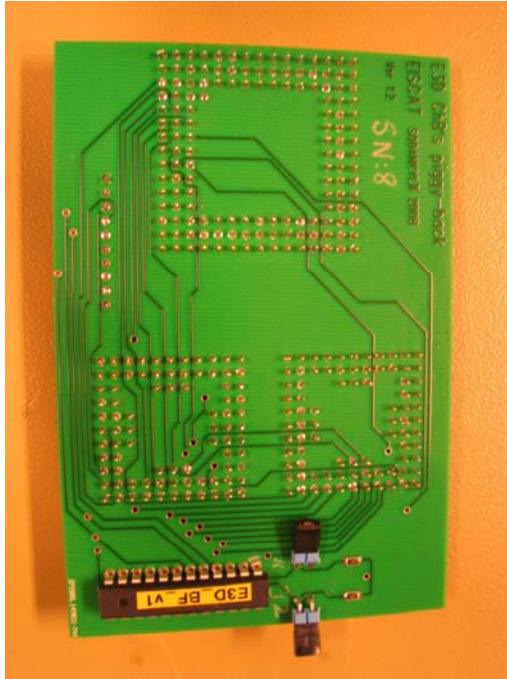
- WP9 Signal processing
 - WP4 & WP9 technical meeting at the Kiruna site (3.4)
 - E3D channel board
 - designing, assembling and testing the six NCO/FIR bypass modules
 - DDC-SERDES integration tests with LGV and Peter B. (29-30.5)
 - Work with the DDC board
 - ISL5416 output timing checks, making new setups and testing
 - Demo receiver installation work (autumn 2008)
 - installation planning and coordination meetings (telephone meetings 22.9, 25.9, 9.10, 16.10, 21.11, 28.11, 5.12, 15.12, 16.1 and 30.1) with LTU and Kiruna site staff
 - Sodankylä site staff was working at the Kiruna site about six weeks altogether
 - Studying HW/SW features of the stand alone micro web server (FOX Board LX832)
 - plan is to control DDC boards with the help of the FOX board

Beam-formers' interface to the channel boards

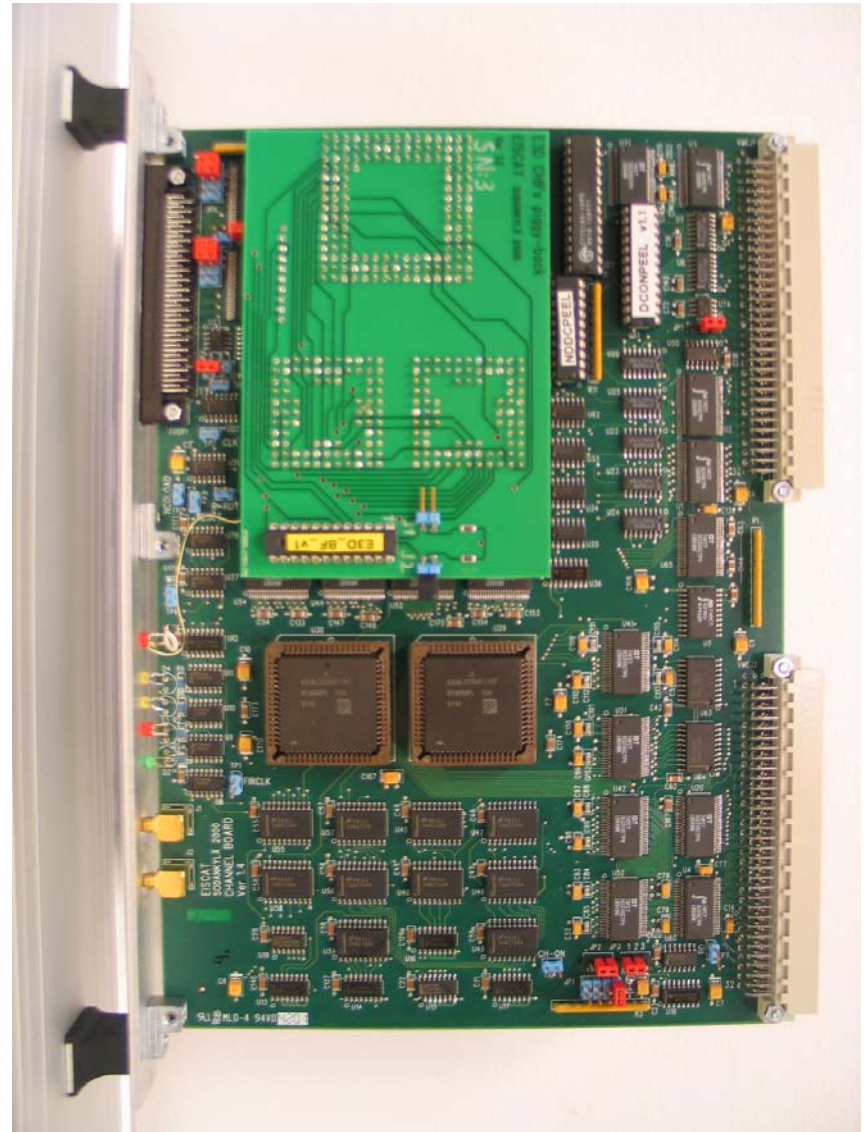


Modes and beams equal than in the X-pol side

NCO/FIR bypass module



Module installed on top of the channel board

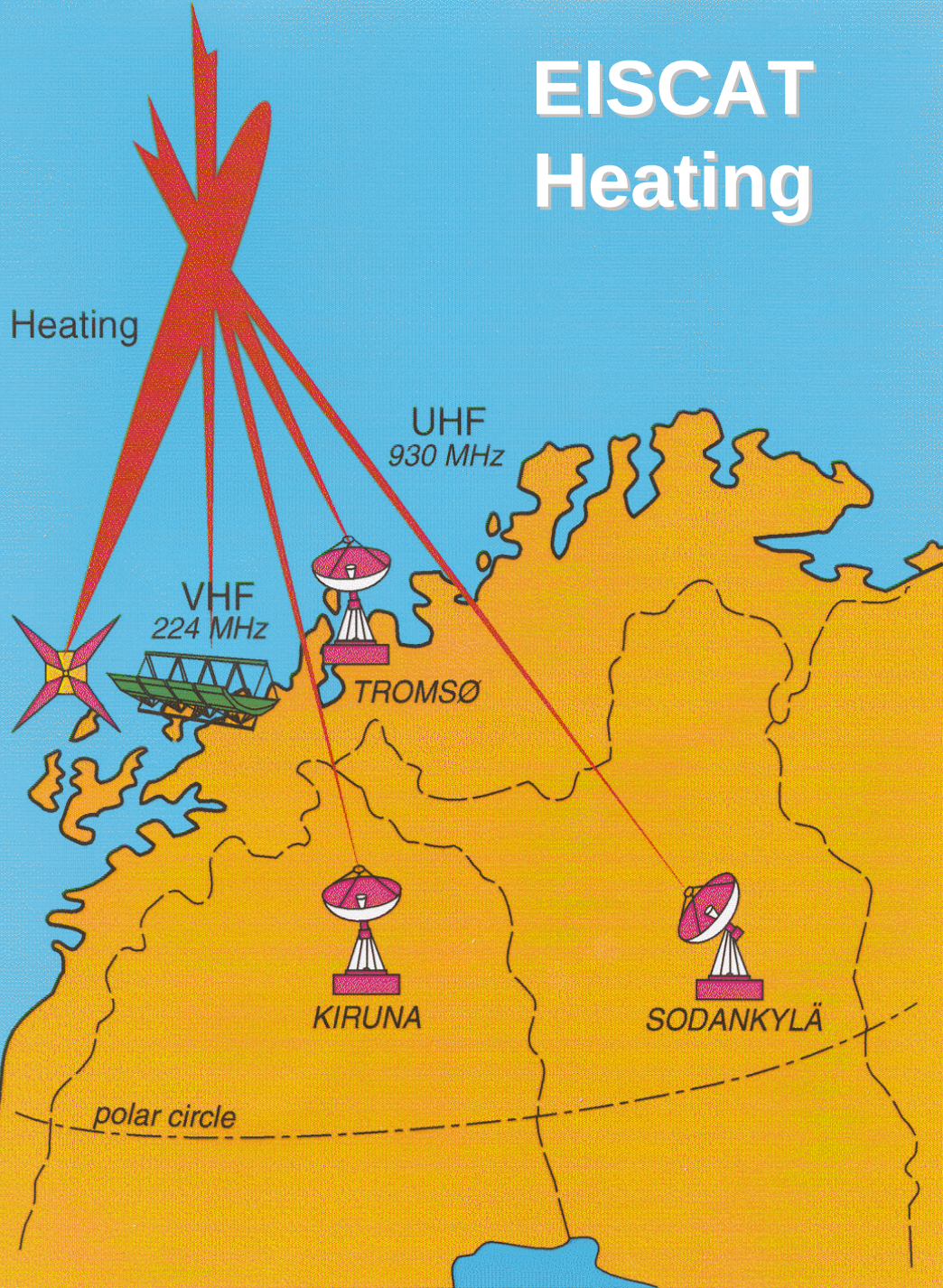


E_3D

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EISCAT Heating



Heating upgrade

- Work started 5/2004
 - DDS chip selected
- 2005
 - DDS proto board ready
- 2006
 - First tests with transmitter (proto)
 - Loading/control SW (scripts)
- 2007
 - Second tests with transmitter (proto)
 - Designing DDS board (PCB), assembling and testing (7 boards), making better output amplifiers...
 - Improving loading/control SW (scripts)
 - Tarlan v.0
 - Defining commands for Eros
- 2008
 - Assembling and testing exciter, digital receiver and RC interface HW at the Heating site
 - Eros h, I/O-control SW, Tarlan h, experiment design
- Ready during 2009?
- **Separate presentation**
afternoon



EROS

- A new EROS version is called "EROS 5"
- The changes from EROS 4 to EROS 5 are numerous, but very few are directly visible to the user. Especially, most existing .elan files should still work without changes.
- Totally new Eros h
- Eros 5 is taken in use at all sites
- A new ("preliminary", as always) EROS command reference, generated from the current EROS source file headers, is in

http://www.sgo.fi/~jussi/eiscat/eros5doc/eros_commands.html

Other matters

- site's www-pages moved to the SGO-server
(<http://www.sgo.fi/Eiscat/index.php>)
- "Staff representation in the EISCAT Council"-procedure

MJP will stop "the extortion" 30th of April 2009



MJP will stop "the extortion" 30th of April 2009



New e-mail 1.5.2009 =>
markku.postila@sgo.fi

Location:
Sodankylä
Geophysical
Observatory/Technical Unit

Tromsø site report for ARM 2009.

Staff

The present staff is:

Arild Stenberg

Knut Hellvig

Roger Jacobsen

Guttorm Mikalsen (temporary position during Stian Grande's military service)

Lisa Baddeley(HQ employed)

Kjellfrid Ingebrigtsen and **Liv Nymo** are employed directly by the University of Tromsø. Kjellfrid is working a 10% position for EISCAT and Liv 25%.

In addition we have 3 trainees:

Espen Rørvoll (to March 2009), **Erlend Danielsen** (to March 2010) and **Are Haugland** (to March 2010)

The staff is insufficient to operate and maintain two radars. In addition it is necessary to help maintaining and also operating the Heating facility. The number of operating hours was more than 1500 hours last year.

UHF radar

Main status:

The receiver is not in operating condition.

We operate the transmitter at reduced output power because of arcing in the polarizer.

We have changed the minimum elevation angle for RF radiation from 16 to 23 degrees

UHF transmitter

IPA. (Intermediate power amplifier)

We have had problems keeping a stable RF level to the klystrons. The power supply in the IPA broke down and we now use a lab supply.

The spare IPA is does not work because of a broken output stage. We have found a replacement part on e-bay, but we have not ordered yet. It would be nice if someone in the organization had a VISA card to make this type of ordering easier.

EXITER

We have had stability (amplitude) problems with the synthesizers. Some amplifiers have been replaced.

The feed-back and feed-forward circuits have not been used the last 10 years and have now been removed.

UHF antenna

Polarizer

One of the phase shifters in the polarizer is damaged. It has arced inside and has done that for a while. The result is a hole that is visible from outside. The phase shifter is quite large and it will not be easy to get it out of the HUB room. The receiver protector has large waveguide parts and it blocks the way out for the phase shifter. It will be difficult to get the phase shifter out. We will manage it, but it may take some time.

When it is down, we will open it and try to figure out how to repair it.

It has been scheduled a 2 weeks maintenance period to fix the problem.

Motors

The brake on one of the elevation motors has been replaced.

Later the motor was replaced.

For a while we had problems with the motor drive circuits. We have done full service on the elevation drive circuits. We need to do this on azimuth also.

UHF Receiver

We have replaced the front end receiver with an un-cooled HEMT amplifier. The noise contribution is about the same as for the cooled GaAs-fet amplifier.

The temperature now is about 120 Kelvin. It should be possible to get it down to 80 with the cooled GaAs-fet amplifier and proper equipment.

Local oscillator

The first local oscillator is not stable. It is drifting with the surrounding temperature. It may have been so for some weeks. The temperature in the hub room has been stable until the heater broke down a few days ago. Then the room temperature dropped to below zero degrees, and the oscillator had a very large offset. As the temperature increased the frequency came closer to the right frequency.

The problem is not critical since we can install a lab generator while it is repaired.

VHF radar.

Main status:

The radar can be operated with one klystron. The two panels that are connected to the klystron can be moved. The two other panels are not working completely.

The license for using the frequencies will not be renewed after January 2010?

Transmitter

We are still operating with only one klystron.

Will we get the B-side klystron in operation?

Is there any point. Frequency band will be used for DAB?

Two main possibilities:

Change the oil.

Replace the vacuum sealant.

VHF antenna

The status is not clear. We do not have a full set of working servo drives.

It is possible that one motor is broken. We have one spare motor, but no spare servo drives.

We have ordered some parts (transistors) and we hope we will be able to repair the servo drives.

EXITER

One of the four generators is not working

We use a lab generator in its place.

We have noticed some RF drop-outs.

VHF receiver

Noise injection has been measured to be 240 Kelvin.

The analyses are use 280 Kelvin.

General

Pre and MORRO have no longer shared power meter with us.

Crowbar

We have bought two new thyatron tubes last year. The crowbars are in good condition.

Cooling system

The cooling system works OK. The leak has been fixed.

Interference:

Digital TV

The digital TV broadcasting use channel 26, 43 and 46. The 3rd harmonics of the VHF frequency is in the middle of channel 46. Interference is from the transmitter, not from the VHF antenna.

DAB

We have interference from DAB 228,304 to 229,840 MHz. This is the main DAB frequencies used all over the country.

The **MORRO** radar (56 MHz) has not been in operation for some months because of technical problems.

RF radiation

The elevation limit for radiating with the UHF antenna has been changed from 16 degrees to 23 degrees.

We were close to the public limits just outside the fence near the UHF antenna.

The radiation level near and in the HEATING antenna has been measured and the level is below the limit outside the antenna.

Ramfjordmoen.

The Mack Brewery in Tromsø wants to move their factory to Ramfjordmoen.

Telephone system

We are in the process of changing to a new telephone system (IP-telephones). We will be hooked up to the University exchange using the internet connection. This means that we will get new numbers.

Key system

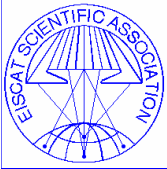
At Heating we can use key or code.

At main building Radar site we can use magnetic card or Keys

At VSQ we can use magnetic card or keys





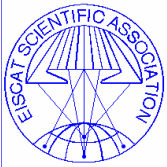


Heating status 2008/2009

M. T. Rietveld

EISCAT, Ramfjordbotn, Norway.

Annual Review Meeting, 11-12 February 2009, Finland



Heating Status, 10 Feb 2009

Staff:

One scientist plus occasional technical help from the radar engineers/apprentices.
Arild sometimes operates the facility in my absence.

Operations:

214 hours in 2008, 0 hrs so far in 2009, but in March there will be much heating,
including the first operation for Russia.

Heating Technical status:

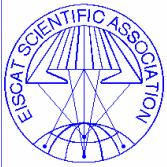
Transmitters mostly OK: an unknown fault exists on Tx1

Rebuilt tube still operating well after >500 hrs.

Second rebuilt tube not yet tested.

Array 3 is disconnected from transmitters for use as a receiving antenna in a radar mode.

All the heating-upgrade hardware works (since Jan 2009), and software (eros h) is being expanded to exploit it. Markku and Jussi will report more on this.



Operations:

Breakdown for 2008:

UK, NI, NO, SW, EI, CN, FI and Ukraine all used heating

Various experiments, F-region, mesospheric, but very few optical night-time experiments because of solar minimum conditions.

Total Heating hours 2008: 214 Hrs

2009:

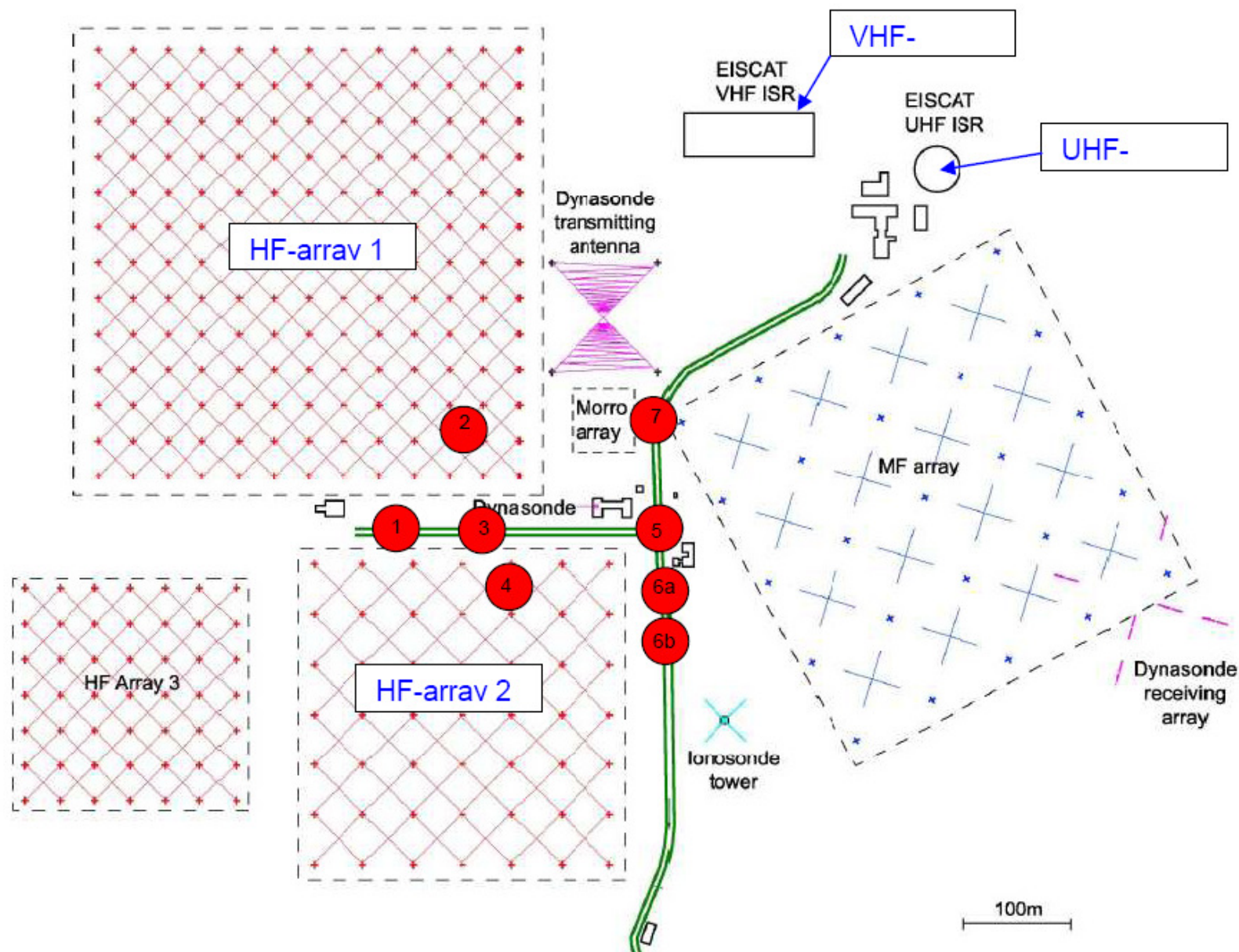
Experiments are planned for Russia, UK, NO etc.

RF measurements:

On request from the University of Tromsø, NPT measured RF levels in and near the antenna arrays. Only inside the antenna arrays are the levels near the public safety levels. A copy of the report has been sent to Statens Strålevern and the university has asked for recommendations and advice concerning any actions that need to be taken.

2. Målinger

Målingene ble utført mandag 29. september 2008. Vi har utført målingene som stikkprøver inne i antenneanlegget og langs veiene inn til EISCAT- anleggene. Punktene er valgt ut fra antatt ferdsel i området og i samråd med EISCAT/UiT. Se skisse



7 Konklusjon

Målingene viser at feltstyrkeverdiene er høyest inne i HF-array 2 (målepunkt 4). Dette harmonerer bra med at det er dette antennefeltet som blir tilført mest effekt per antenneelement. Måleverdiene for henholdsvis E- og H- felt ligger på ca 116% og 80% av anbefalt grenseverdi. Videre ligger nivåene inne i HF-array 1 på ca 50% for E-felt og 8-13% for H-feltet. Samme nivå ble også målt langs veien inn til senderhuset når HF-array 2 var i drift. Langs hovedveien inn til EISCAT er høyeste nivå ca 11% for E-felt og 5% for H-felt målt på veien rett ved HF-array 2. Inne i kontrollrommet ligger nivåene betydelig lavere enn de anbefalte grenseverdiene med 0,02 % for E-felt og 0,005 % for H-felt.

Målingene viser at opphold inne i antenneanlegget, når dette er i drift, kan medføre at man blir eksponert for strålingsnivåer som overskrider anbefalingene fra ICNIRP. På bakgrunn av dette blir rapporten oversendt til Statens strålevern for vurdering av hvilke tiltak som bør i verksettes.

Post- og teletilsynet

Frekvenskontrollen i Trondheim

17/10-2008

Dynasonde Status, 10 February 2009

Tromsø Dynasonde:

The Tromsø sounder is running very reliably.

Operates every 6 minutes with alternating soundings of different type.

Svalbard Dynasonde:

The BAS ex-Halley dynasonde is on Svalbard next to SPEAR and works.

Lycksele Dynasonde (IRF, ex Christer Juren)

We should be able to get it for spare parts.

New dynasonde

The new systems being built in USA are being delivered. Maybe we can get external funding to buy the new systems.

New analysis and database site:

We are installing the latest analysis software and database on a new computer in Tromsø. The installation is being done remotely via internet by N. Zabotin/Bill Wright from USA.

Both Tromsø and Svalbard data will be handled here.



Site Report: HQ

- *Staff changes*
 - Esa Turunen
 - New Director from 1.1.2009
 - Tony van Eyken formally left 31.12.2008
 - Esa's contract is for three years - 31.12.2011
 - Lisa Baddeley
 - Now at Ramfjordmoen (since 1.6.2008)
 - Will from now on concentrate on site support as Site Scientist





- Budget Development (regular op)
 - Will operate roughly as usual
 - But no IPY
 - Less on Svalbard and bit more on mainland
 - Last year
 - EISCAT_3D design study
 - TNA project
 - Staff
 - New Engineer Tromsø
 - To be hired later this year such that he/she is in place latest 1 Jan 2010
 - EISCAT_3D project leader



- Budget Development (regular op)
 - Investments
 - New Car Tromsö
 - Plug-in Hybrid
 - Pay-off loan on house Svalbard
 - Data archive - off-line copy



- Budget Development (regular op)
 - New Income

Regular Call-Up

Associate	Regular amount	Extra amount	Total	Increase	Currency	Budget 2009 rate	Calculated Amount	Share
CRIRP	2 806 000	70 150	2 876 150	2.50%	CNY	1.050	3 019 958	12%
DFG	180 000	0	180 000	0.00%	EUR	9.250	1 665 000	7%
NIPR	21 000 000	525 000	21 525 000	2.50%	JPY	0.06000	1 291 500	5%
RCN	4 769 000	119 225	4 888 225	2.50%	NOK	1.200	5 865 870	24%
SA	350 000	14 746	364 746	4.21%	EUR	9.250	3 373 901	14%
STFC	320 000	8 000	328 000	2.50%	GBP	12.000	3 936 000	16%
VR	5 400 000	227 502	5 627 502	4.21%	SEK	1.000	5 627 502	23%
							24 779 730	
Affiliates								
CNRS	150 000	0	150 000	0.00%	EUR	9.250	1 387 500	
AARI	220 000	0	220 000	0.00%	EUR	9.250	2 035 000	
							28 202 230	

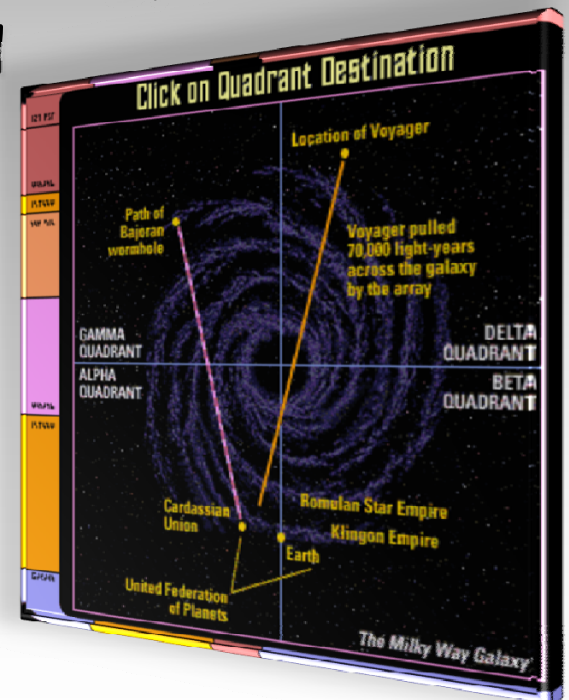
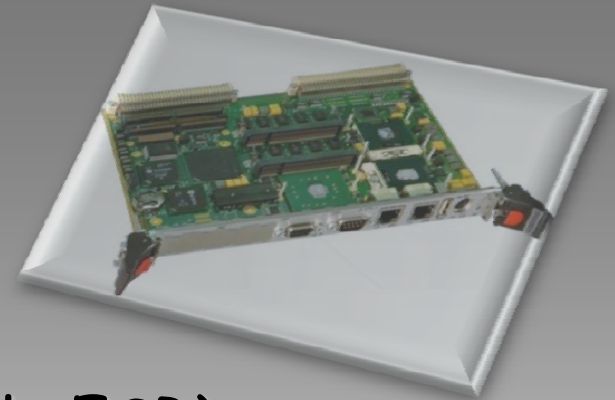
708 kSEK
Associates
Add-on



- Additional plans
 - EISCAT_3D project leader
 - budgeted and to be installed swiftly
 - New Web site(s)
 - WEB Developer Position to be opened soon
 - www.eiscat.se
 - www.eiscat3d.se
 - Dynasonde Analysis Package
 - Dynasonde Solutions, Nick Zabotin
 - Analysis machine Kiruna site
 - Soffari Ltd, Paul Gallop



- Additional plans
 - VME computers
 - Replacing CPU-50T's (initially ESR)
 - Assimilating Eiscat3d technology
 - After design study has ended
 - We need to decide route re the VHF klystron





Recession effects

- Funding crisis?
 - Not foreseen. We are on "state" funding
- Spend crisis?
 - Exchange rates effects
 - NOK and SEK equally weakened (anyway rate fairly constant)
 - EUR much stronger - effects Sodankylä costs
 - But we also receive EUR's - so ok.
 - If SEK continues weak
 - We will gain...



Associates

- CRIRP (People's Republic of China)
 - Plans are to build a deep space probe communication station on Svalbard
 - May result in a third antenna at ESR
- DFG (Germany)
 - Fixed commitment that ends 2011
 - CAWSES support in Germany
 - JR one of the lead persons in building a new German user base



Associates

- NIPR (Japan)
 - NIPR and STEL jointly Associates
 - Polar research and Solar Terrestrial
- RCN (Norway)
 - Large contributor (24%)
 - Committed to Svalbard but supports also strongly EISCAT and mainland
 - ESFRI SIAEOS
 - » Svalbard infrastructure science platform



Associates

- SA (Finland)
 - Large Contributor (14%)
 - More than doubled commitment (5%)
 - Long term
 - Scientists strongly support Eiscat3d



Associates

- STFC (United Kingdom)
 - Work is progressing in UK to transfer EISCAT Associateship to NERC
 - Solar Terrestrial into Natural Environment
 - Looks promising
 - If not - STFC will eventually leave
- VR (Sweden)
 - Big Contributor (23%)
 - Long term commitment
 - ESFRI Eiscat3d



Associates

- AARI (Russia)
 - Really time-buyers
 - Contract for three years with AARI
 - Arctic and Antarctic Research Institute St. Petersburg
- CNRS (France)
 - Really time-buyers
 - No contractual commitment but continues to use EISCAT against hourly cost



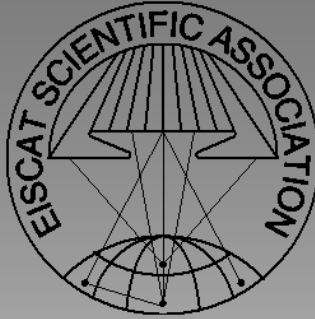
Associates

- New (Ukraine)
 - Stated that they will join but no news (since long)



Critical years

- 2009
 - Eiscat3d preparation phase bid..
- 2010
 - Remotes..
- 2011
 - VHF frequencies..
- 2012
 - UK and Germany funding..
- 2014
 - UHF frequencies..
- 2015
 - Eiscat3d operational..



The EISCAT logo

Policy: keeping old logo until major change
to the Association (like Eiscat3d).

Polar Bear logo fine for Svalbard use
(if so wanted)



Review 2008

- Why and how we did it
- Operations
 - Hours run
 - SP CP Budget
 - CPs
- Highlights
 - Very personal, only things that past me
 - KST
 - ESR
 - IPY
- New exps
 - CP3

Operations 2008

- CP Common
 - Overrun mainly due to IPY
- SP Special
 - High load in Nov/Dec
- 'OP' Other Programmes
 - IPY(jan-apr), TNA (IT BL IL), TB (FR Pepsi), 3P (UA US RU), EI

KST TOTALS

2008	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total	Target
CP	44.5	38	84.5	120	88	120.5	202	105.5	71	182.5	96	82	1234.5	469
SP	148.5	183	235.5	30	6	42	98	13.5	33	63.5	184.5	59.5	1097	878
OP	0	0	36	10.5	0	24	16	0	0.5	9.5	54	82.5	233	295
Total	193	221	356	160.5	94	186.5	316	119	104.5	255.5	334.5	224	2564.5	1642

ESR TOTALS

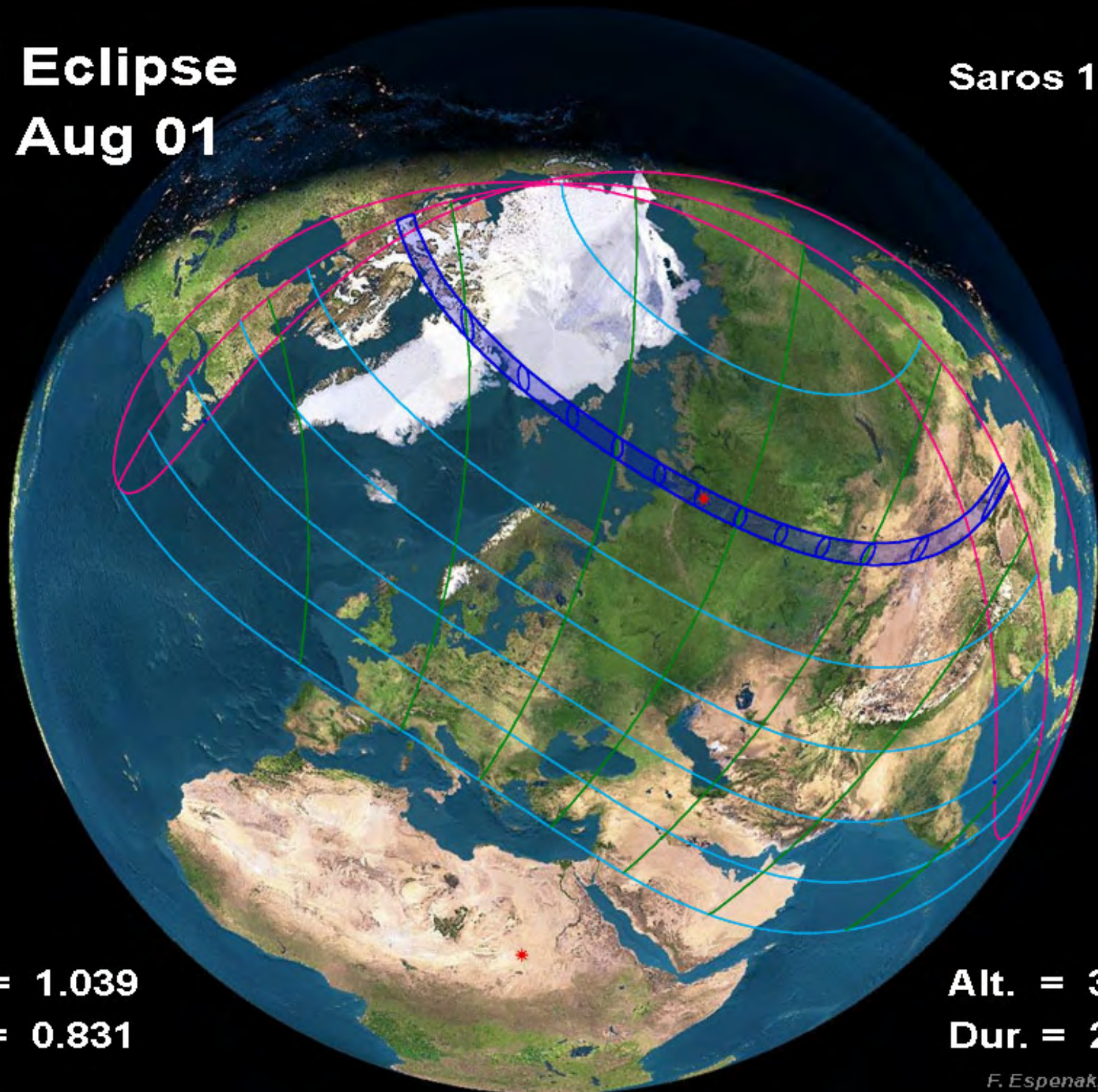
2008	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total	Target
CP	0	0	0	44.5	63	80	71.5	17	0	113	84	55.5	528.5	375
SP	128	67	67.5	21.5	14	44	22.5	0	0	84	59	91	598.5	843
OP	556.5	584.5	59.5	59.5	8	13.5	0	6	0	12.5	77	50.5	1427.5	1451
Total	684.5	651.5	127	125.5	85	137.5	94	23	0	209.5	220	197	2554.5	2669

Common Programs 2008

- World Days
 - IPY
 - Continuous at ESR 1 Jan – 29 Feb
 - CP1
 - Bi-weekly 30h runs at ESR&UHF March-Dec
 - CP2
 - QP TID
 - Quasi-Periodic Medium-Scale Travelling Ionospheric Disturbances
 - 2-3 days in April+June+October
 - CP1
 - TEC Mapping
 - ISR/GPS Coordinated Observations of Electron Density Variations
 - 5 days in July
 - CP3
 - Synoptic runs
 - Database filling
 - 1-2 days in September+November
 - CP3

Total Eclipse 2008 Aug 01

Saros 126



Mag. = 1.039
Gam. = 0.831

Alt. = 34°
Dur. = 2^m 27^s

Solar Eclipse 1 Aug 2008

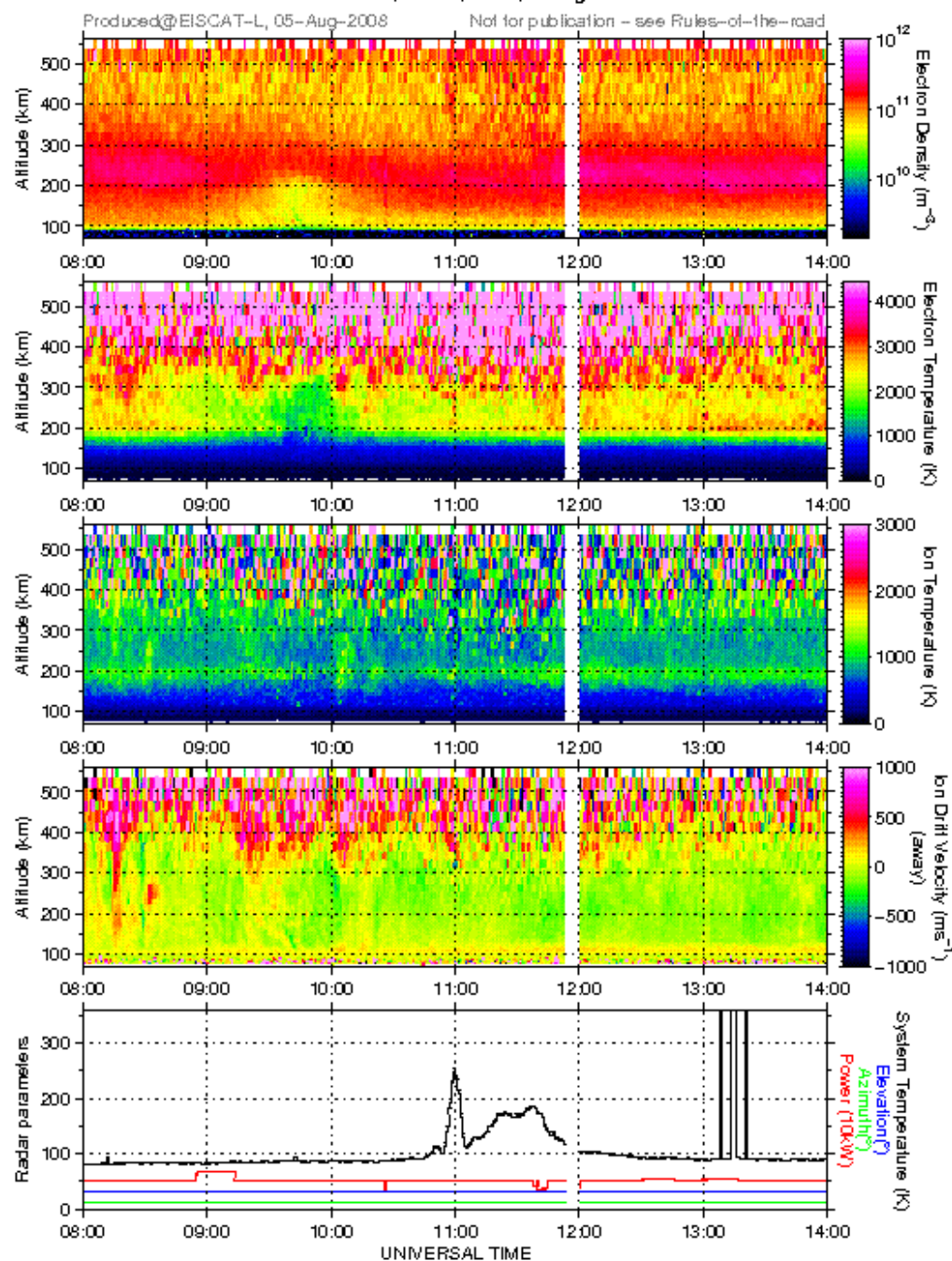
- VHF
 - beata zenith
- UHF
 - beata CP1
- ESR
 - folke lowelnorth



EISCAT Scientific Association

EISCAT SVALBARD RADAR

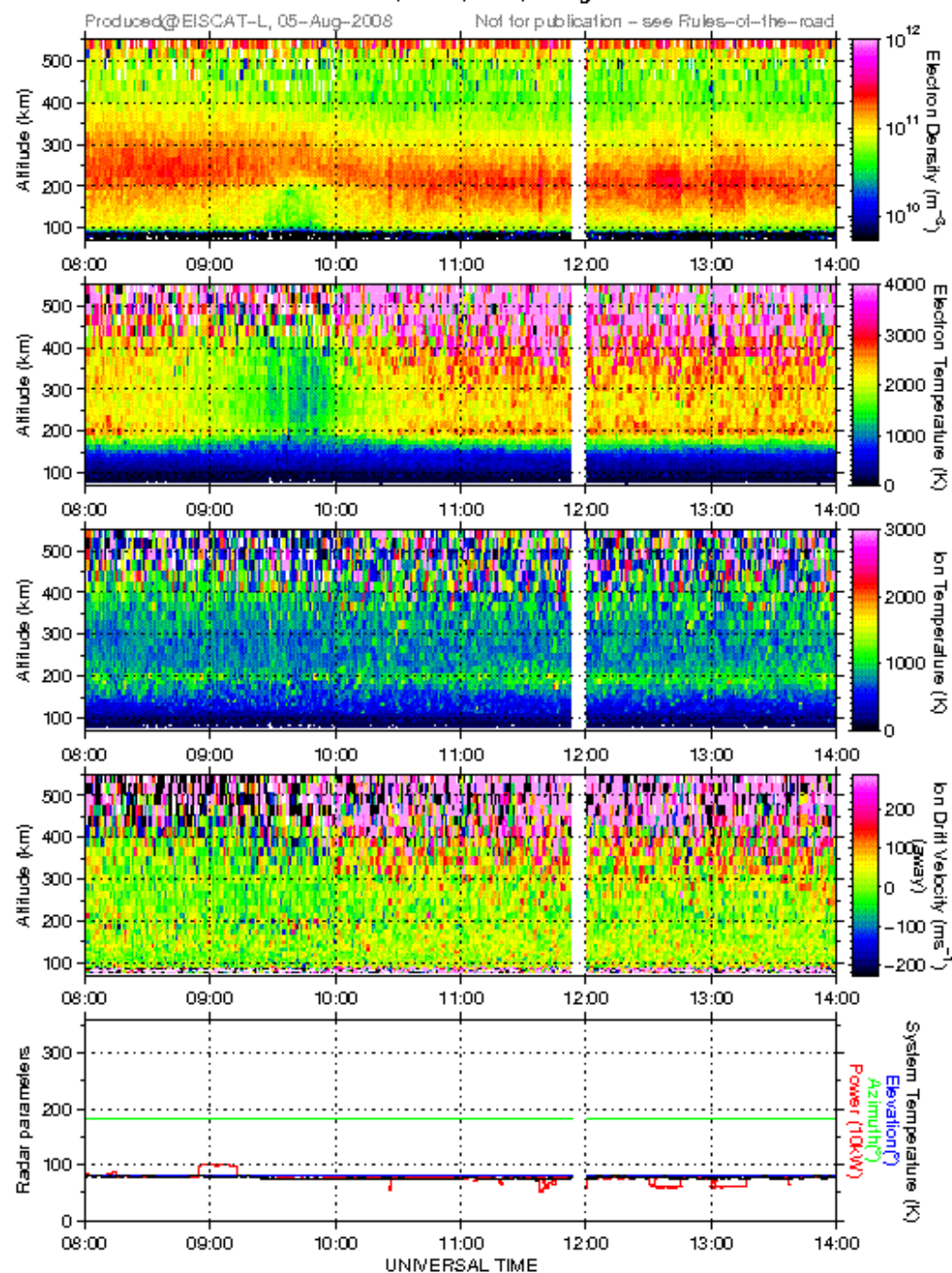
IPY, 32ma, folke, 1 August 2008



EISCAT Scientific Association

EISCAT SVALBARD RADAR

CP, 42mc, folke, 1 August 2008

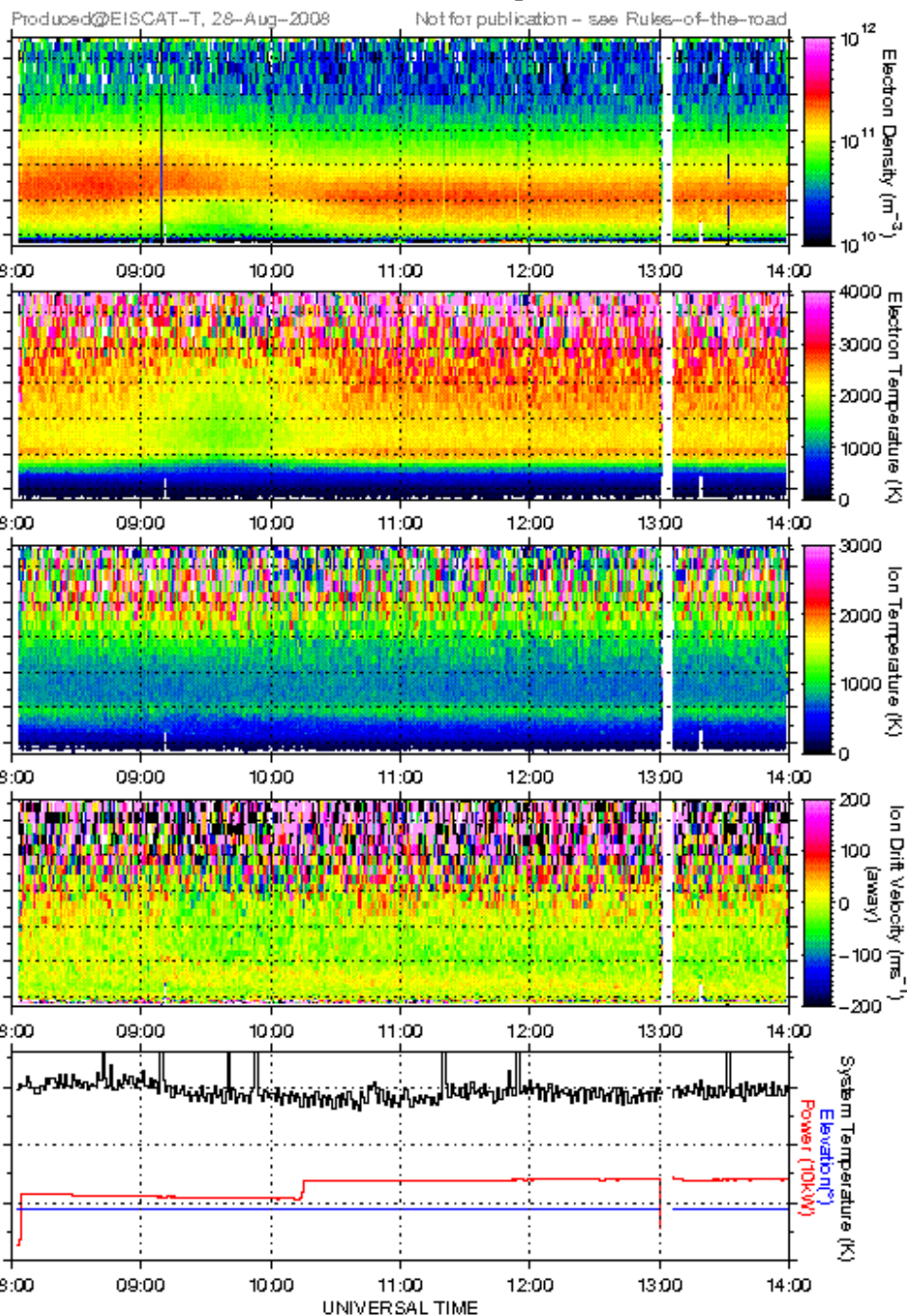




EISCAT Scientific Association

EISCAT VHF RADAR

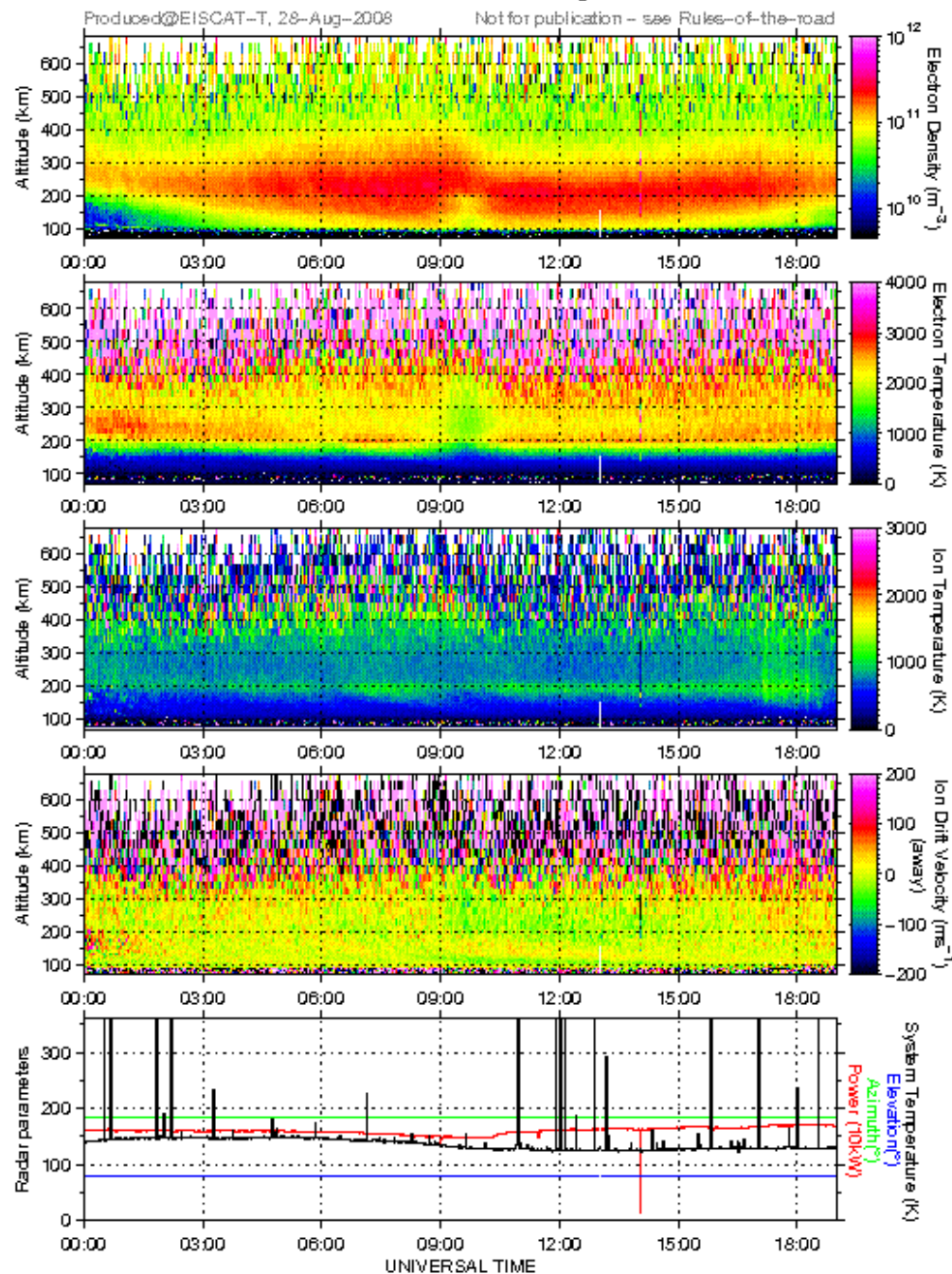
CP, vhf, beata, 1 August 2008



EISCAT Scientific Association

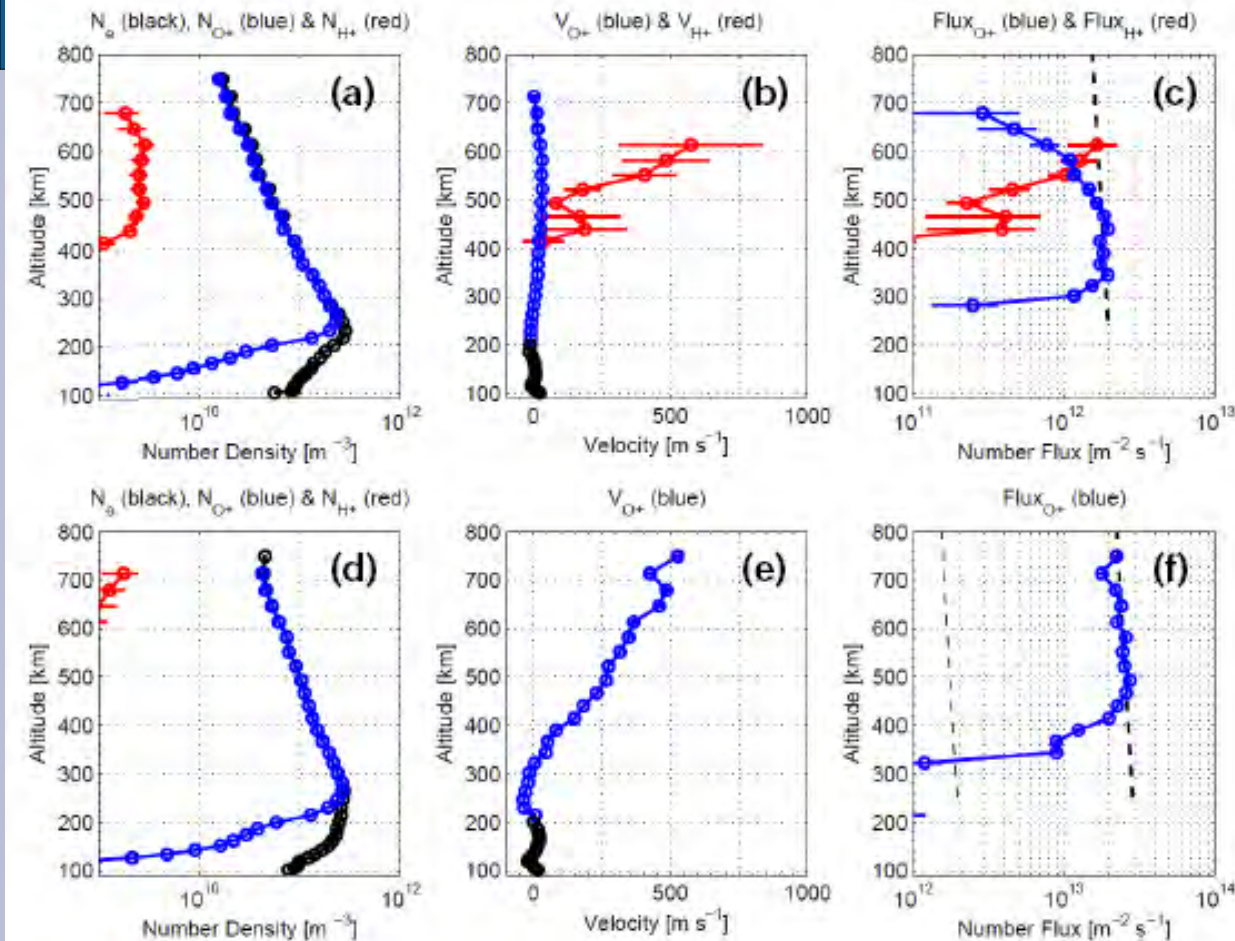
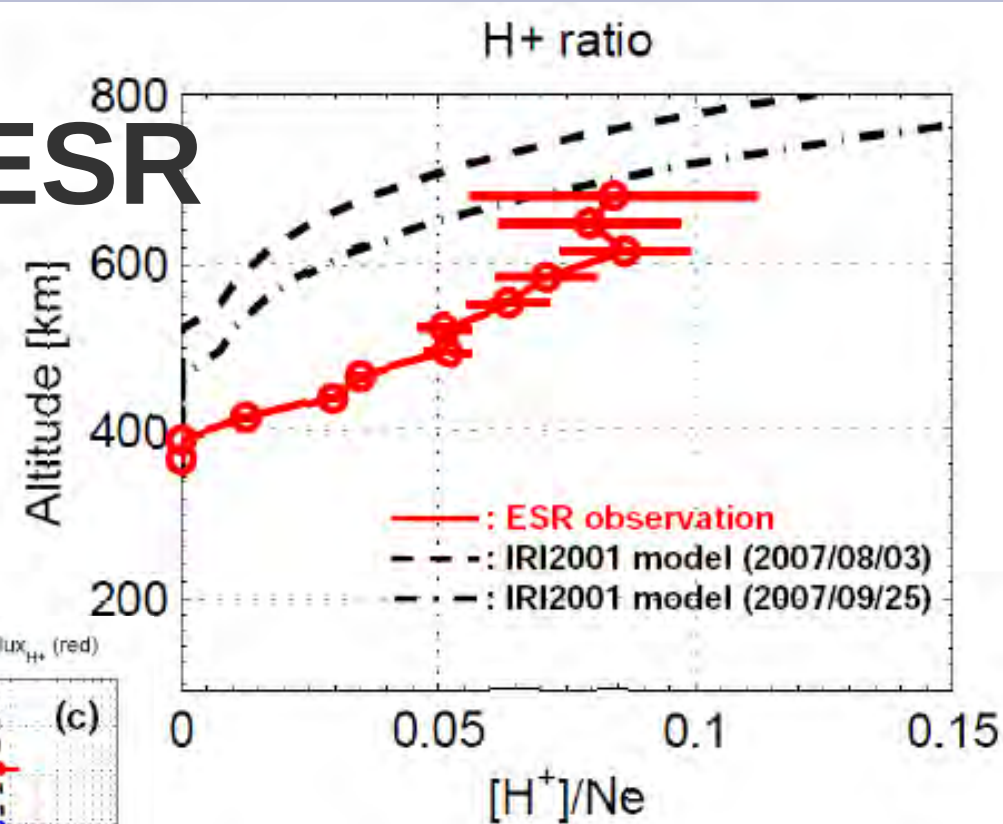
EISCAT UHF RADAR

CP, uhfa, beata, 1 August 2008



Hydrogen ions @ ESR

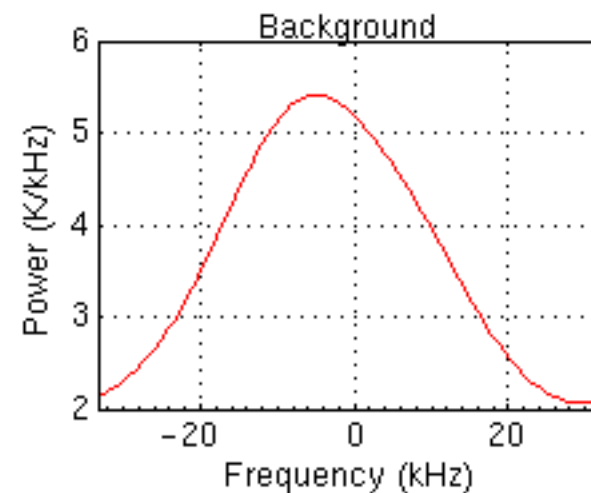
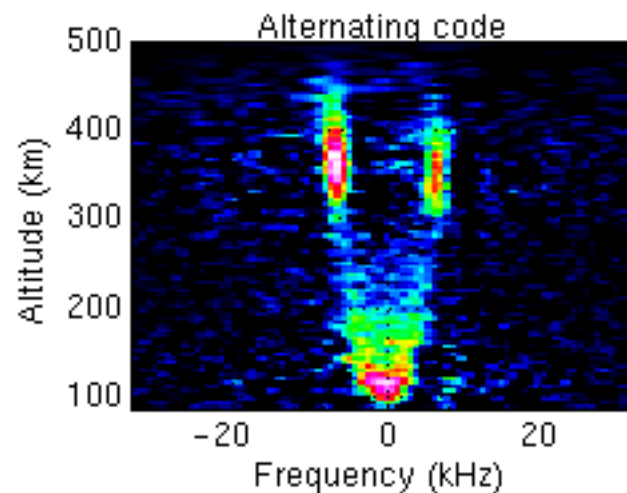
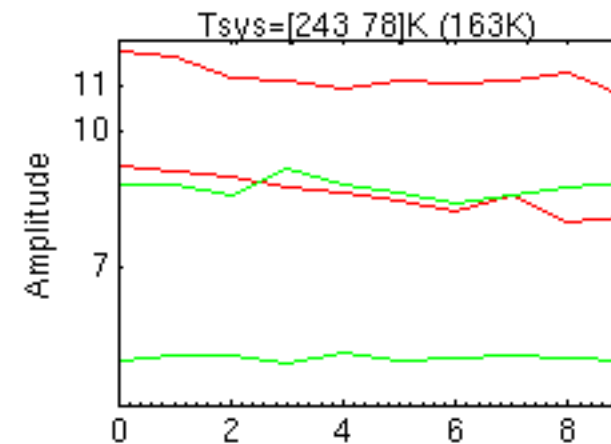
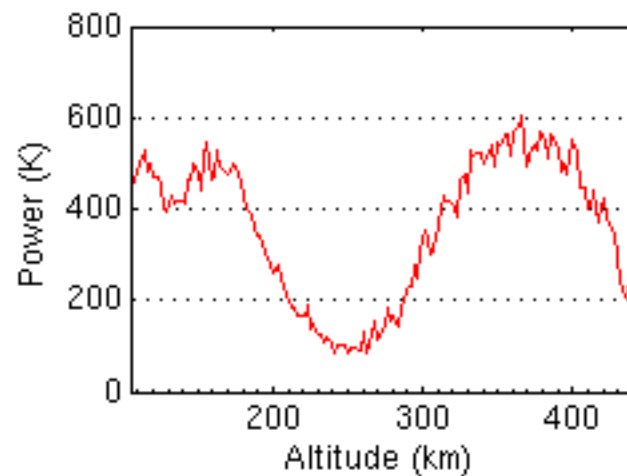
Long range + Wide filter + low densities = difficult



- One of the main goals
- H⁺ down to 400 km
- In cusp proper
 - No H⁺
- H⁺ south of cusp
 - High velocity
 - Flux conserved!

Enhanced spectra

- Usually enhancements in the shoulders
 - Above the F region peak



ISR 50 years!

- 1st reception 21 October 1958
- Bowles – Gordon
- Illinois 41MHz

Table I. Parameters of radar equipment used.

Operating frequency	40.92 Mc/sec
Peak pulse power	$(4 \text{ to } 6) \times 10^6$ watts
Pulse duration	$(50 \text{ to } 150) \times 10^{-6}$ sec
Average power	4×10^4 watts maximum
Receiver bandwidth	10, 15, or 30 kc/sec
Antenna cross section	116 × 140 meters (1024 half-wave elements in phase above ground)
Antenna polarization	north-south
Calculated antenna gain	~ 35 decibels/isotropic

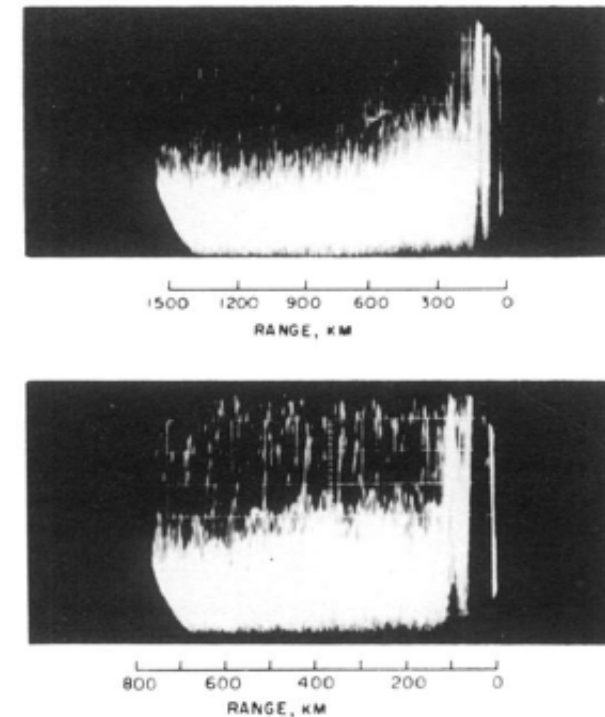


FIG. 1. (a) Pulse width 140 μ sec (21 km); bandwidth 10 kc. (b) Pulse width 120 μ sec (18 km); bandwidth 10 kc

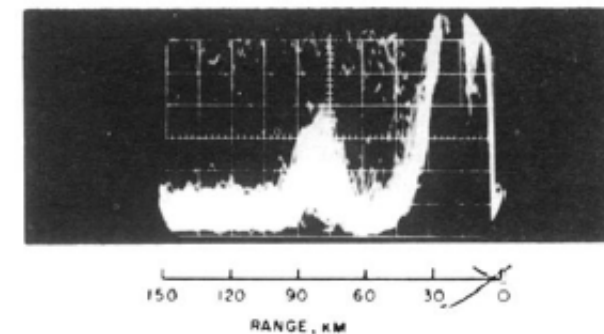


FIG. 2. Pulse width 50 μ sec (~8 km); bandwidth 30 kc

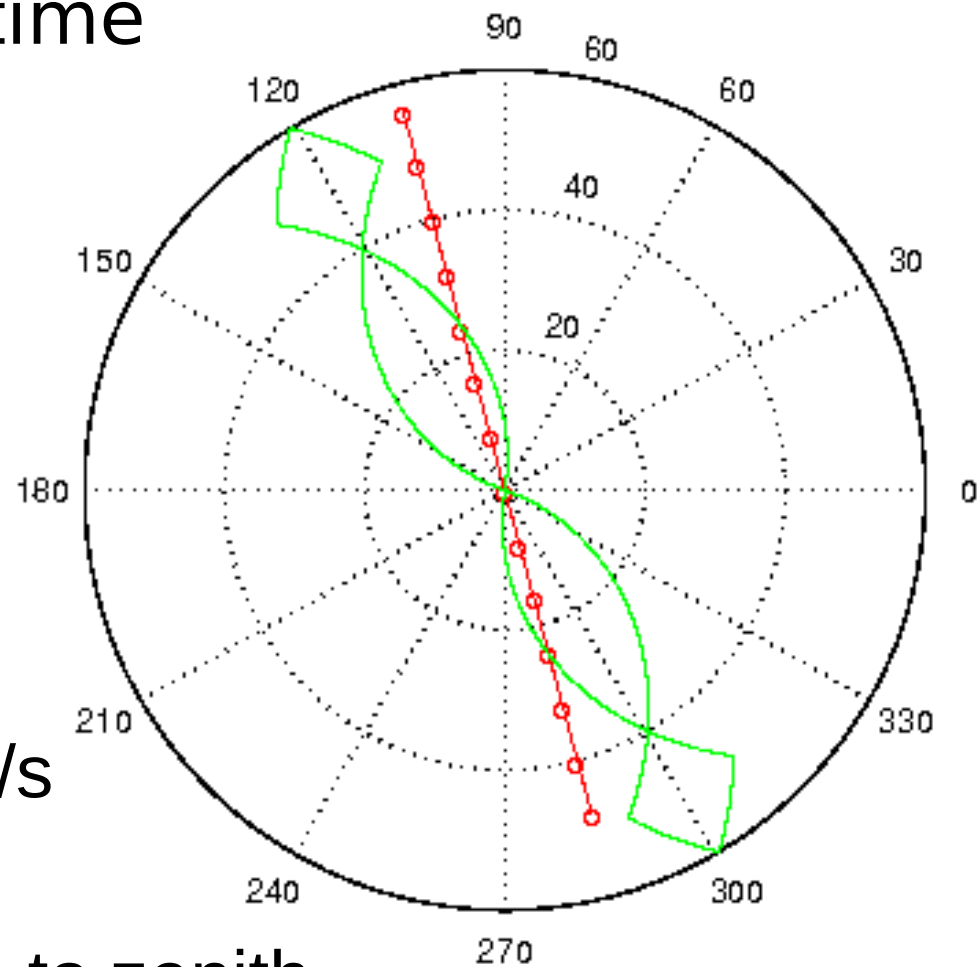
Rocket campaigns 2008

- SCIFER-2
 - Sounding of the Cusp Ion Fountain Energization Region-2
 - Launch 18 Jan 07:30 from Andøya
 - UHF+VHF +ESR
- NEMI
 - Night-time Emissions from the Mesosphere and Ionosphere
 - Launch 31 Jan 19:14 from Andøya
 - UHF+ESR (CP2) (VHF disturbed by MORRO)

Rocket campaigns 2008

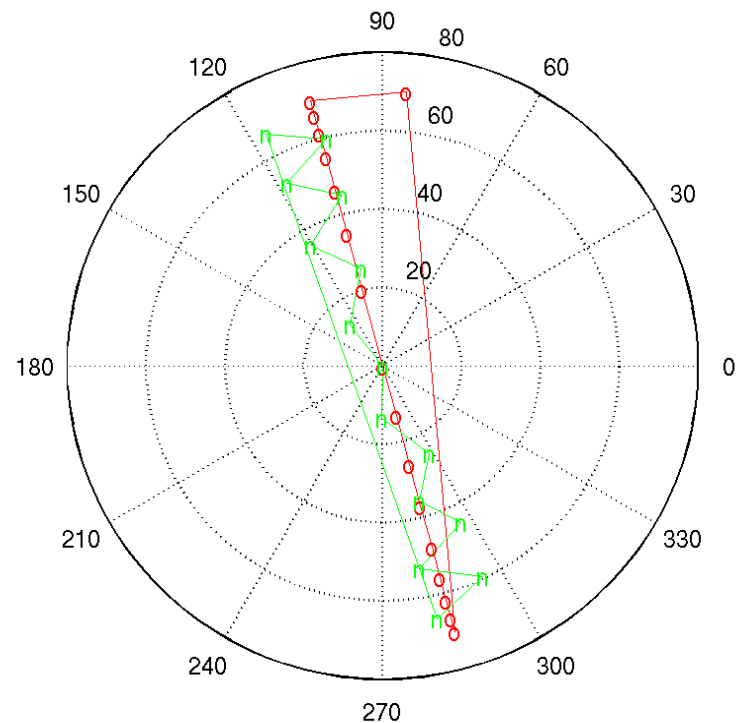
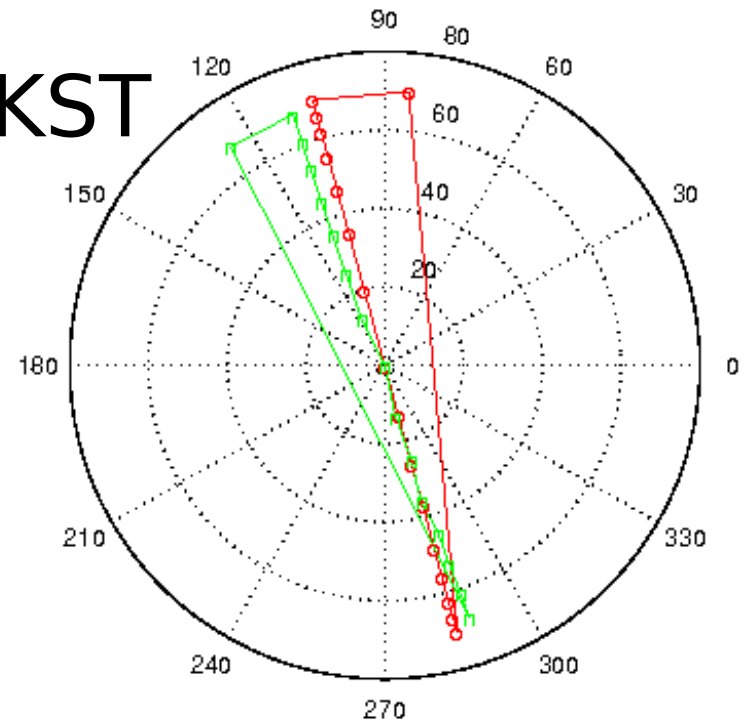
- ECOMA
 - Existence and Charge state Of Meteoric smoke particles in the middle Atmosphere
 - Launch 30 June + 2130 7 July + 1046 12 July
 - VHF + None + VHF/UHF
- ICI-2
 - Investigation of Cusp Irregularities
 - Launch 5 Dec 10:35 from Ny-Ålesund
 - ESR + UHF (CP2)

- ESR convection scan
 - Tools exist
- Sweep
 - Free integration time
 - Adjustable
- E-W motion
 - **E** fields
 - E region currents
 - Tides
- taro/folke
 - 24' scan = 0.16 °/s
 - Lubrication free
 - Use also 42m close to zenith



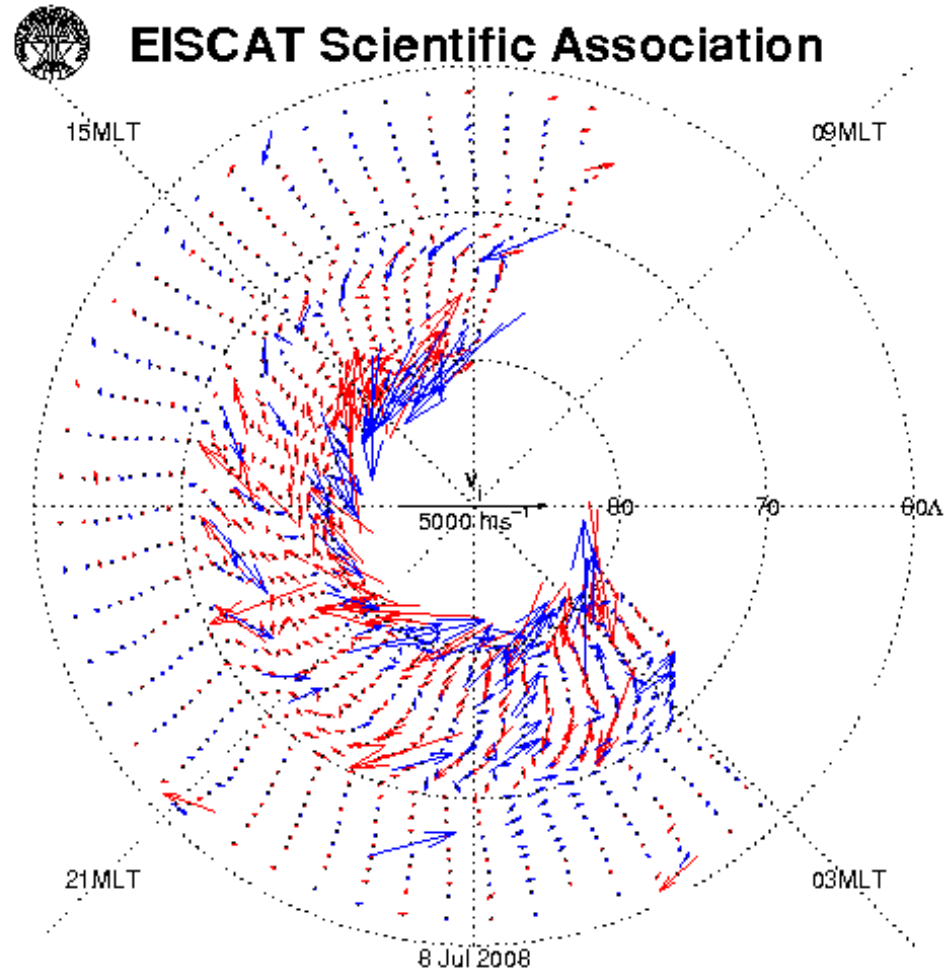
New CP3 KST

- Radiation hazard
- Geomagnetic north
 - 20° W
- Meridian between T-K
 - Rotate above T+K
- Future
 - monostatic
 - Add E-W motion
 - Also E region velocity map



Multisite vectors

- CP3
 - ESR
 - UHF
 - KIR
 - SOD



Other stuff

- Moon scatter
 - wrapped image
 - Juha?
- Earthquake
 - 20 Feb, IPY
 - Very popular subject
- Doritos
 - 6 June, Ad to the stars
- Meteors
 - more than 1000/h

2009 plans

- Less than 2008
 - No IPY
 - ESR/UHF
- HF
 - Russia
 - Radar
- Offset budget time limits?
 - Nov/Dec heavy months
 - Associates spend remaining hours

2009	Target	2008
UHF	808	1305
VHF	315	395
Heating	237	217
Passive UHF	2222	2302
ESR	1246	2542
Passive ESR		48

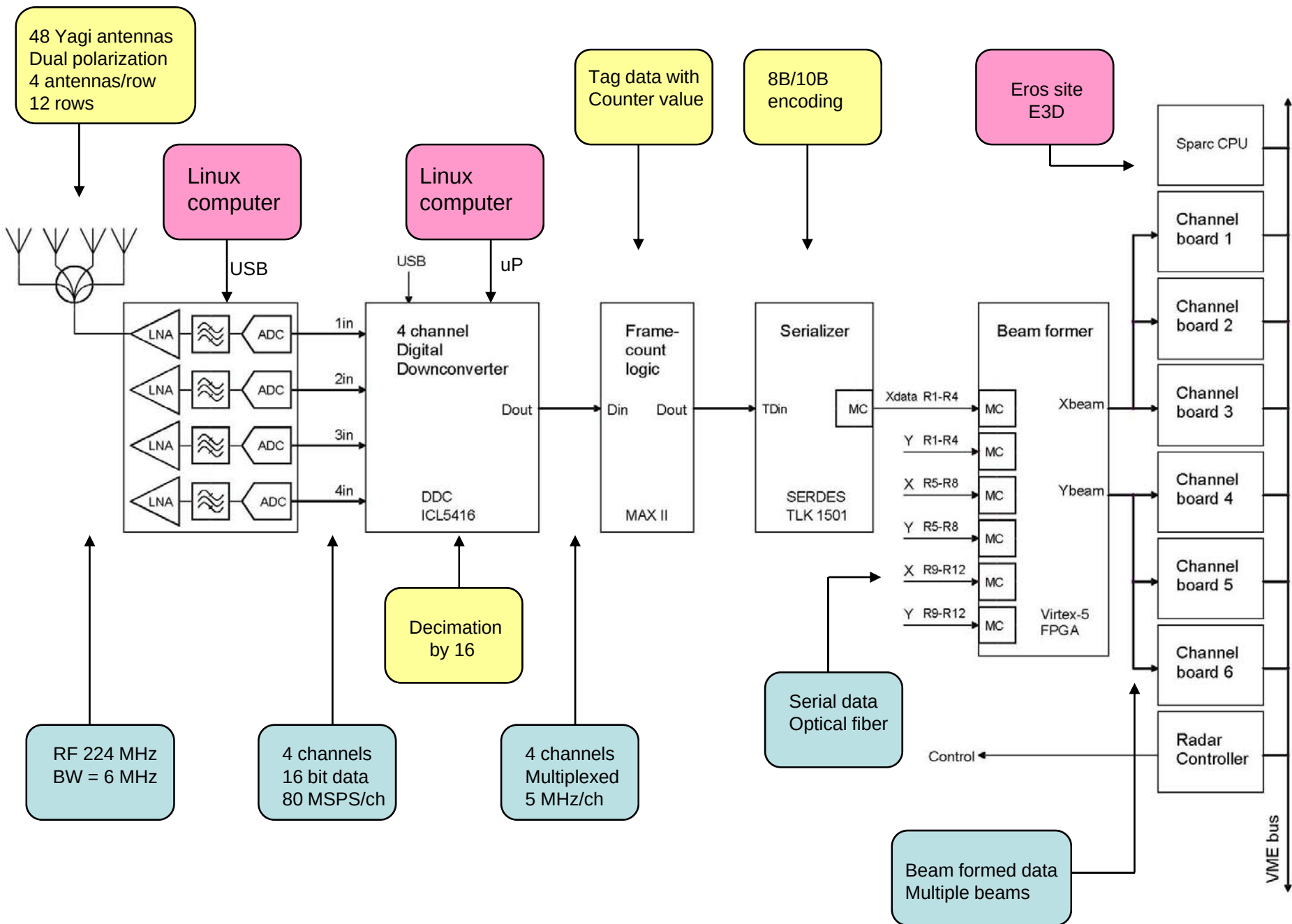
Common Programs 2009

- IPY
 - 8+22 Jan, 19 Feb, 1d
- TID
 - 4 Feb, 12 May, 15 Sep, 2d
- Meteor
 - 22 June, 1d
- PMSE
 - 23 June, 2d
- TEC
 - 7 Dec, 5d
- Stratospheric warming or Wind reversals
 - Alert Feb, 10d
 - Alert Sep, 10d

EISCAT_3D

Demonstrator Array





Yagi antenna



Dual polarization

6 + 6 elements

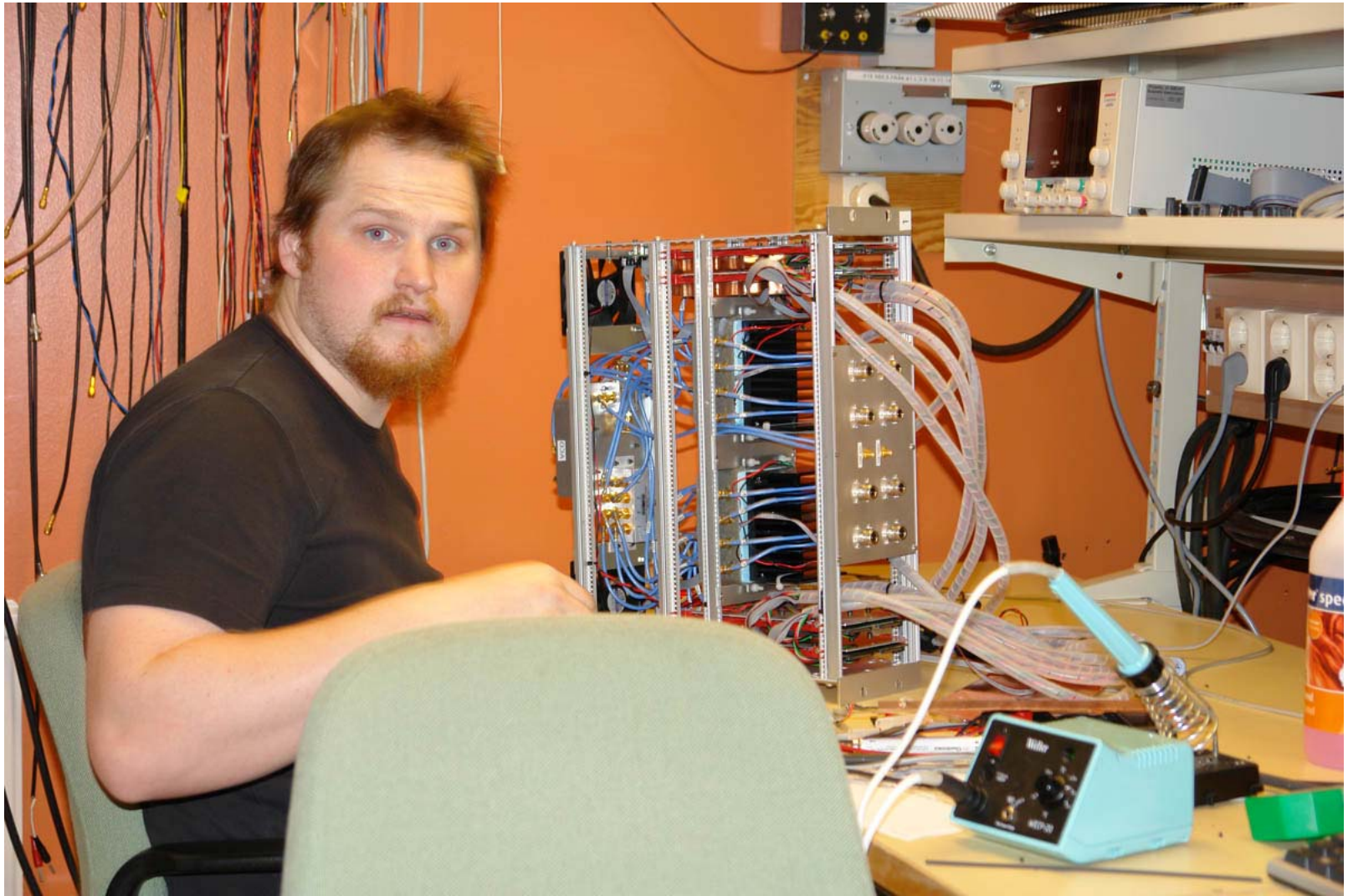
Gain = 11 dBi

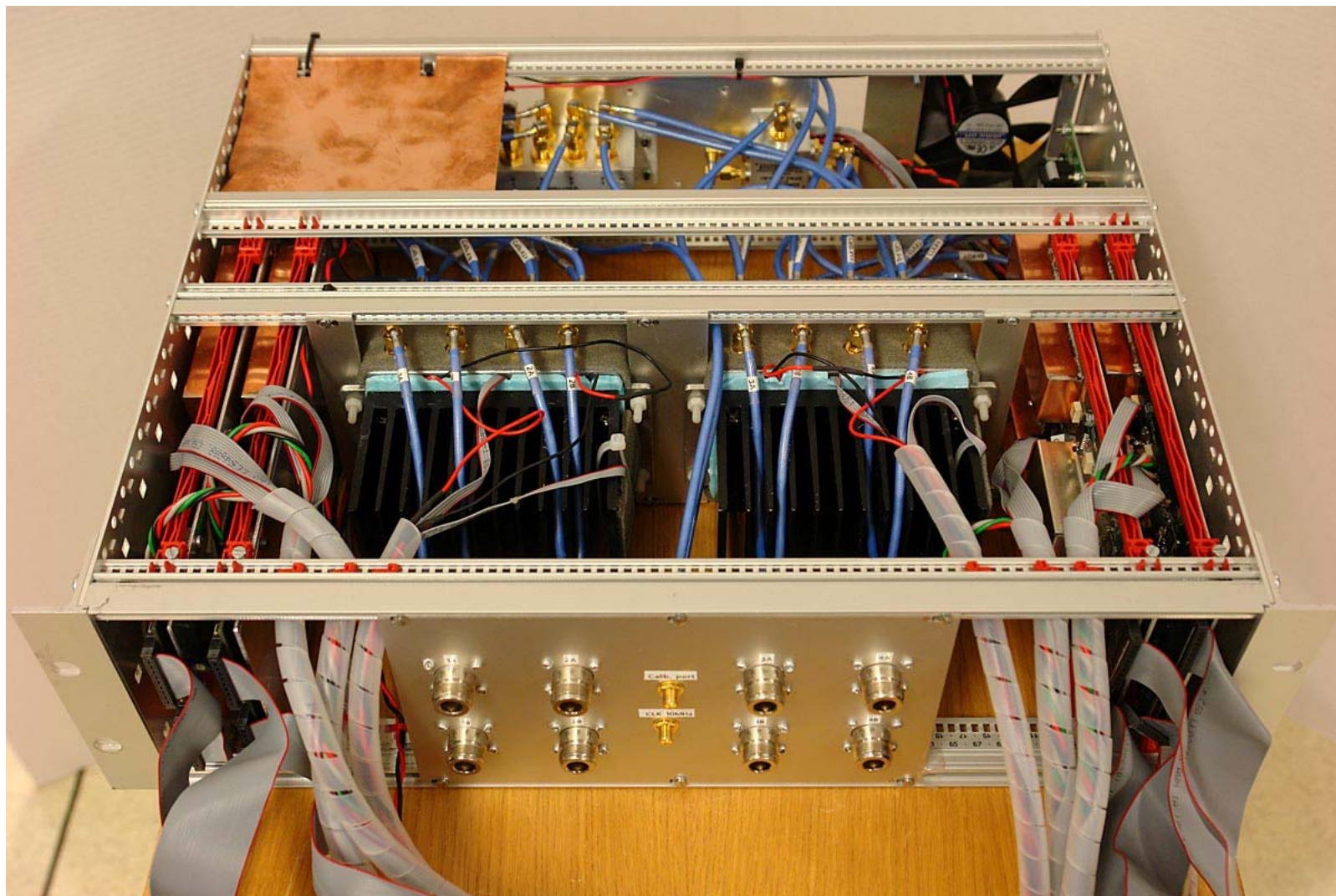
$F_c = 224 \text{ MHz}$

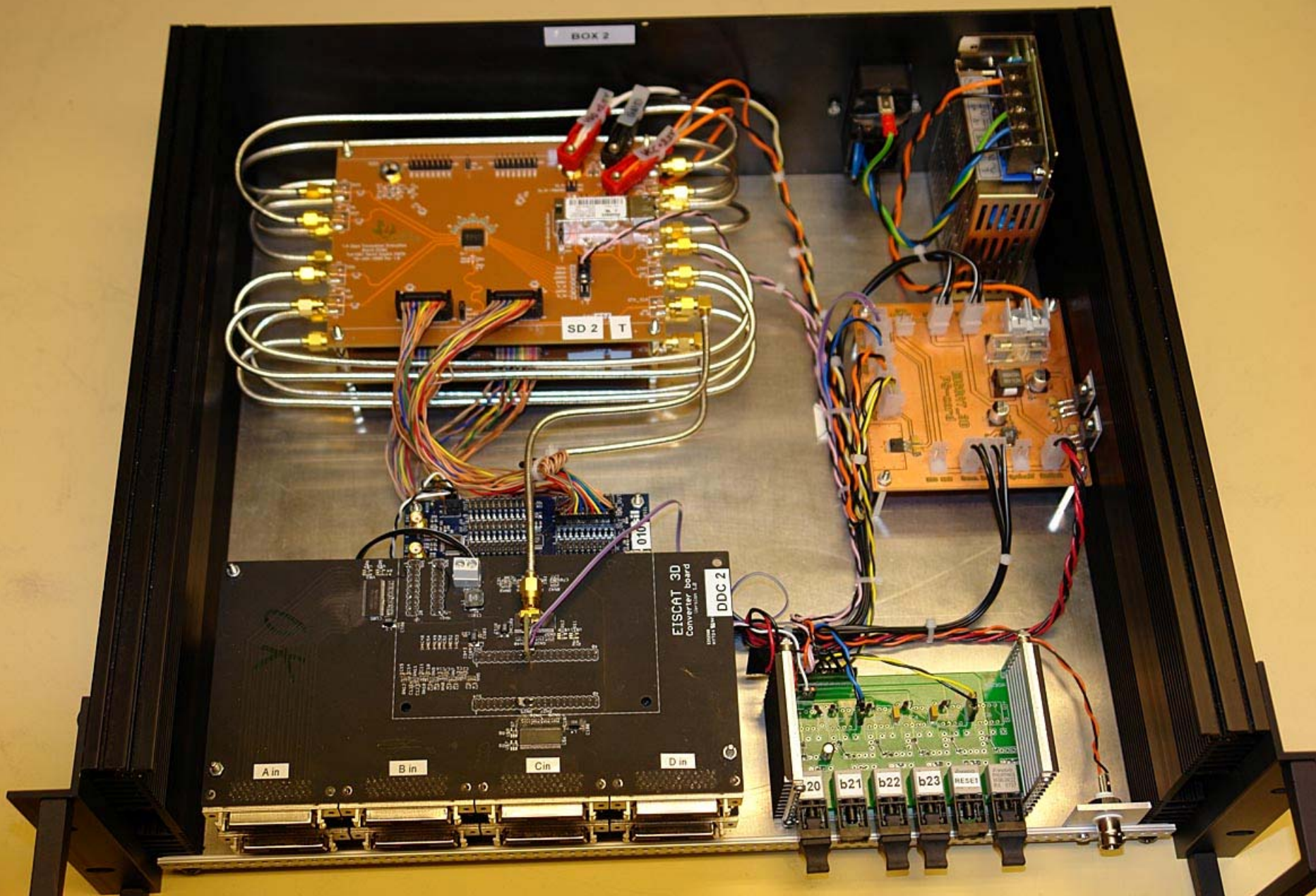
$BW = 6 \text{ MHz}$

55 degree elevation

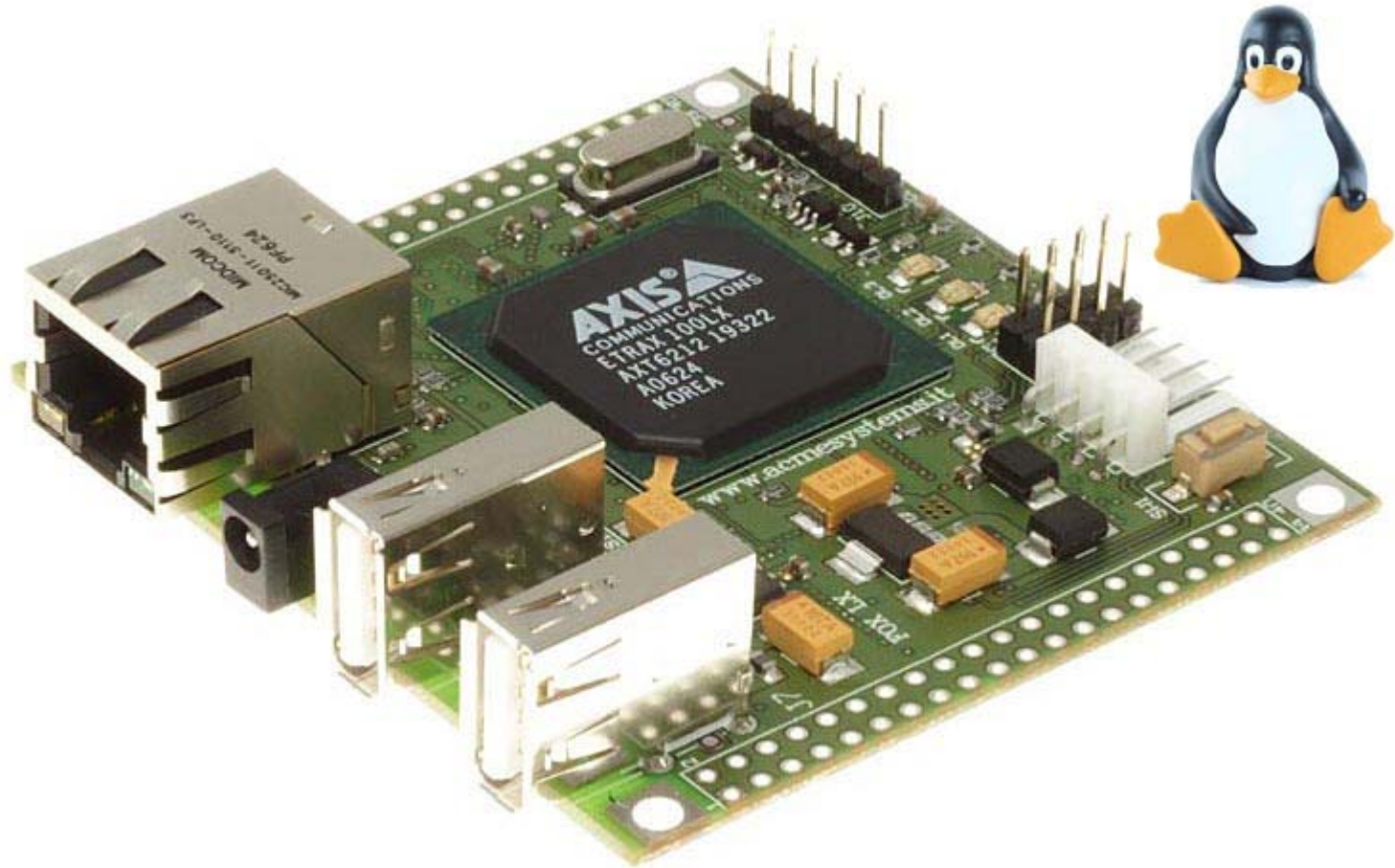


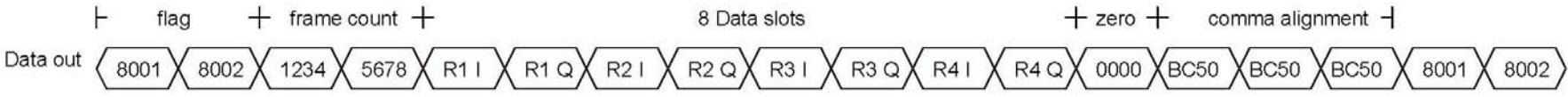
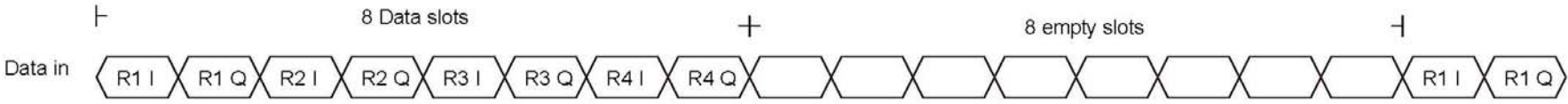






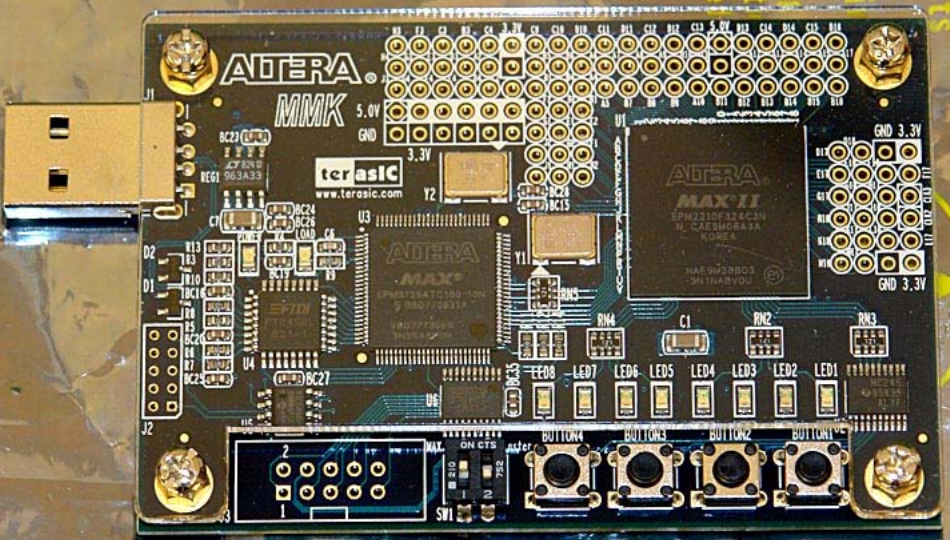
Fox Board LX832 a complete Linux system in just 66 x 72 mm

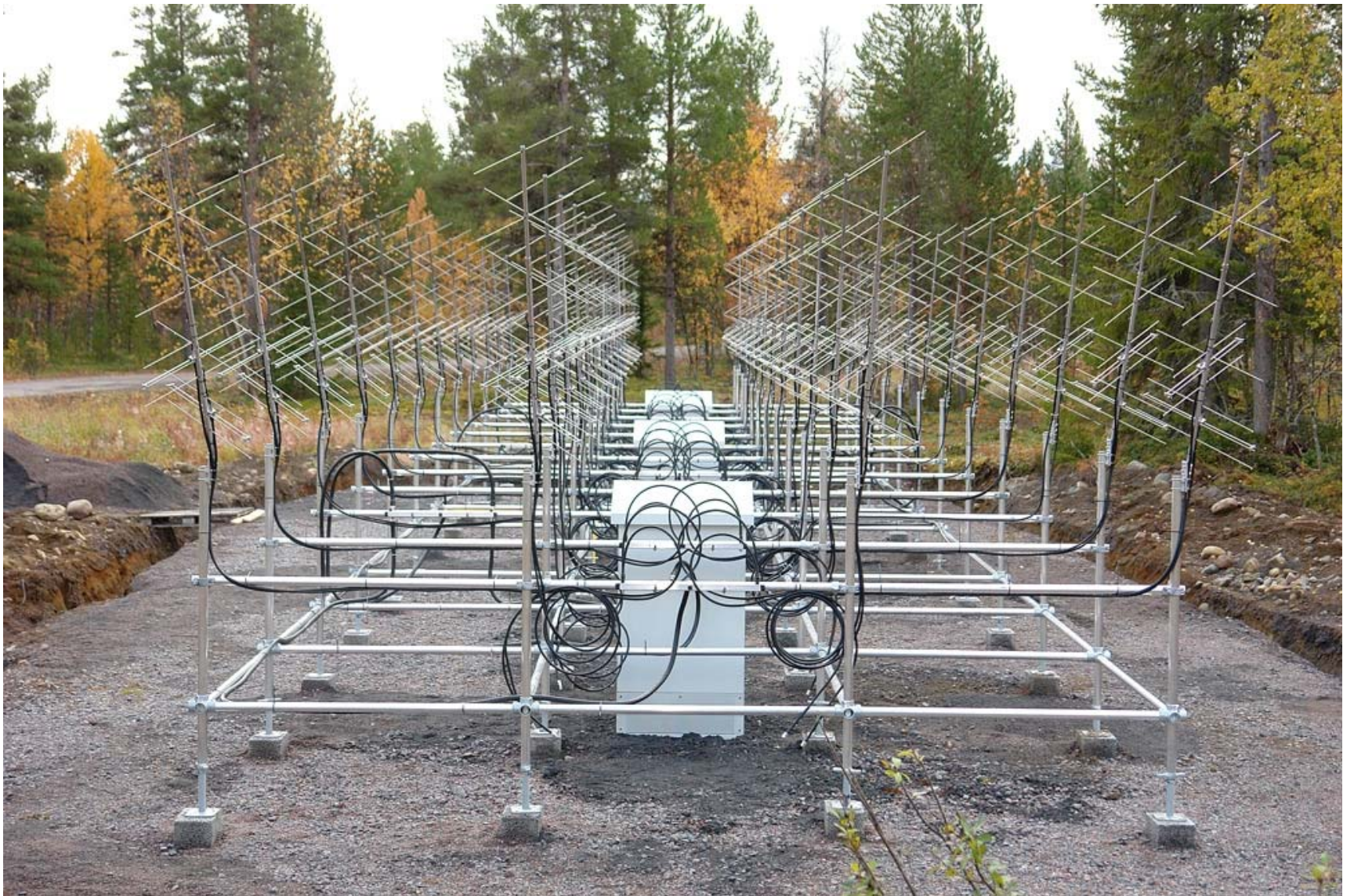




ATTENTION
Contents
Static
Sensitive
Handling
Precaut
Require

SCC 1000
Static Shield Bag



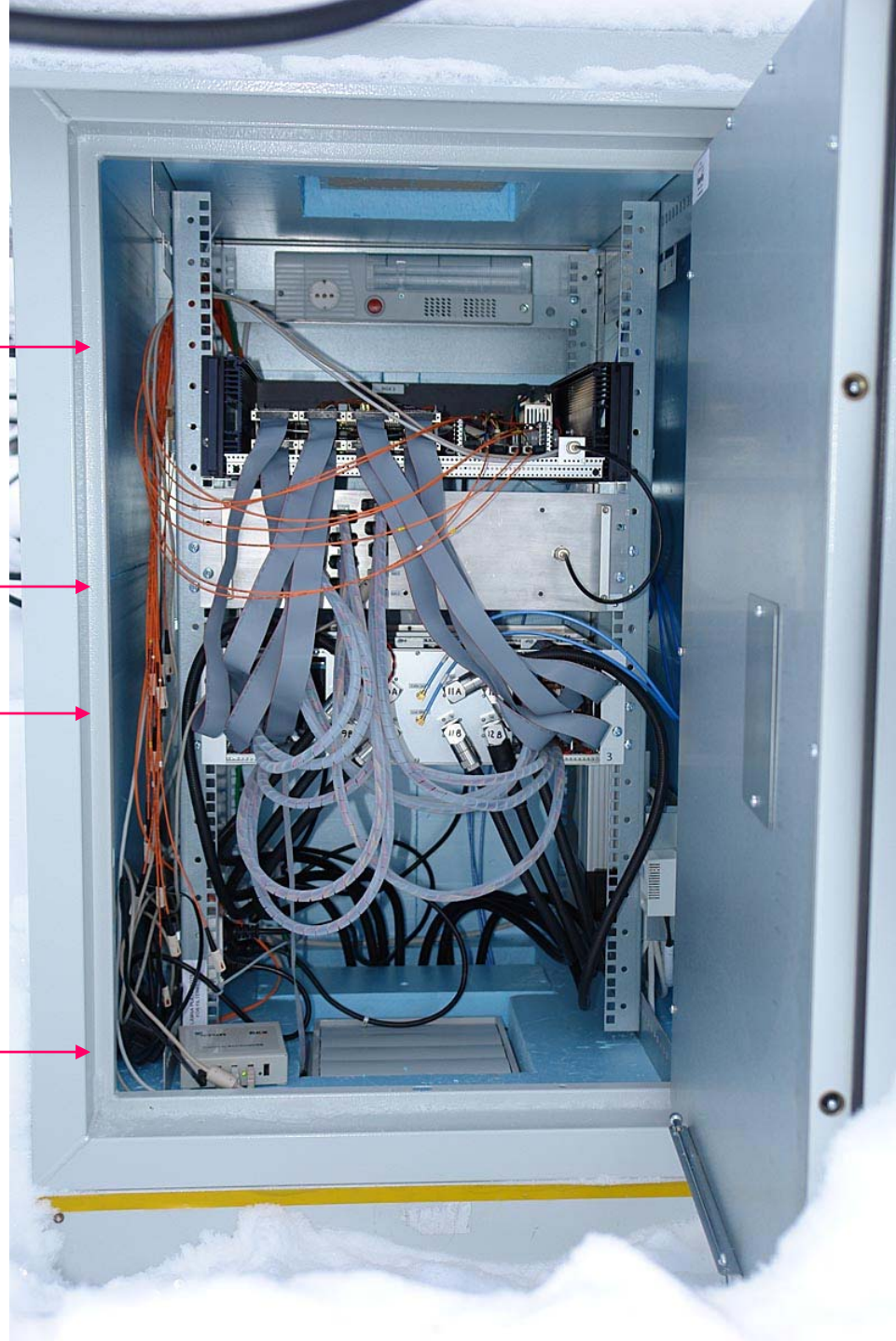


DDC/SERDES Box

Power Supply
Control board

LNA/ADC

USB hub





EISCAT
SODANKYLÄ 2000
CHANNEL BOARD
Ver 1.4

93 HLO-4 94V0

E3D_BF_V1

NDDOPEEL

DCCOPEEL V1.1

32K642700L100
814400P1 U2A
5100

32K642700L100
814400P1 U2B
5100

venabili

“making the raw data access really elegant”

Working brief

“The planned work should include installing and integrating the machines, setting them up so that they are visible and usable by the user community, and making some progress on making the raw data access really elegant so that users can really exploit the resources of both the archive and the machines.”

Tony van Eyken, 14 July

The planned work should include...

- installing and integrating the machines
- setting them up so that they are visible and usable by the user community
- make some progress on raw data access
- then make some progress on making the raw data access really elegant
- really exploit the resources of the machines

So, what's in the box?



- Networking stuff
- 2 storage servers
 - 2 Opteron 270 CPUs
 - 4GB RAM
 - 4 x 400GB SATA HS drives
- 2 process servers
 - 2 Opteron 270 CPUs
 - 4GB RAM
 - 4 x 400GB SATA HS drives
- 2 Xen servers
 - 2 Opteron 270 CPUs
 - 5GB (10GB?) RAM
 - 2 x 80GB SATA HS drives

Installation: overview

- Storage

- flexible

- Processing

- Use available power
- Xen virtual machines

- More processing

- Scalable and extensible

- Management

- Control
- timely reports

But keep it simple:

- Duplication not redundancy
- Established technologies:
 - Redundant DHCP
 - NIS
 - NFS
 - Ethernet, TCP/IP
 - SCSI
 - Affordable and available components

Xen

- Single physical box supports multiple virtual machines
- Easily and quickly create new virtual machines
- Migrate for maintenance, load-balancing
- Snapshotting
- Play with configurations and resources

Installation: storage

NFS shared storage for data, user areas etc

- Heartbeat (High Availability)
 - Manages NFS server, ensures always running
 - Manages IP address for NFS server
- LVM
 - Manage disk space
 - Take snapshots for backups
- DRBD
 - Immediate replication of data to other server
- Software RAID
 - Combine several disks as one big disk

Installation: more storage

SCSI disks available to Xen virtual machines

Server-side

- iscsi-target
- DRBD
- LVM
- Software RAID

Client-side

- Unix file system
- Xen device
- Multipath
- Open-iscsi

A working platform

- Webserver
 - MoinMoin, python-based
 - Forms package
- Login server
 - SSH
- MySQL server
 - All parameter blocks (80 bytes)
 - Federated Archive
 - Activity log
- Nis server
 - Accounting information
 - Groups and UserAgent
- Mailer
 - User notification
 - Monitoring and reporting
- Grid server
 - Sun's Grid Engine

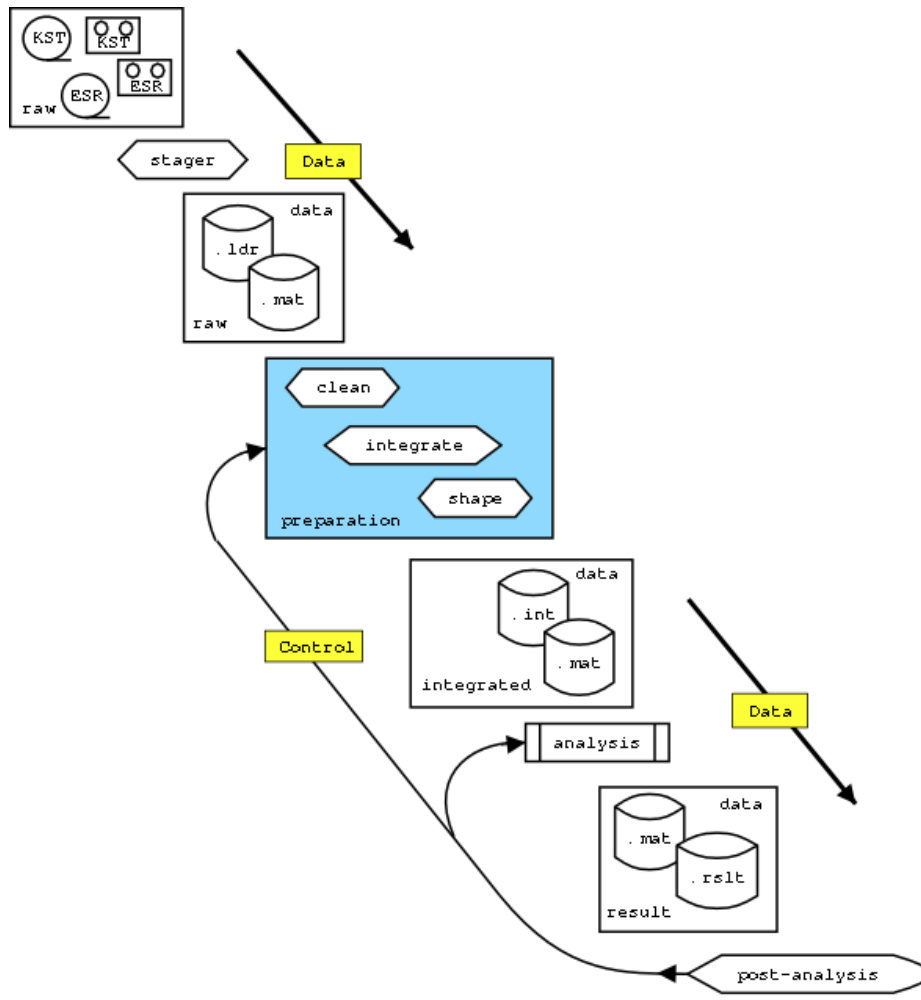
So what makes it elegant?

metadata

data about data

guisdap initialisations

How do you use it?



- RAL software
 - All to be installed!
- Pipelined nature
- Swap in users' own programs
- Mostly documented and tested

Venabili application highlights

- Database with parameter blocks
 - Multi antenna experiments entered separately
 - Integration possible through database
- Fetching data from archive
 - Requests for any data
 - Copied to local stager space, could export?
- Guisdap v8.5 ported to Octave v3.0
 - Initial comparison of results is good
 - No performance details
- First cut at metadata
 - Generate ACF's, need fractionality. Hmm.

Work in progress

The d-layer analysis program

- an old Fortran program
 - has an API for Matlab files and parameter blocks
- Lots of D-region data, esp. IPY
- Shows how Venabili works
- Made lots of assumptions
 - esp. about use of metadata...

What's next?

(next 2-3 weeks)

- Metadata and ACF's
 - Generate ACF's (spectra!) from lpm's using data from metadata database
- Restore website!
 - Summary overviews
- Populate database
 - Automatic update of new data, one year behind?
- A real, working demonstration
 - Probably with guisdap?

What's later?

(a month or so)

- The D-layer program
 - Needs metadata fixing to generate ACF's
 - Need some proven/published test results to compare with
 - Problem is old program hardwired for CP6
- Integrator
 - Select data from database for integration
- Queues
 - Utilise Grid Engine for integration and analysis
- Monitoring and reporting
 - Monitor subsystems and pass reports on up

And finally...

Document and handover!



European Strategy Forum
on Research Infrastructures

ESFRI

EUROPEAN ROADMAP
FOR RESEARCH
INFRASTRUCTURES

Roadmap 2008

>Environmental Sciences

EISCAT_3D – The next generation European incoherent scatter radar system



The facility:

EISCAT_3D is the upgrade of the existing EISCAT (European Incoherent SCATter) facility, which provides state-of-the-art radar facilities to study various processes taking place in Earth's atmosphere. These studies can help understanding the formation and evolution of our own, and other, solar systems.

ESFRI Roadmap political decision Dec 2009 carries us into the future

- staying on the map is not self-evident
- project advance is reviewed regularly

Background.

EISCAT_3D will be a major upgrade/replacement of the existing infrastructure that will improve the range of available data as well as the temporal and spatial resolution of data. This upgrade is based on an ongoing design study. EISCAT is a facility for studies of both fundamental physical processes and environmental issues such as space weather. The upgraded facility will provide high-quality ionospheric and atmospheric parameters on an essentially continuous basis for users as well as providing near-instantaneous response capabilities for those users who need data to study unusual and unpredicted disturbances and phenomena in the high-latitude ionosphere and atmosphere. The present members of the EISCAT Scientific Association are China, Finland, Germany, Japan, Norway, Sweden and the United Kingdom.

What's new? Impact foreseen?

The EISCAT_3D radar system is heavily modular and lends itself to phased construction, both on the large scale, where the multiple radar sites can be constructed either sequentially or in parallel, and on a smaller scale where individual sites are made up of very large numbers of identical elements clustered into larger and larger sub-systems until the full system driven by the scientific requirements has been constructed. This design feature allows great flexibility in the implementation of the construction phase; the system will provide unique monitoring capabilities from a relatively early point in the construction though the more difficult scientific goals so far identified can only be addressed with completion of the full system.

The new facility will greatly extend the range of available data, improving its temporal and spatial resolution by about one order of magnitude as well as the geographic, altitude, and temporal extent. The goals for real time data availability place extreme demands on both data distribution and data storage and will exploit and extend European expertise in ultra-high bandwidth data distribution amongst large numbers of simultaneous data providers and users.



Photos by T. J. J. J. J. J.

Photos by Lars-Göran Karlsson

»Environmental Sciences



SIAEOS – the Svalbard Integrated Arctic Earth Observing System

The facility:

SIAEOS is the upgrade of the present infrastructure and research activities on Svalbard to become an Integrated Arctic Earth Observing System. SIAEOS integrates the studies of geophysical, chemical and biological processes from all research and monitoring platforms – land, sea, ice/glacier and atmosphere/space based – thus responding to a highly relevant need to monitor global environmental change. The research infrastructure is mainly European, with the presence of a large number of research institutes and a broad and interdisciplinary user community from all over the world. SIAEOS offers unique opportunities for education and training of young scientists, since the operational centre will be integrated with the international University Centre in Svalbard (UNIS).



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ESR is an essential part of SIOS (note: new abbreviation)

Background.

Svalbard's geographical location and extensive research infrastructure provides excellent opportunities for studies of ecosystem changes and their effects on the food chain, oceanic and atmospheric transport patterns which prevail in the Arctic region, integrating observations and analysis of the changing Arctic ice cover, unique studies of the energy balance between layers of the atmosphere, from the borders of space to the surface of Earth and for dense satellite monitoring. The impact of climate change, pollution and other pressures on the environment appear sooner and with more severe consequences in the high Arctic than in regions at lower latitudes. The high Arctic can therefore be seen as an early warning region.

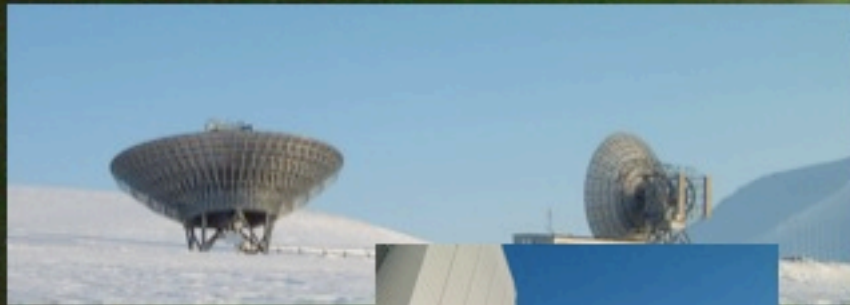
What's new? Impact foreseen?

As an observation platform, SIAEOS will be complementary to projects like SAON (Sustaining Arctic Observing Networks), and could be developed as a major hub in the SAON system. SIAEOS will establish a framework of database and meta-database tools offered to the circum-arctic and European research communities. The database services will aim at the full and open access and exchange of the temporal and spatial resolved data within multiple disciplines which constitute the 4 dimensional SIAEOS knowledge base. A portal for online earth observation system (EOS) data in Svalbard will be offered in close collaboration with the European and circum-arctic research community, as well as in close coordination with and links to global and circum-arctic initiatives and databases like AMAP Thematic Data Centres, GEOSS and a number of other relevant networks and repositories for arctic environmental data.

Svalbard is already a strong research site with large scale research facilities and many medium-size laboratories, the international university and the necessary support structure to host international research consortia. The proposed "link" would not only underline the leading role of European institutes in polar research, but it would also highlight a successful EU-Research policy. The global research presence is based on a general open-door policy and the Spitzbergen-Status.

EISCAT 3D - Next generation Incoherent Scatter Radar

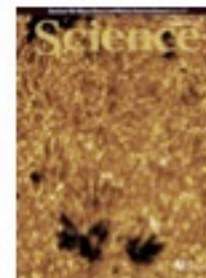
European Incoherent Scatter Scientific Association



Esa Turunen

EISCAT Scientific Association, Kiruna, Sweden

Background



- EISCAT today is a world-class success story of international science collaboration
 - Cutting-edge science development
 - Good publication record in space sciences, with respect to investment
 - ~60 publications 2008
 - Successful renewals of technology were performed in history
 - *Large collection of existing and new science opportunities by ISR listed in the current EISCAT SOC 5 yr and 5-10yr documents, as well as in the original EISCAT 3D proposal to EU*

BUT

- With increasing costs, facility overgrown to be sustained profitably for long as such
 - Although EISCAT is succesful in operations, staffing is now in the lower limit
 - Associates do have a funding pressure
 - ISR as such is maybe not regarded as novel
 - Public awareness of the importance of ground-based space science is low.



UHF probably fully operational only in 2009

- Last year of EISCAT tristatic UHF operations
 - Mobile phone networks occupy the band
 - IPS observations at 1.4 GHz can't support remotes as a science case
 - Consider focal plane phased array in another frequency (separate project by users)
 - Staff effort towards constructing EISCAT3D



Fully operational now and in future - ESR!

- ESR offers associates a continued science platform
- Excellent example: the IPY one year run data!
 - Support and gain from infrastructure development in Svalbard
 - The proposal for a 3rd antenna by China
 - Investigate adding steerability of the beam to ESR fixed antenna
 - Continue international ISR collaboration
 - RISR coordination important
 - RISR start early 2009?



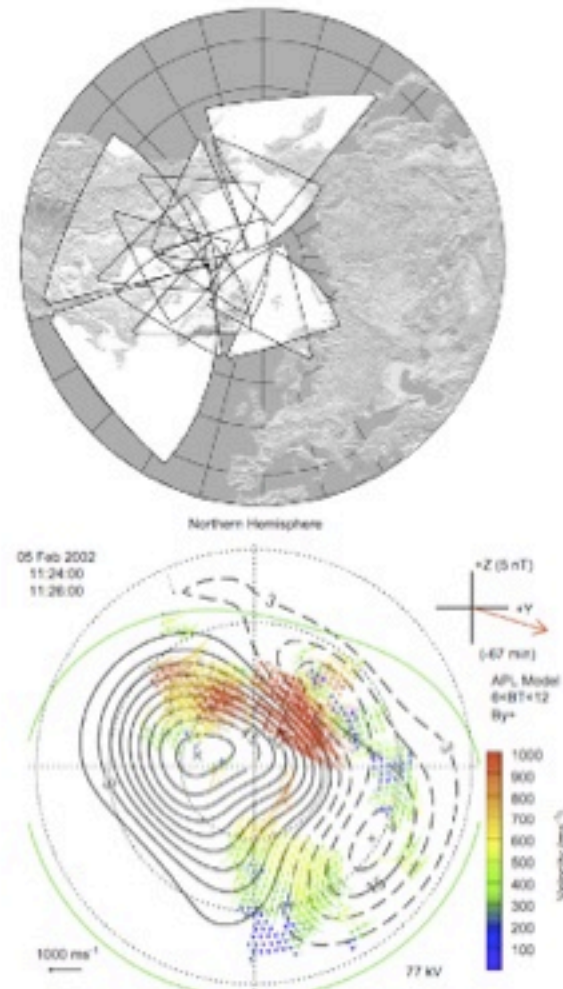
EISCAT Heating

- World-class opportunity
 - Hardware upgrade
 - Still novel physics waiting!!!
 - Supported by VHF
 - Monostatic UHF beyond 2009-2013 at least
 - Radar applications
 - Multiple uses simultaneously
 - Dynasonde
 - User Optical Instruments
- New development at Svalbard with SPEAR heating facility



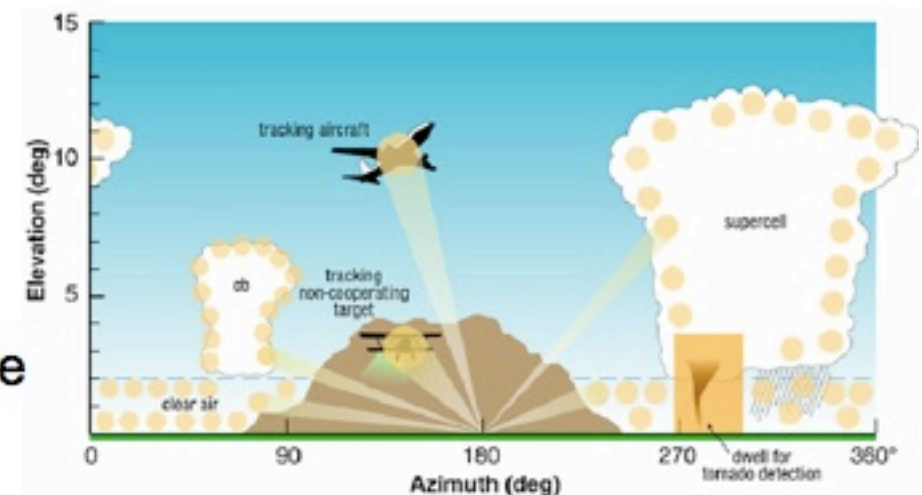
Just to remind: some recent trends...

- It is not enough to have a unique instrument
- **You have to have a network of instruments (like SUPERDARN)**
- It is not enough to have experimental data
- **You have to have models and data assimilation tools**
- **AND THE ULTIMATE PURPOSE OF MODELLING IS PREDICTION!**



Technology note: New radar development should favour phased arrays

- No moving parts
- Electronic beam steering
- Simultaneous beams
- Reduced maintenance
- Digital receivers
- Computational speed increase
- Distributed power amplifiers
- Multitasking, etc...



Next generation incoherent scatter radar is being planned: work name EISCAT 3 D

- EISCAT 3D:
 - NOW ON ESFRI Roadmap!
 - New boost of ISR development in the US, Canada, Antarctic...
 - PFISR
 - RISR
 - AMISR Antarctic, Argentina
 - Note:
 - New importance of the need for general Space Weather awareness in the society
 - The original EU FP6 proposal was excellent
 - HOWEVER: the science case needs reconsideration in order to reach a wider user community



EU FP6 funded EISCAT 3D design study

- 4 year project 2005-2009, funding 2.8 MEUR
- Project ends April 30, 2009
- Internal review of the final report: R. Woodman, W. Kofman, by May 20, 2009
- User meeting 27.-28.5. in Uppsala, Sweden, to evaluate the design study
- EISCAT workshop 3.-7. August, 2009 has an EISCAT 3D session
- New implementation study to be started during 2009, seek for EU funding
- EU call to be published Sep, 2009, application deadline 3rd Dec, 2009, max 5 MEUR/ project



Basic concepts of the proposed new radar (EISCAT)

- Increased antenna area
- Use phased arrays
- Increased transmission power
- Use distributed power amplifiers
- Multiple, distributed receivers
- Electronic beam steering
- New receiver and IT technology (heavier use of DSP)
- Built in interferometric capability
- Better altitude resolution
- Better altitude range coverage
- Good tri-static coverage at all altitudes



Rutherford Appleton Laboratory

Increased antenna area
Use phased arrays
Increased transmission power
Use distributed power amplifiers
Multiple, distributed receivers
Electronic beam steering
New receiver and IT technology (heavier use of DSP)
Built in interferometric capability
Better altitude resolution
Better altitude range coverage
Tri-static coverage at all altitudes

Unique science platform: Northern Scandinavia with EISCAT 3D

- New and exciting science emerges from investment
 - Collection of supporting geophysical instrumentation around EISCAT 3D and EISCAT Heater will be unique in the world
 - Opportunities include:
 - Northern Scandinavia research platform (including Svalbard)
 - solar wind-magnetosphere coupling
 - magnetosphere-ionosphere coupling
 - ionosphere-atmosphere coupling
 - ionospheric induction
 - 3D simultaneous vector data with spatial coverage
 - wind mapping
 - continuous long-term operations
 - auroral fine structures, small-scale plasma structures
 - naturally enhanced ion acoustic lines
 - artificial optical emissions

New and exciting science emerges from investment, opportunities cont.:

- coupling space weather and climate
- unique location at the edge of polar vortex
- MLT observations
- aerosols and charged aerosols
- role of metals and meteor smoke
- meteor studies
- thin layers
- PMSE, PMWE
- water
- negative ions
- radar method development
- application of perfect and near-perfect radar codes
- mathematical statistical inversion theory
- analysis based on non-processed echo data
- statistical lag profile inversion
- space debris measurements
- space weather services
- navigation application support
- mapping of Moon and asteroids
- satellite support
- rocket science support, ARR, ESRANGE
- chemical release experiments
- dust nanoparticle experiments
- Etc...

Additional opportunity:

- Space science education
- Ionospheric science education
- Atmospheric science education

Development challenge

- Attraction of EISCAT 3D:
 - EISCAT was always pushing ISR methods forward, both in theory and applications
 - EISCAT 3D continues this motivation
 - ESFRI roadmap -> several active sites in Norway, Sweden and Finland
 - High spatial resolution by interferometric applications
 - modular construction facilitates new results in early phase
 - New radar method development
 - Perfect and near-perfect radar codes
 - Inversion analysis of non-processed echo data
 - Associate-driven feasible technical projects
 - Massive data applications
 - Combining 3D ISR data with other 3D data
 - » E.g. ALIS optical network
 - Giving 3D to other data which is 1D or 2D
 - » TEC data, Satellite tomography data
 - Supercomputing solutions

EISCAT_3D Design targets and Central Core Layout

Radar field-of-view (FOW)

The beam generated by the central core transmit/receive antenna array will be steerable out to a maximum zenith angle of $\sim 40^\circ$ in all azimuth directions. At 300 km altitude, the radius of the resulting field-of-view is approximately 200 km. In the N-S plane this corresponds to a latitudinal coverage of $\pm 1.80^\circ$ relative to the transmitter site.

The antenna arrays at the 3-D receiving facilities will be arranged to permit tri-static observations to be made throughout the central core FOW at all altitudes up to 800 km.

Beam steering

It will be possible to steer the beam from the central core TX/RX antenna array into any one of > 12000 discrete pointing directions, regularly distributed over its FOW and separated by on average 0.625° in each of two orthogonal planes. The beam steering system will operate on a $< 500 \mu\text{s}$ timescale.

2.10 Transmitter parameters

Centre frequency:	between 220 – 250 MHz, subject to allocation
Peak output power:	$\geq 2 \text{ MW}$
Instantaneous –1 dB power bandwidth:	$\geq 5 \text{ MHz}$
Pulse length:	0.5–2000 μs
Pulse repetition frequency:	0–3000 Hz
Modulation:	Arbitrary waveforms, limited only by power bandwidth

2.11 Receiver parameters

Centre frequency:	matching the transmitter centre frequency
Instantaneous bandwidth:	$\pm 15 \text{ MHz}$
Overall noise temperature:	$\leq 50 \text{ K}$ referenced to input terminals
Spurious-free dynamic range	$\geq 70 \text{ dB}$

Central core parameters: First phase Fully instrumented

Number of elements:	16 K	30 K
Diameter [wavelengths]:	87	116
Element separation [wl]:	0.6	0.6
P x A [GW m ⁻²]:	91	295
One-way Half Power BW [degrees]:	0.62	0.46

Cf. the EISCAT VHF system in Mode 1 (full antenna, 3 MW):

$$P \times A = 2.4 \text{ GW m}^{-2}, \text{HPBW} = 0.6 \times 1.7 \text{ degrees}$$

2.12 Sensor performance in incoherent scatter mode

The parameters of the different subsystems will be chosen such that, for each of the measurement scenarios tabulated below, the radar will generate estimates of incoherently scattered signal power (or equivalently, uncorrected electron density) with statistical accuracies of better than 10 % in the specified integration times:

Altitude [km]	Electron density [m ⁻³]	T_e/T_i	Ion composition	Height resolution [m]	Integration time [seconds]
80	1×10^8	1.0		≤ 100	30
100	3×10^8	1.0		100	1
150	1×10^{10}	1.0	50% NO ⁺ , 50% O ⁺	100	1
300	3×10^{10}	2.0	100% O ⁺	300	1
800	3×10^{10}	3.0	5% H ⁺ , 95% O ⁺	1000	10
1500	1×10^{10}	4.0	10% H ⁺ , 90% O ⁺		60

2.13 Sensor performance in in-beam interferometer mode

In interferometer mode, the sensor will provide horizontal, 2D resolution of better than 20 m at 100 km altitude.

The E3D Central TX/RX Core

- "Crossed-dipoles over groundplane" phased array (like this one),
- but **much** larger, about this size:

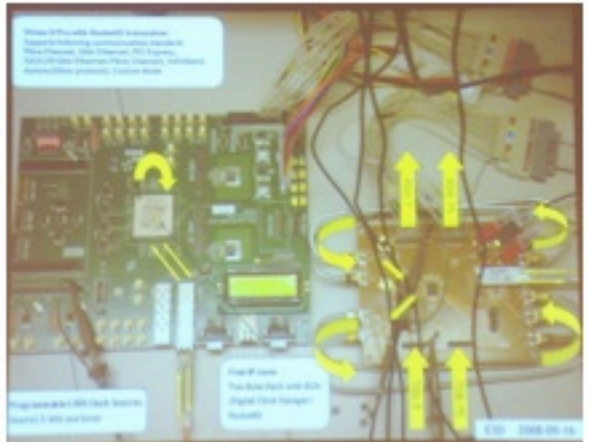


- Each X dipole to be fitted with a (400+400) watt VHF transmitter module and a direct-sampling receiver,
- A 4000 element array will just about match the PxA of the present EISCAT VHF; a 16000 element ($d \approx 150\text{m}$) array will come close to the 3D PSD target,

From G. Wannberg et al, 2007

The EISCAT_3D Test Array ("Demonstrator")

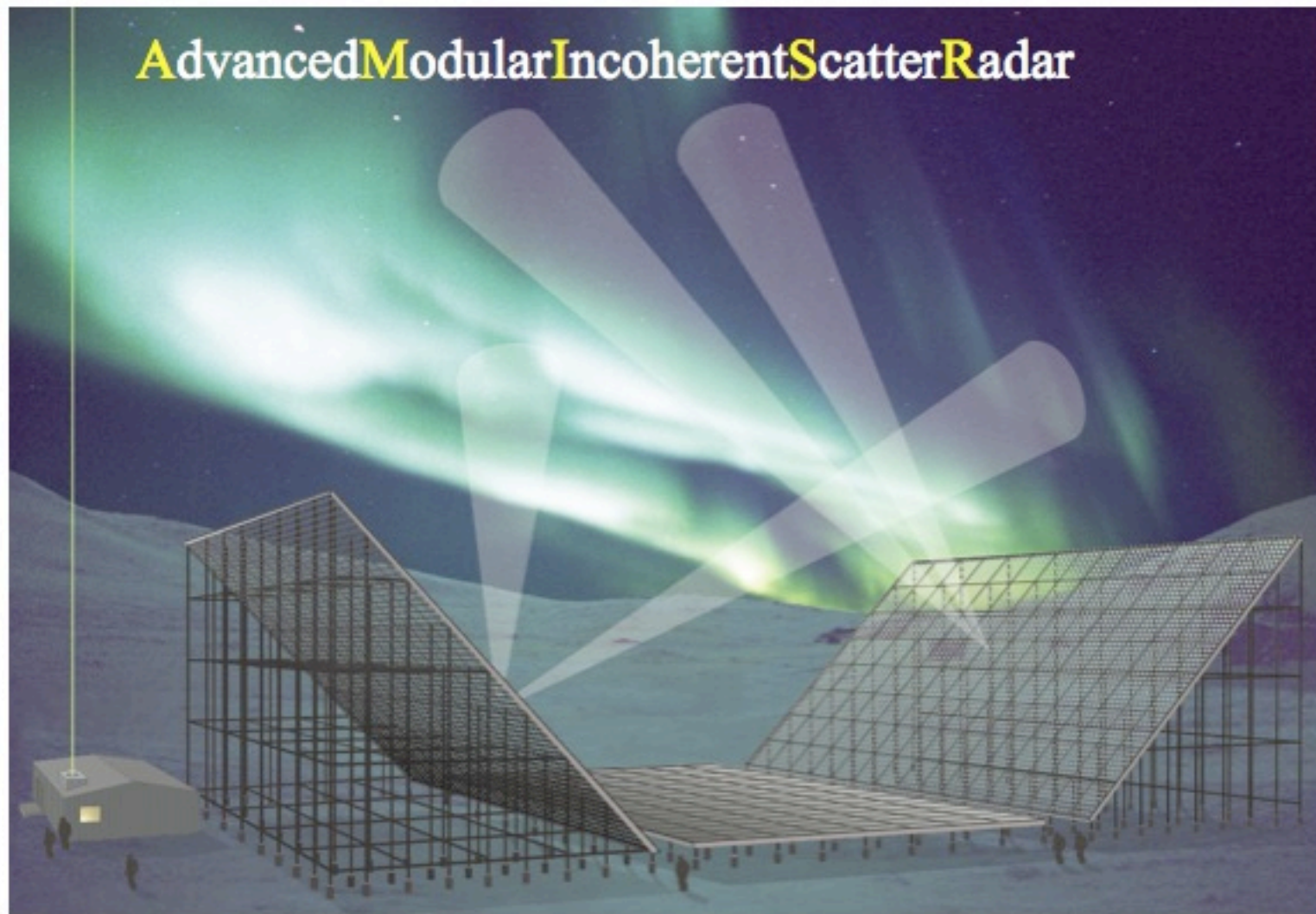
- 200 m² array at EISCAT Kiruna site
- Orientation Tro-Kir plane; 48 short (6+6) element Yagis at 55° elevation,
- Center frequency of (224 ± 3) MHz , reception of TRO VHF system.
- SNR sufficient for bistatic IS work (> 6% @ 300 km, 1.0 10¹¹ m⁻³),



From G. Wannberg et al, 2007

E. Turunen, EISCAT Scientific Association, Kiruna, Sweden

PFISR and RISR (“AMISR” concept)



Example on volumetric E-region data: PFISR

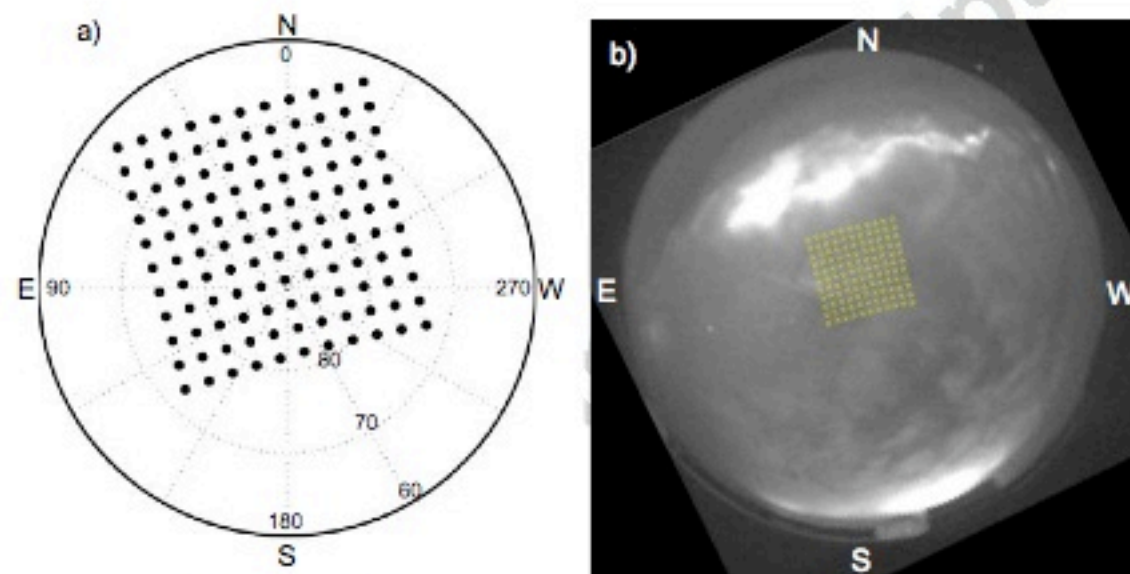


Fig. 1. a) PFISR beam positions used in this experiment, depicted in a horizon-based polar coordinate system. b) beam positions superimposed on an image recorded with the collocated all-sky camera.

Semeter et al., JASTP., 2008

Example on volumetric data: PFISR

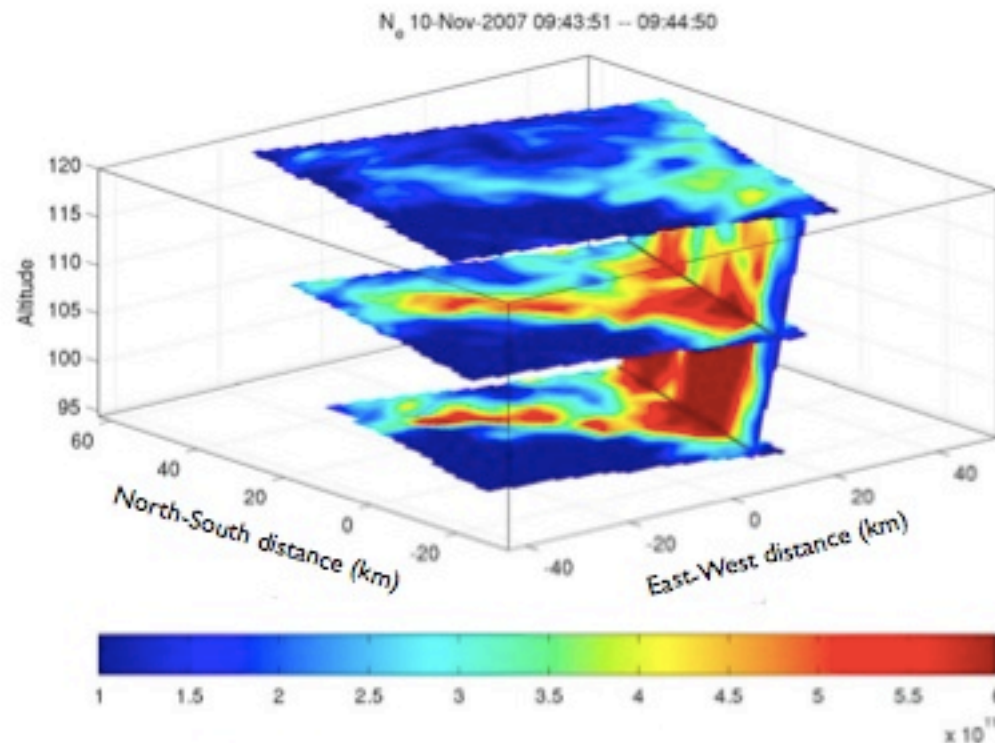


Fig. 2. Volumetric image of *E*-region on 10 November 2007, 09:43:51–09:44:50 UT. The image was produced by averaging 192 pulses-per-position. The horizontal cuts are at 100, 107, and 120 km. The structured density enhancement seen in the image was produced by auroral electron precipitation in the 20 keV range.

Semeter et al., JASTP., 2008

Example on volumetric data: PFISR

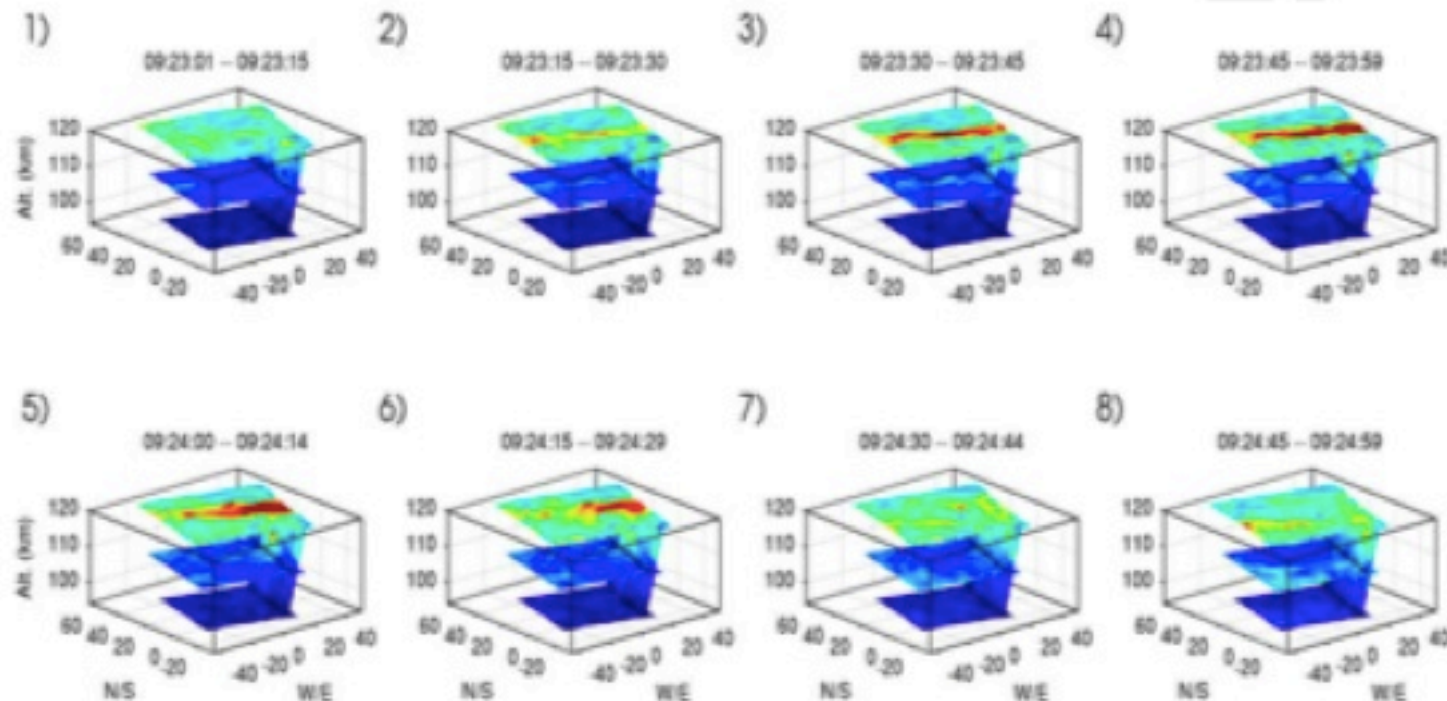
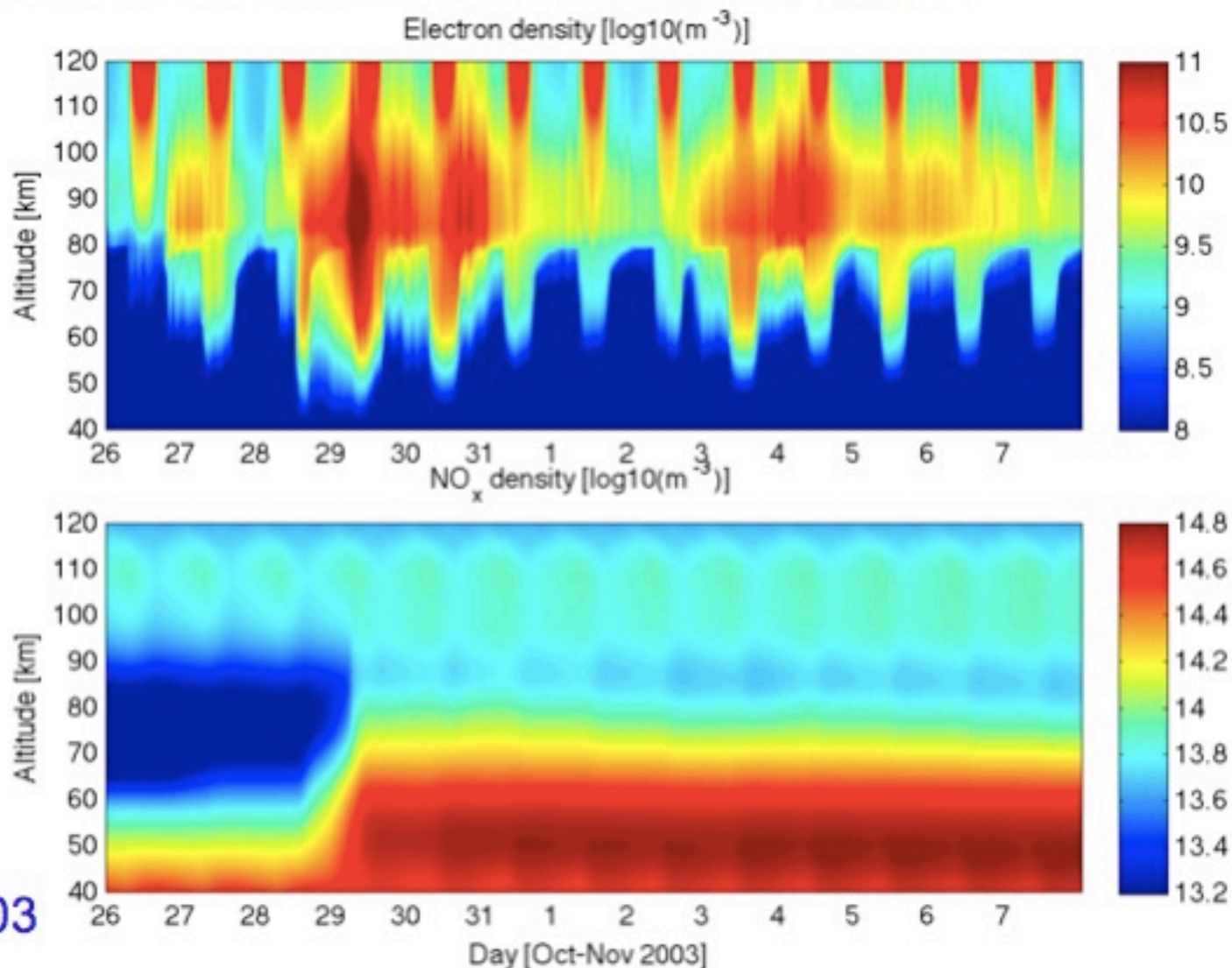


Fig. 5. PFISR volumetric images at 14.6-s cadence in the interval 09:23:01–09:24:59 UT, showing the formation and decay of an east-west arc-related ionization enhancement at 120-km (same color scale as Figure 2).

Semeter et al., JASTP., 2008



Particle precipitation, NO_x , HO_x , O^3

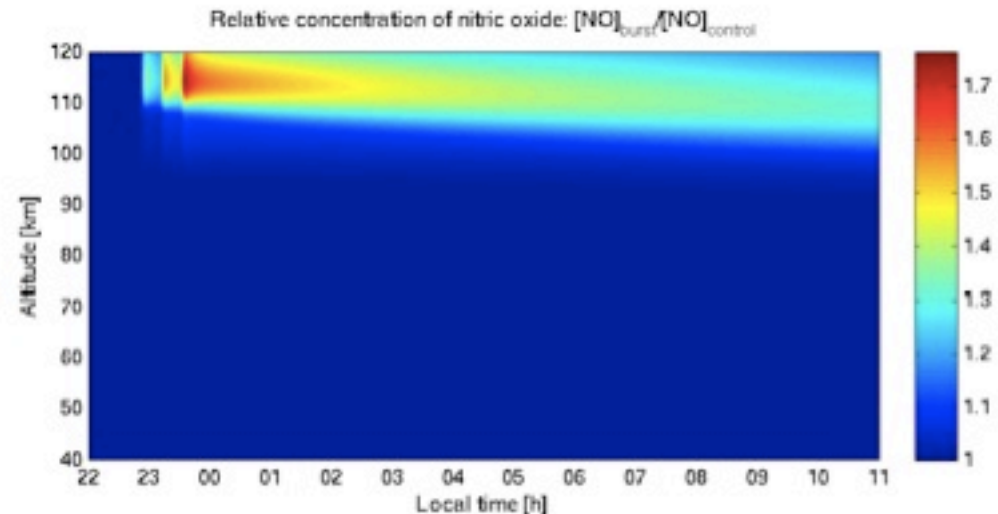
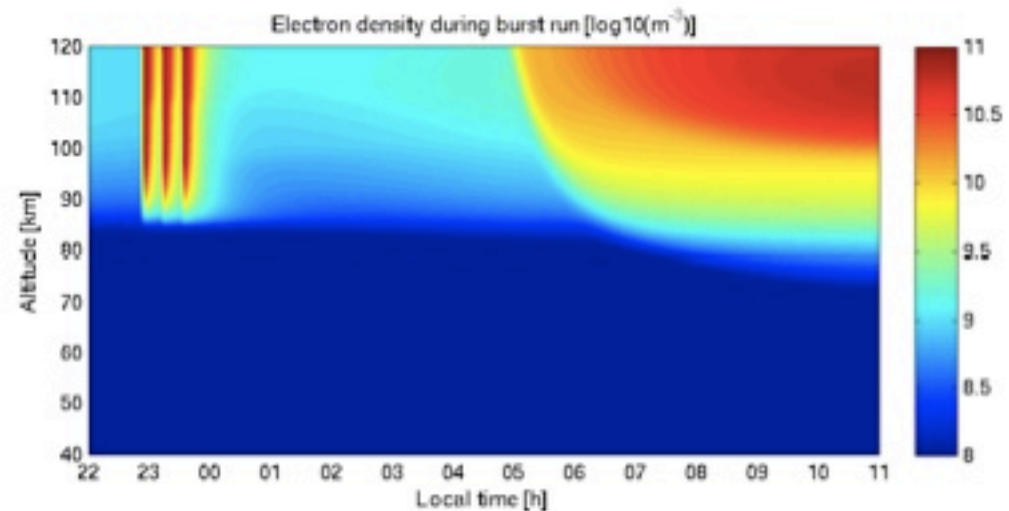


Effect of auroral electrons, SIC model:

The bursts of electrons have a characteristic energy of 5 keV and a total energy flux of 10 mW m^{-2} .

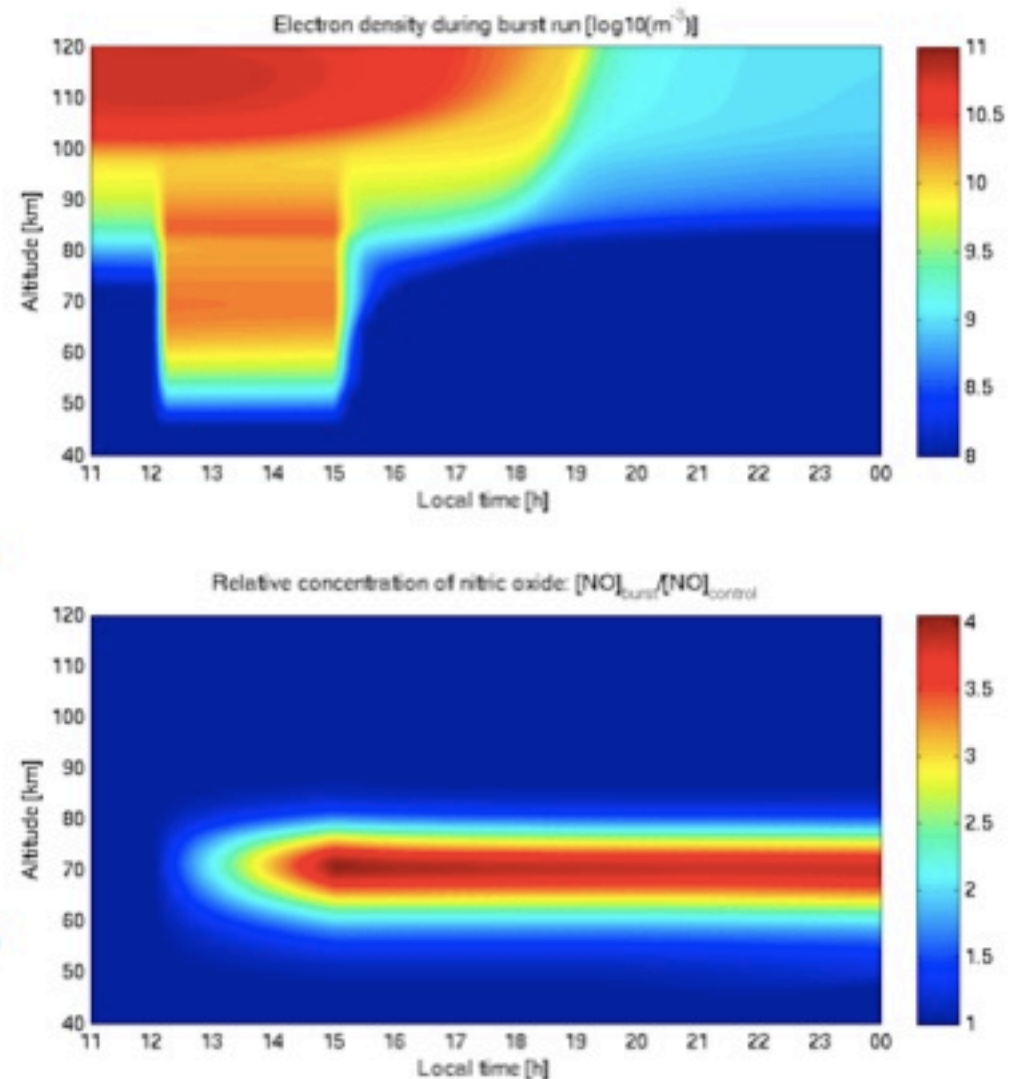
Upper panel: electron number density

Lower panel: the behaviour of NO concentration relative to the background level. The electron bursts last 5 min each, starting at 23:05, 23:25, and 23:45 LT



Effect of relativistic electron precipitation

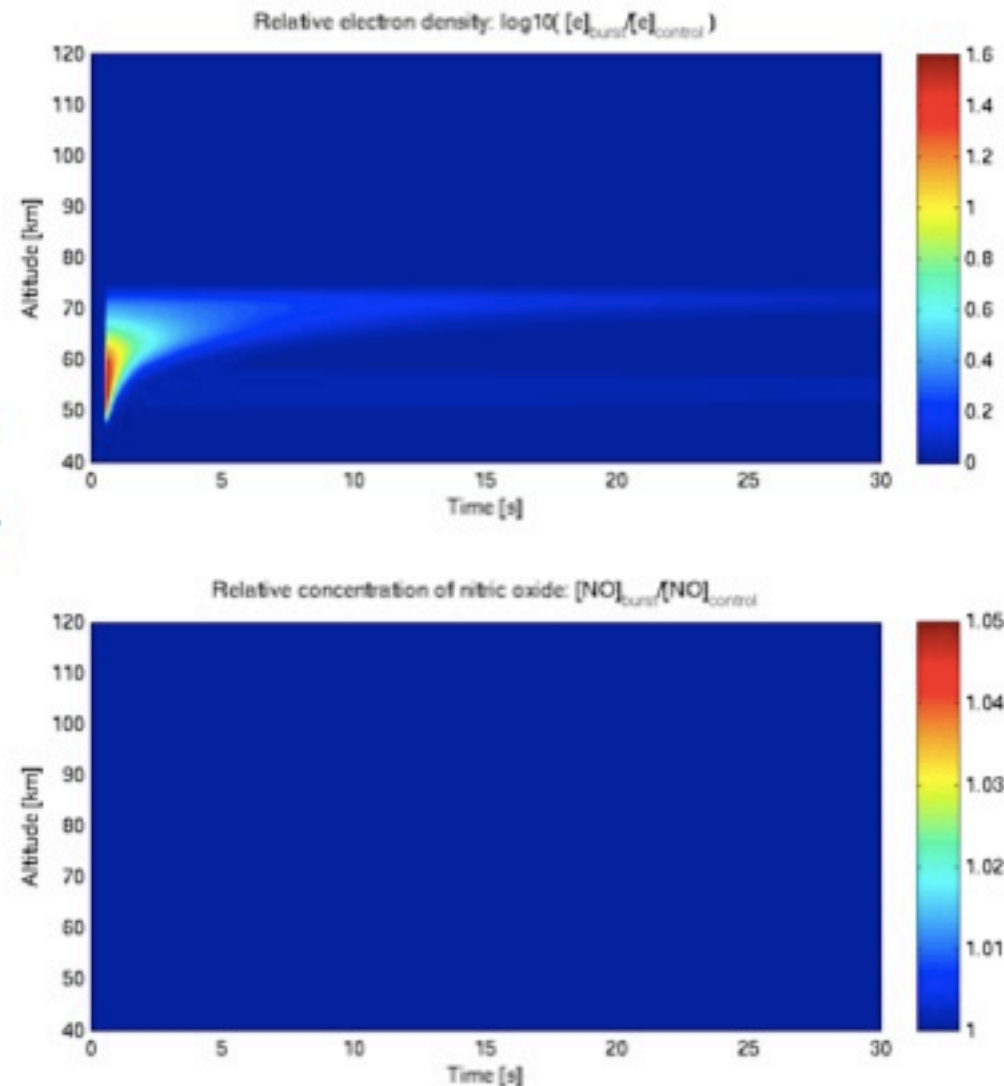
Similar as previous figure, but showing the effect of a 3 hour long burst of REP on electron number density and NOx levels using the precipitating fluxes measured in the bounce loss cone at L=3.5-4 by the UARS on 18 May 1992 (Gaines et al., 1995). The spectrum of the REP event is very hard, containing significant fluxes at energies as high as 5 MeV.



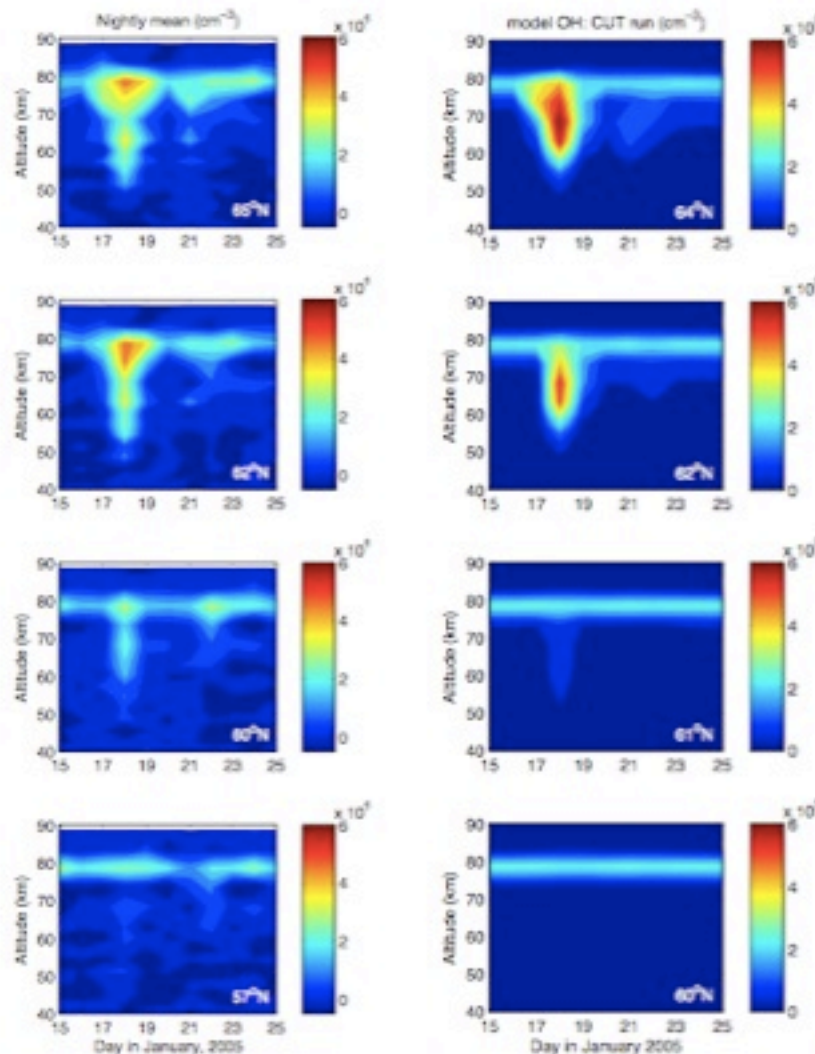
Effect of a relativistic microburst

Same as the previous figure, but showing the effect of a REP microburst on electron number density and NOx levels. We have assumed a 0.1 s burst of 2 MeV monoenergetic relativistic electrons with a flux taken from those reported by SAMPEX.

The microburst is too short to cause significant changes in [NO].

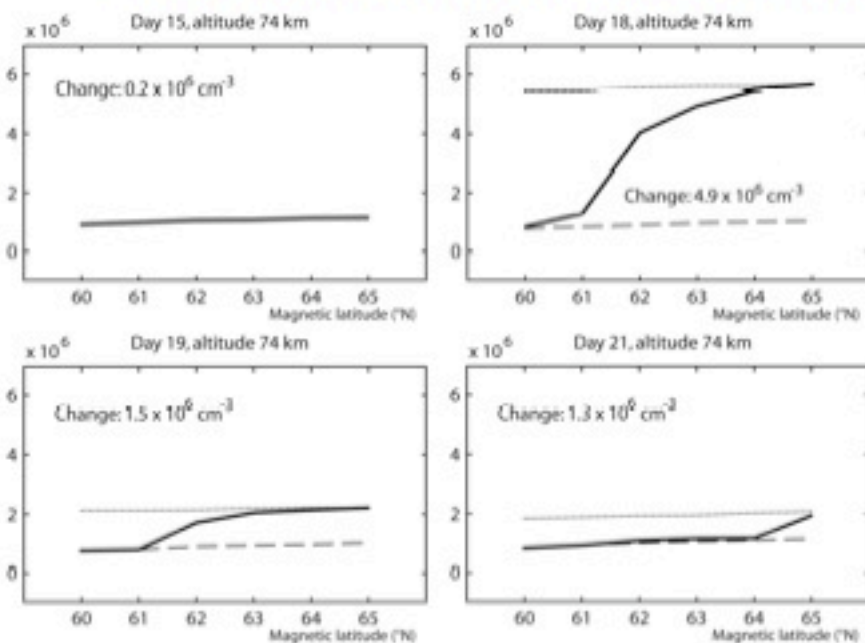


Odd hydrogen, latitudinal EPP effects



Odd hydrogen responds to extreme EPP

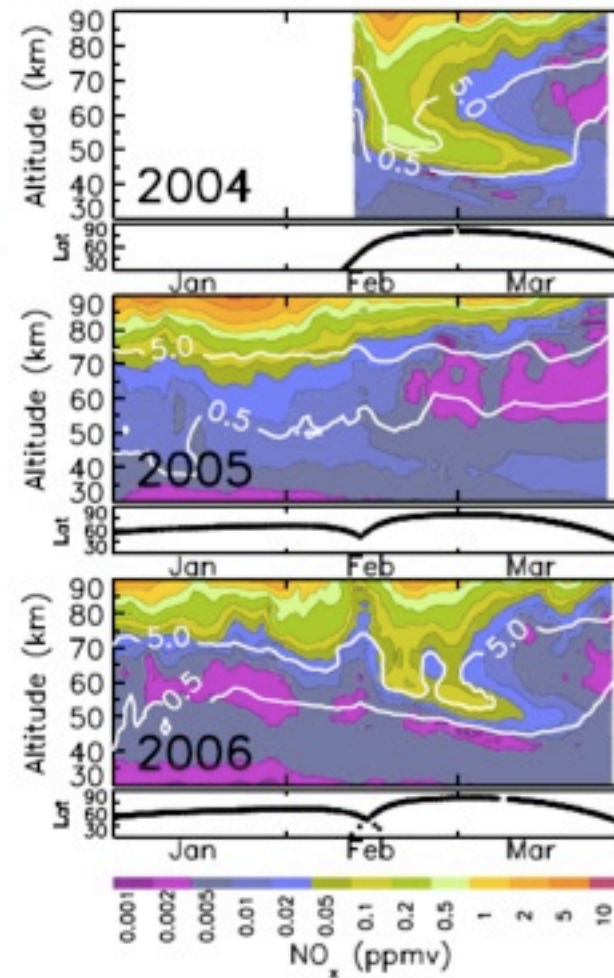
- Left panel: Aura/MLS
- Right panel: SIC model
- Below: latitudinal variation at 74 km



From Verronen et al, Ann.Geophys., 2007

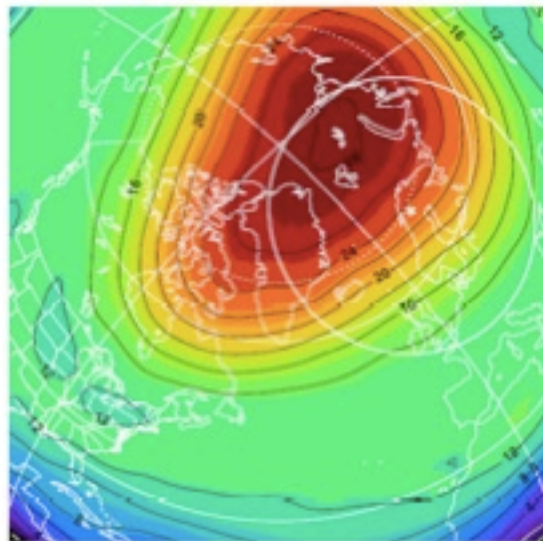
Development of polar vortex affects importance of NOx from thermosphere

- Atmospheric Chemistry Experiment (ACE) NOx mixing ratios poleward of 50° in 2004, 2005 and 2006
- citation: Randall, C. E., V. L. Harvey, C. S. Singleton, P. F. Bernath, C. D. Boone, and J. U. Kozyra (2006), Enhanced NOx in 2006 linked to strong upper stratospheric Arctic vortex, *Geophys. Res. Lett.*, 33, doi: 10.1029/2006GL027160
- No significant descent of NOx during spring 2005!



Polar vortex

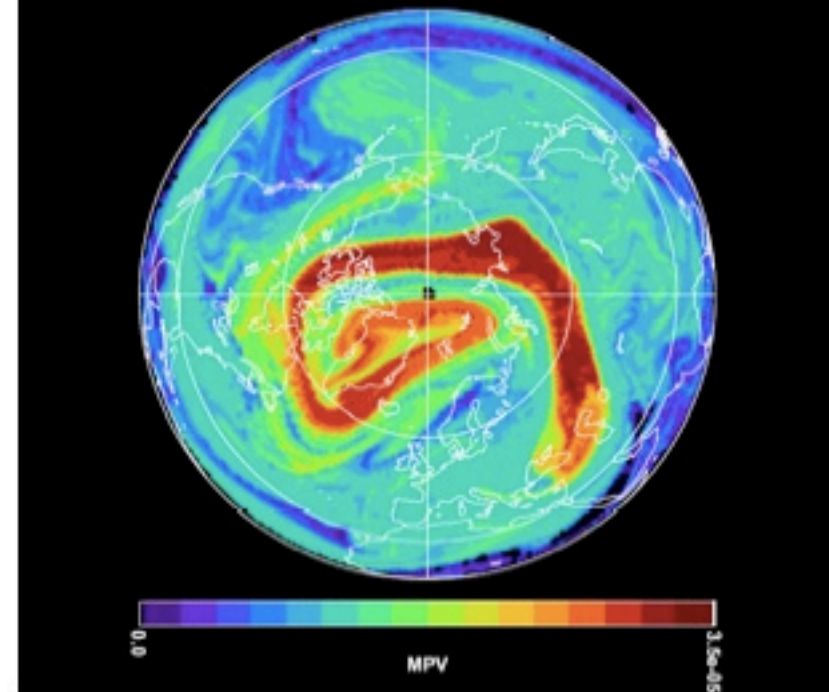
January 480 K Mod. PV



P. Newman/NASA

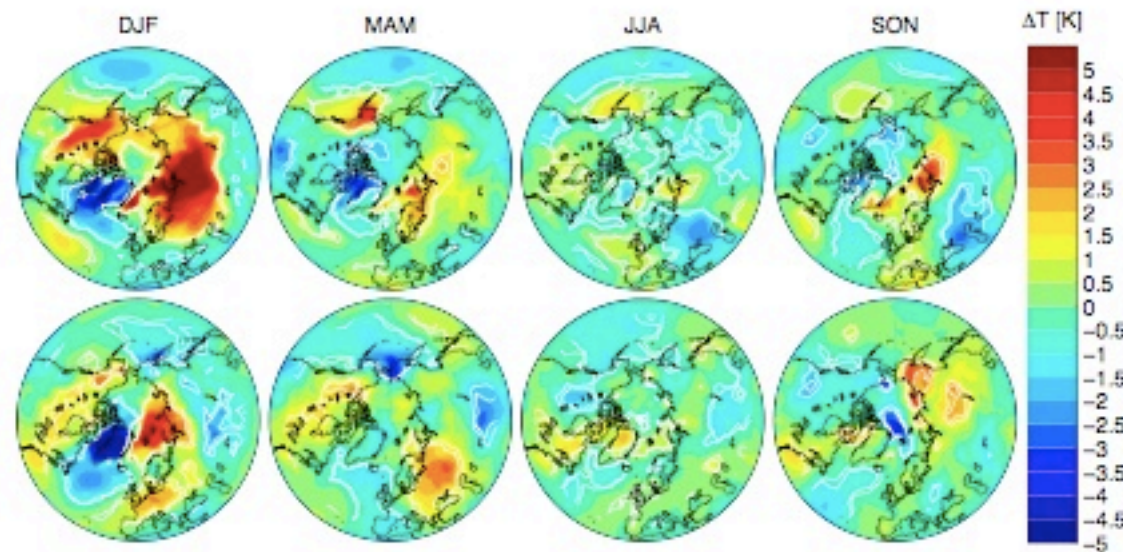
The location of the arctic polar vortex averaged over the period 1979-1998

24 January, 1992 NMC Mpv 450 K



A polar vortex filament structure

Is there a link between solar variability and climate?

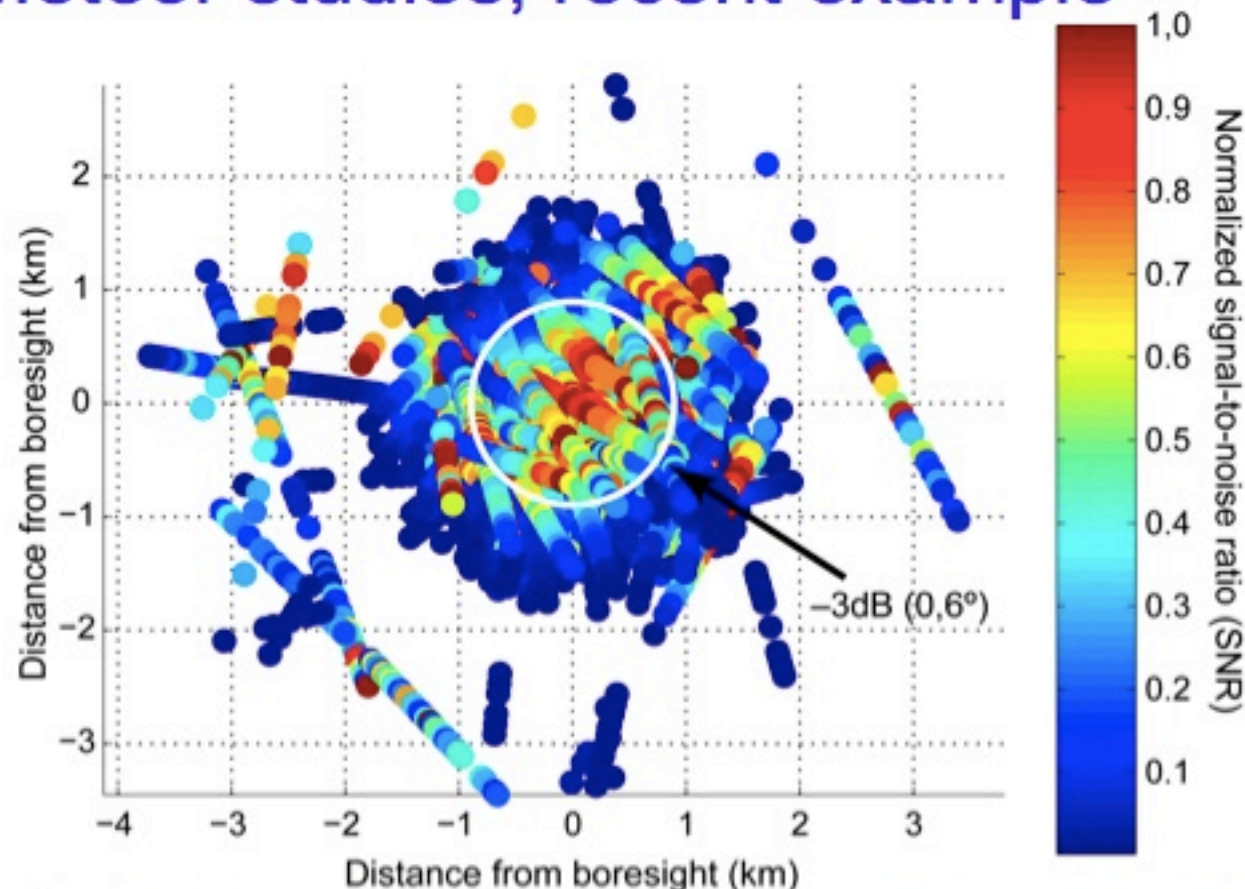


The northern hemisphere seasonal differences in surface air temperature ($\Delta T = \text{High Ap} - \text{Low Ap}$) for intermediate top panels and low F10.7 values (bottom panels) for the seasons denoted in each column. White contours represent the 95% and 99% confidence levels.

One possible link might be the precipitation of high-energy particles and transport of produced long-lived chemical species, such as NO_x.

*Figure from Seppälä et al. , 2008,
Presented at The 1st International workshop on High-Energy Particle Precipitation
in the Atmosphere, Helsinki, May 2008 (to be published)*

Meteor studies, recent example

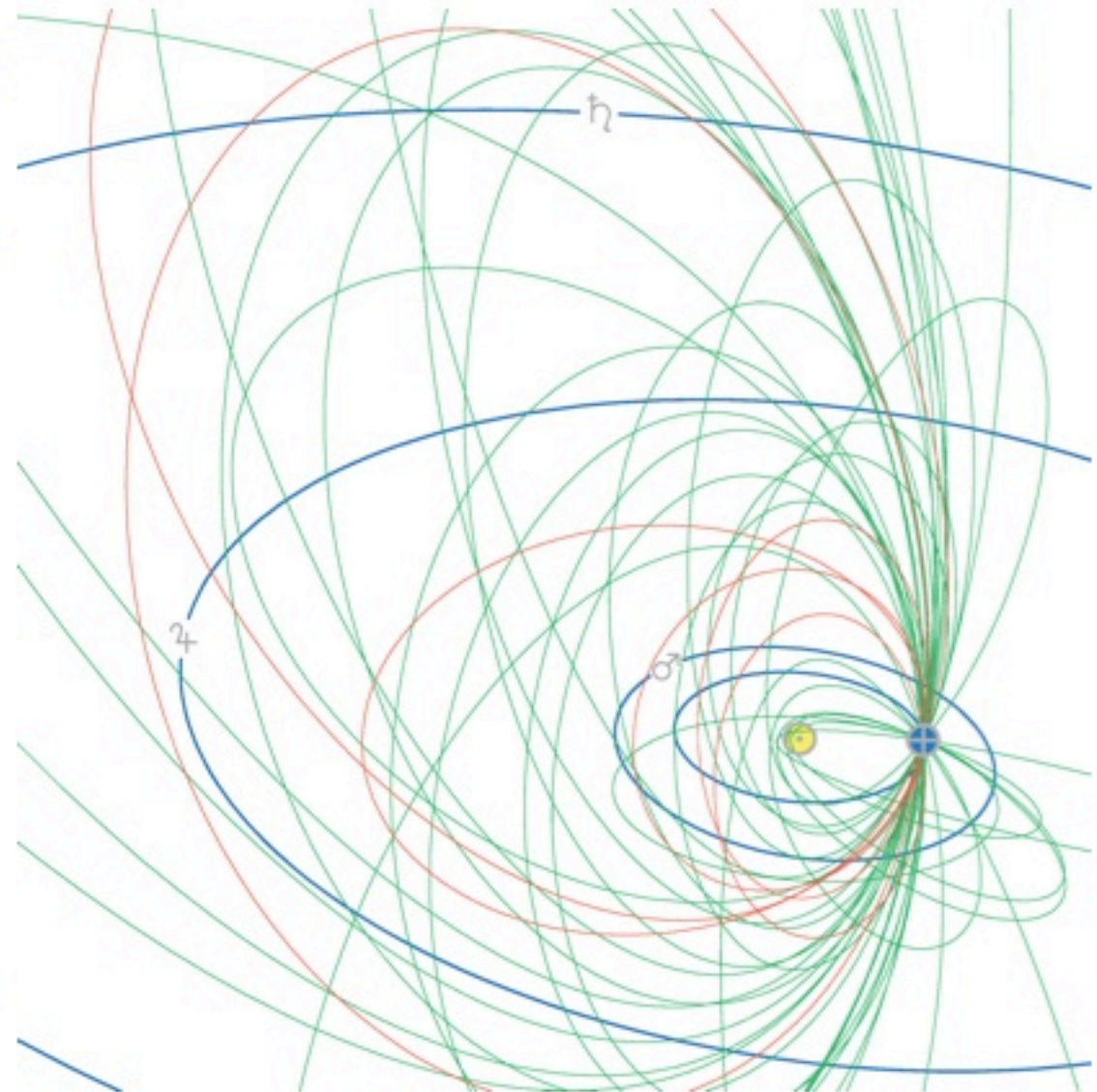


The Ph.D. thesis “High-resolution meteor exploration with tristatic radar methods” by Kero (2008) describes a method to determine the position of a compact meteor target with the EISCAT UHF system. This figure displays 194 meteoroid trajectories projected onto a plane perpendicular to the Tromsø radar beam. The maximum SNR of each meteor head echo streak is normalized to one. The white circle marks the -3 dB beamwidth (0.6°).

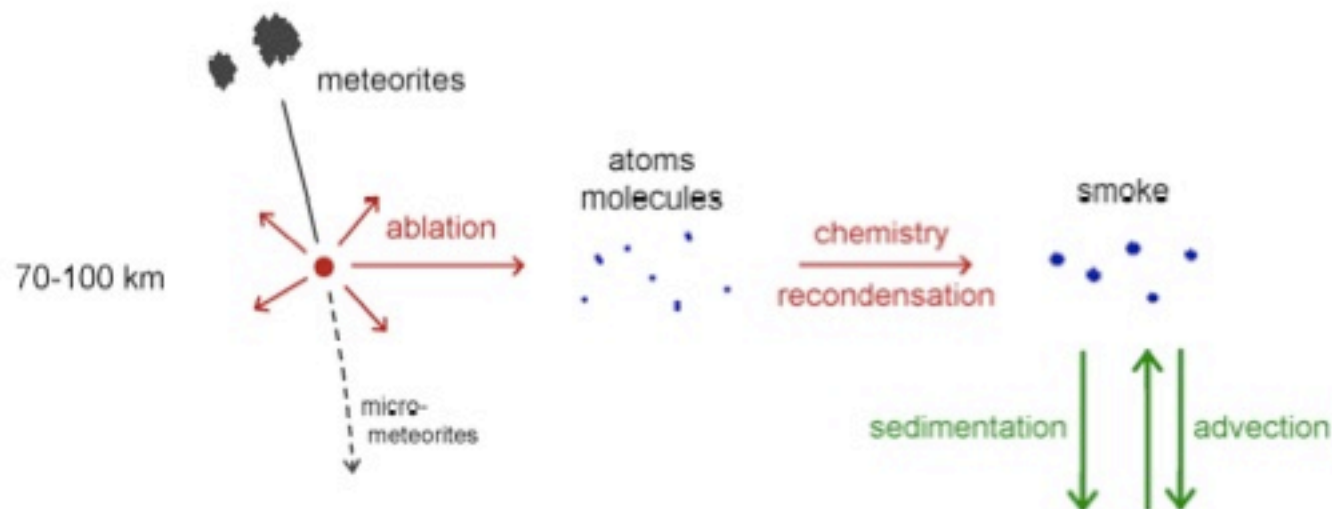
Meteor studies

The Ph.D. thesis "Radio meteors above the Arctic Circle - radiants, orbits and estimated magnitudes" by Szasz (2008) describes meteoroid orbit calculations from EISCAT UHF measurements. This figure displays the sun (yellow), the Earth (blue) and 39 prograde (green) and retrograde (red) meteoroid orbits.

With EISCAT 3D we could map the whole dust cloud of the solar system!

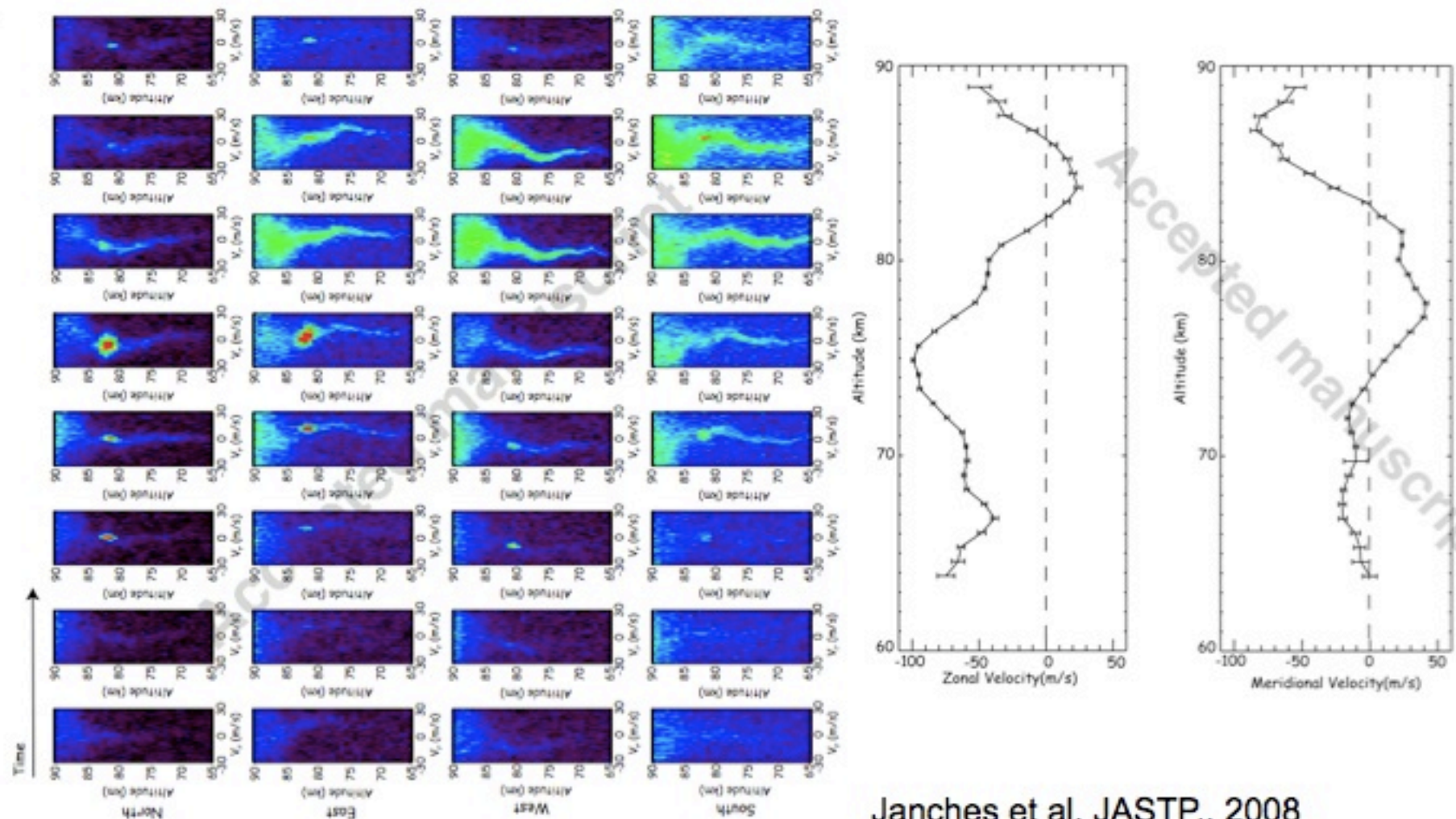


The role of smoke particles



Nanometre-sized meteoric smoke particles (MSP) formed from the recondensation of ablated meteoroids in the atmosphere at altitudes >70 kilometres, are transported into the winter polar vortices by the mesospheric meridional circulation and are preferentially deposited in the polar ice caps. Further smoke particles resulting from recondensation of the meteoric vapor, are believed to be an important ingredient in a number of mesospheric processes.

PFISR: unexpectedly good D-region data?



Janches et al, JASTP., 2008

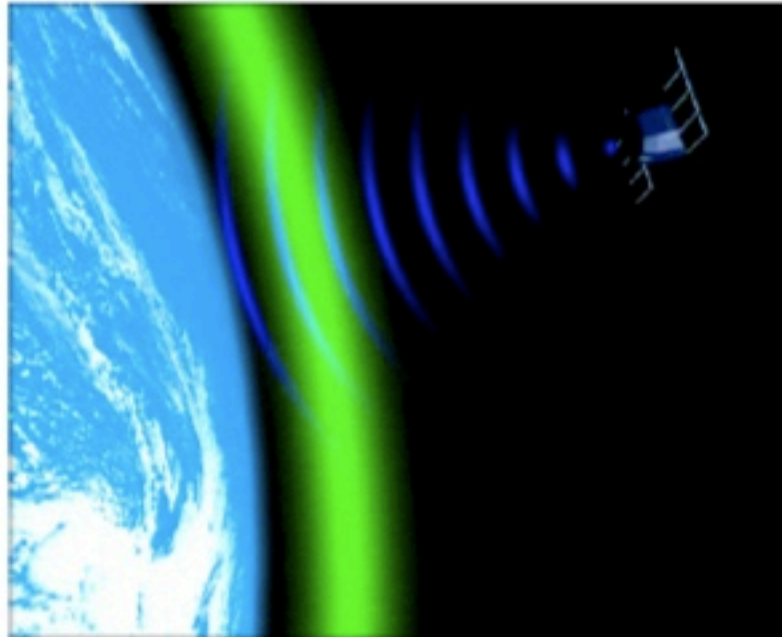
Application opportunity

- EURIPOS
 - Large FP7 proposal (A. Belehaki)
- Space debris
- Continuous ionospheric monitoring
- Effects on GALILEO etc.



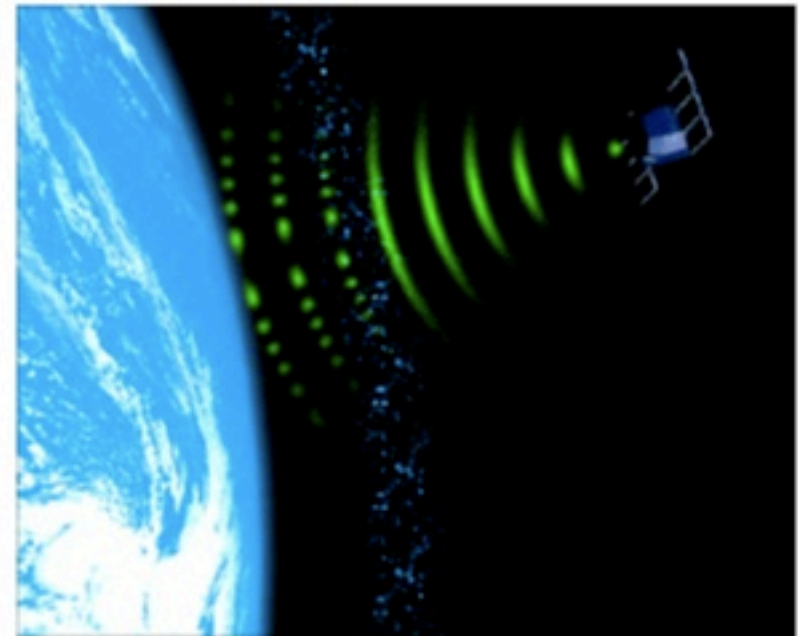
Does GALILEO work at high latitudes?

Ionosphere and GPS



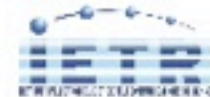
Delay

**Perturbs the signal propagation speed
proportional to total electron content
tens of metres error at solar maximum**



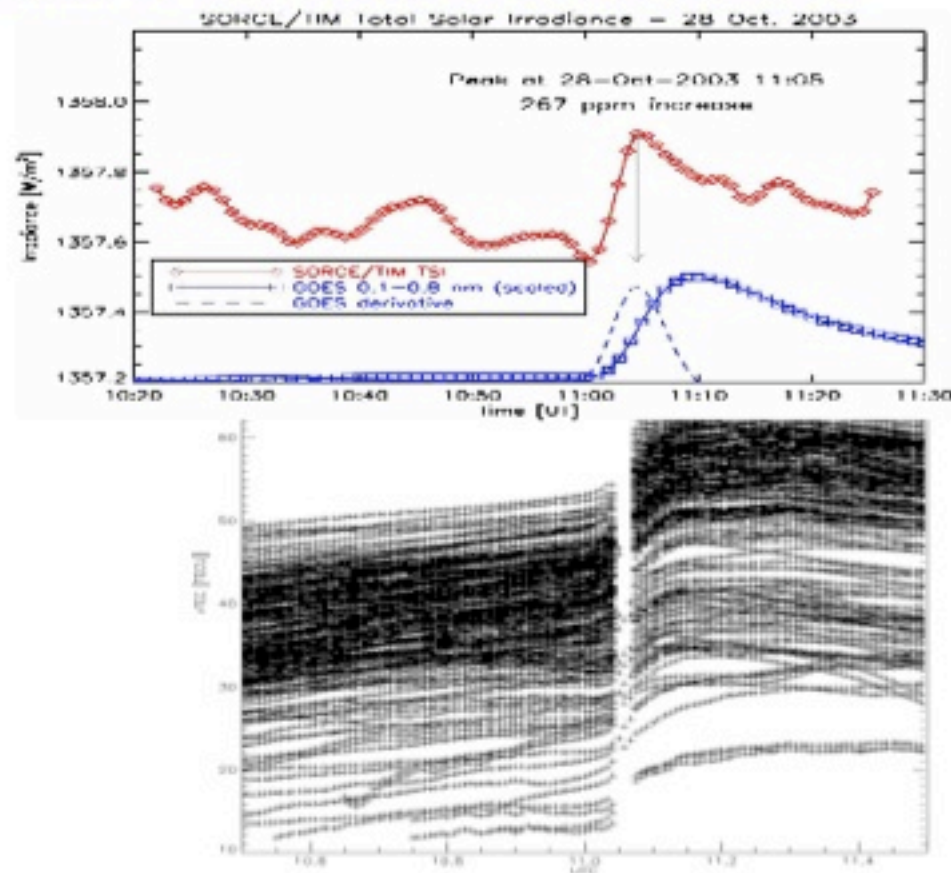
Scintillation

**Causes rapid changes in signal phase
and signal strength – most severe in
auroral/equatorial regions and storms**

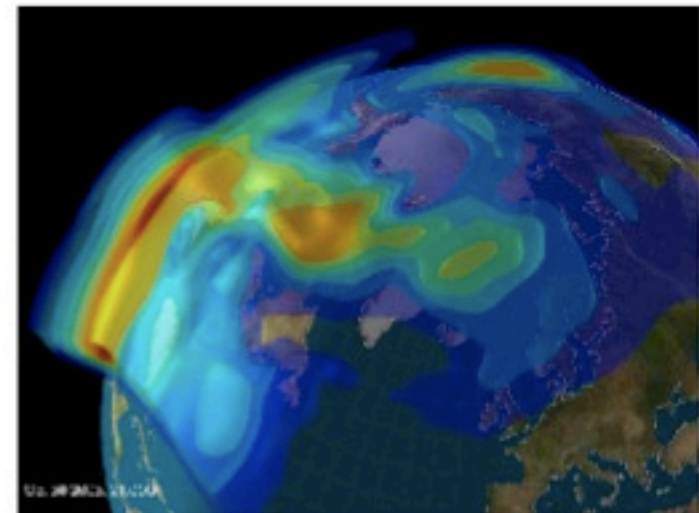
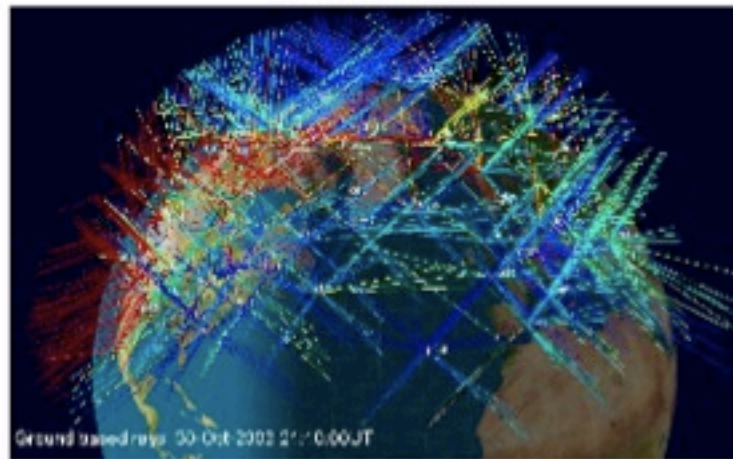
The University of
Nottingham


Solar flare effect in TEC on 28 October 2003

- Strong solar flare on 28 October 2003 at 11:05 UT
- Total irradiance of the sun enhanced within a few minutes by 267 ppm
- TEC data processing indicates loss of data at numerous GPS links
- The number of usable GPS links for TEC processing was reduced rapidly from more than 30 to only 7

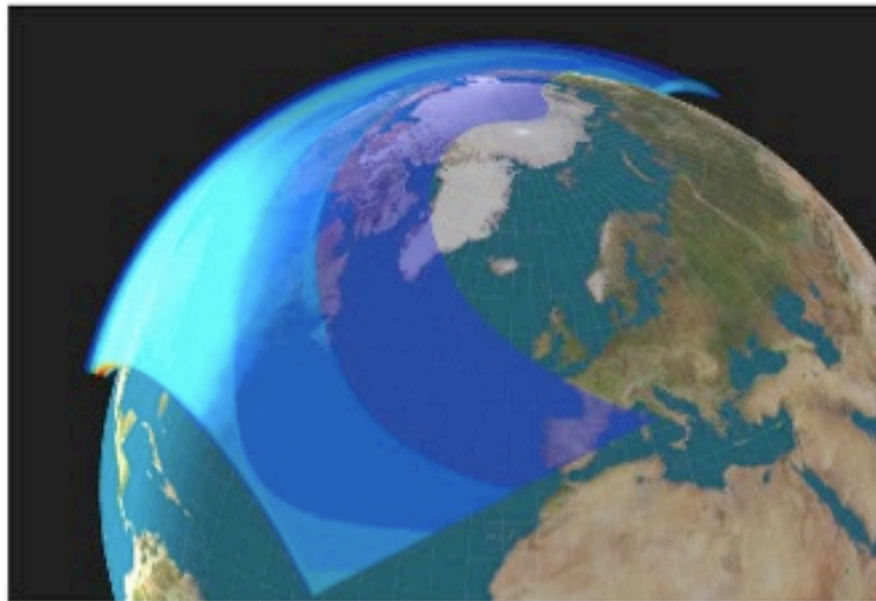


3D Electron density retrieval from TEC

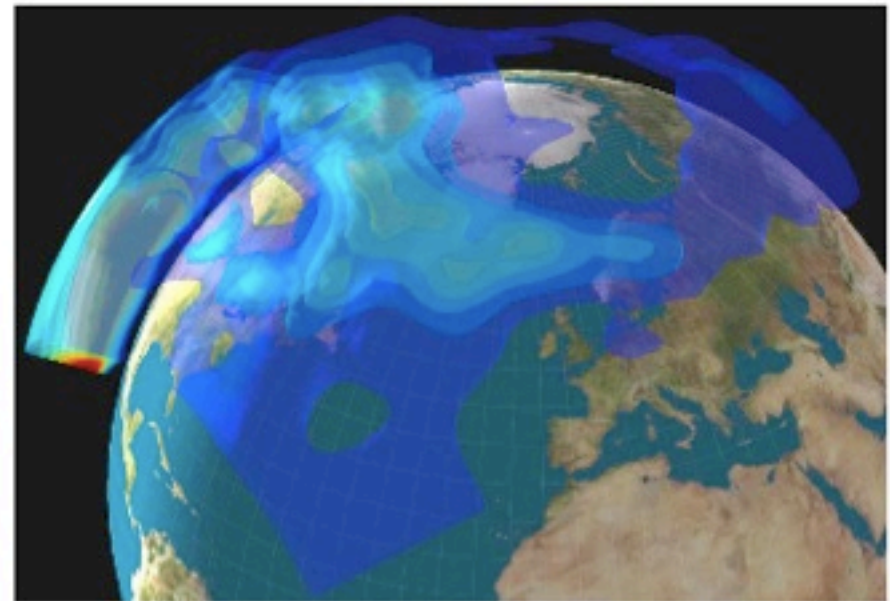


By: Allain et al., 2008

3D Electron density retrieval from TEC



IRI



MIDAS

By: Allain et al., 2008

Example: TEC map from EUREF GPS

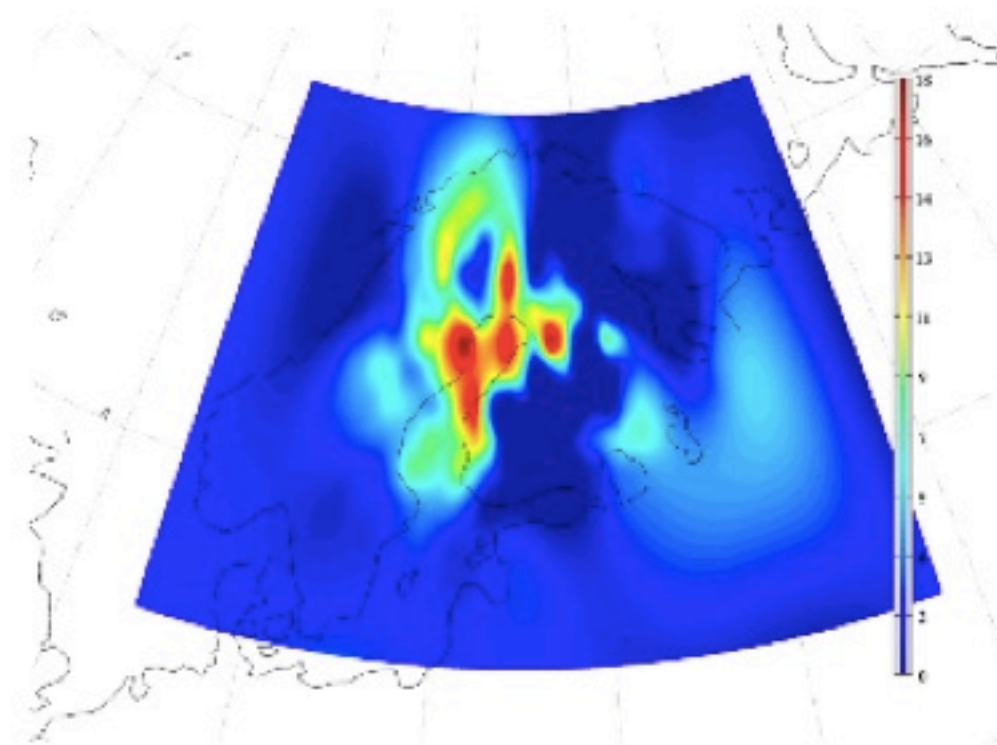


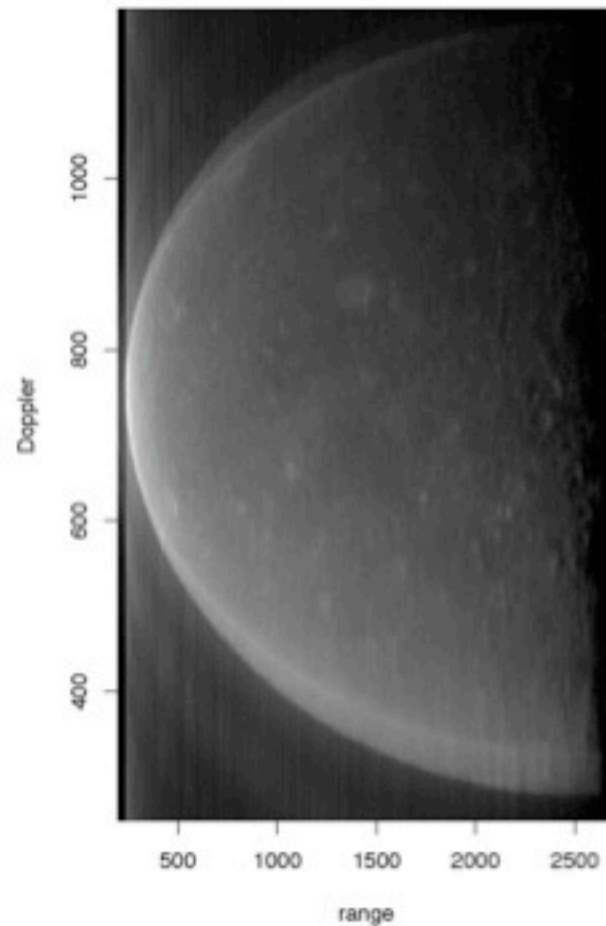
Fig. 1. High resolution TEC map on 15 December 2007 at 02:00 retrieved with the MIDAS algorithm (Luntama et al., 2007). The GPS observations used in the retrieval are from the 86 station GNSS network in Finland operated by Geotrim Ltd. The color bar shows the TEC values in TECU (1 TECU $\equiv 10^{16}$ electrons/m²).

First picture of the Moon as seen by EISCAT

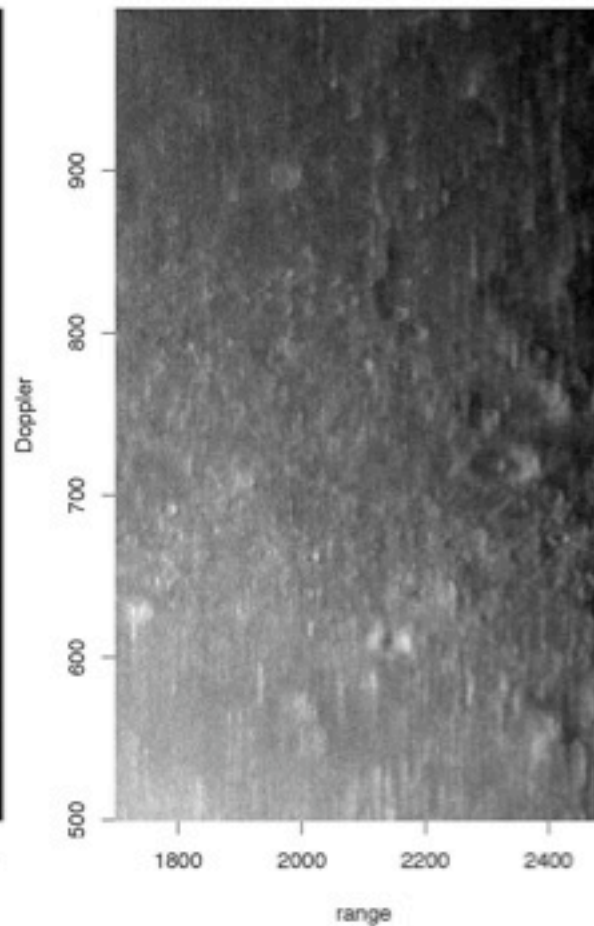


First pictures of the Moon by EISCAT

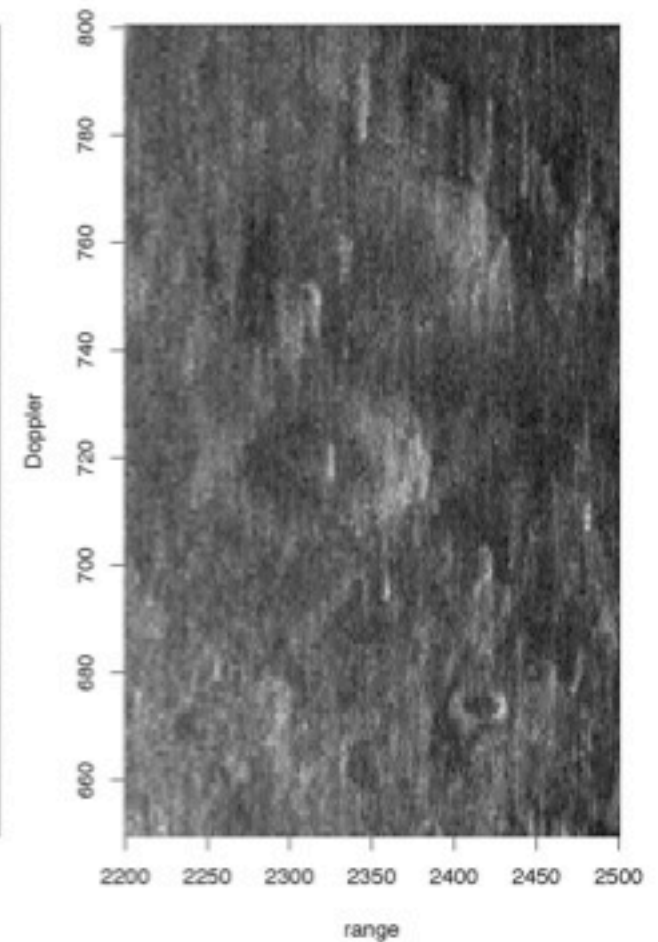
14thDec2008 23.37UT:
5 looks averaged, 10000 ipp in each



The sharp region expanded



and even more



Proposal by speaker:

- THINK BIG HERE!



EISCAT 3 D

- Design Study 2005-2009
- Implementation studies 2009-2011
- Construction 2011-2015
- Operation 2015-2045



- Modular construction
- Site locations need to be considered carefully
- Sites may be very different in size and purpose

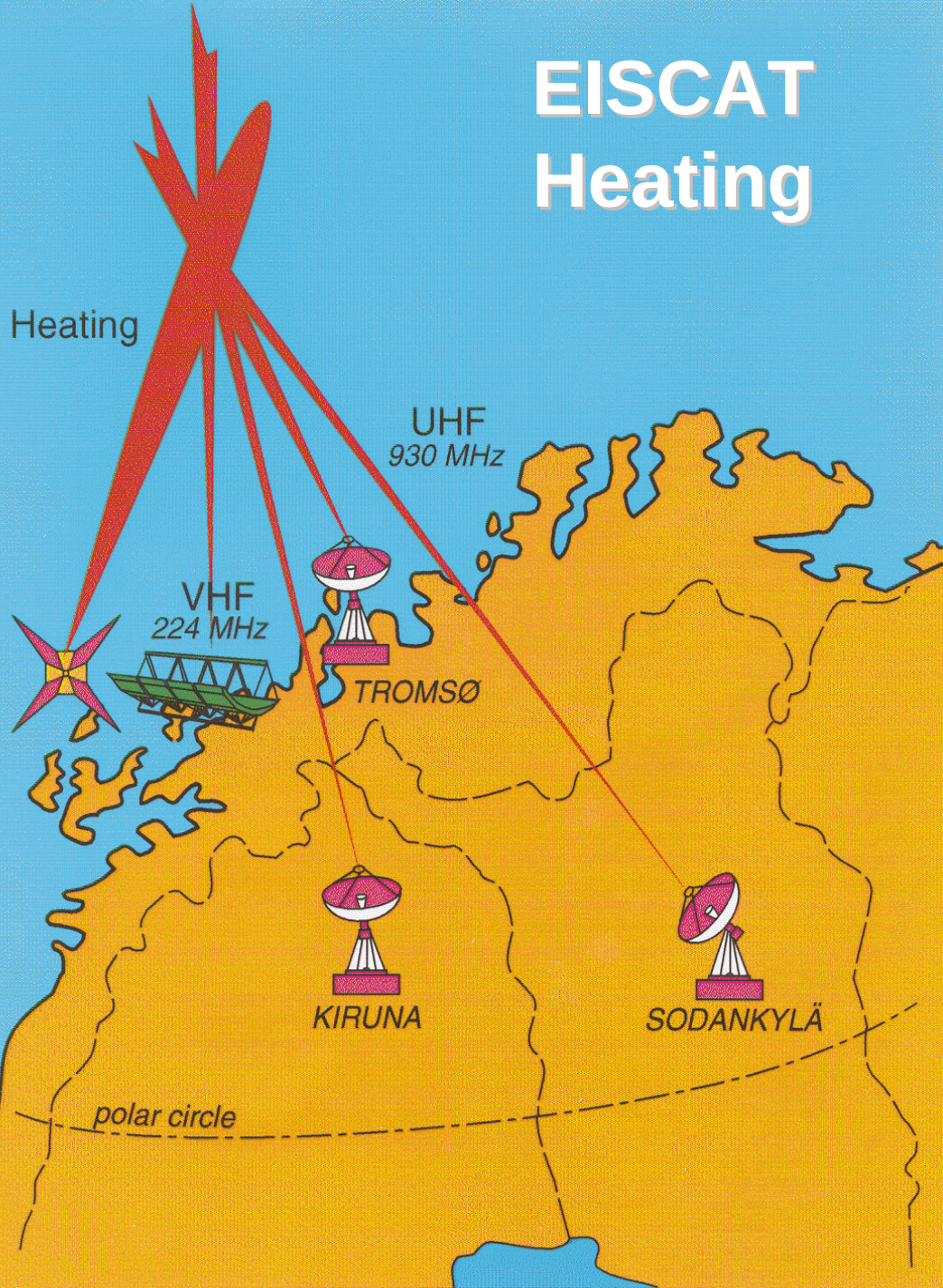




Heating upgrade HW

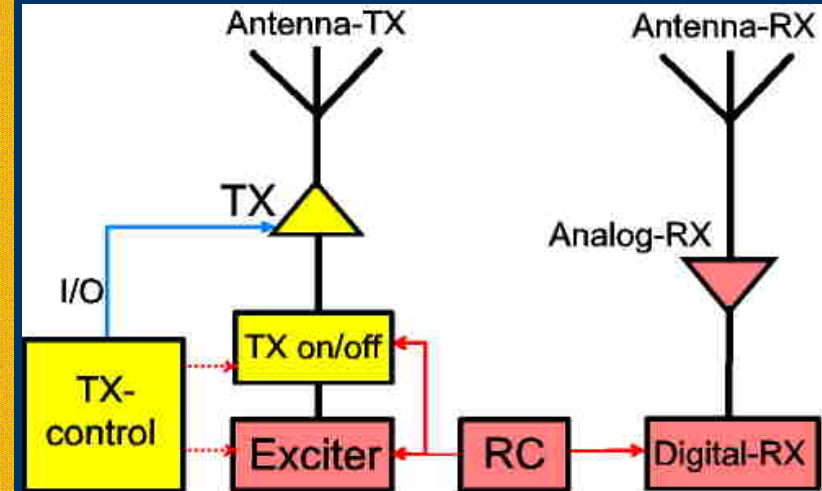


EISCAT Heating



Upgrade → Heating RADAR

- Replace HP synthesizers with **DDS**
- Construct Heating receiver



HP analogue synthesizers



HF control room

1 set of meters per transmitter

RF freq.
synthesizers

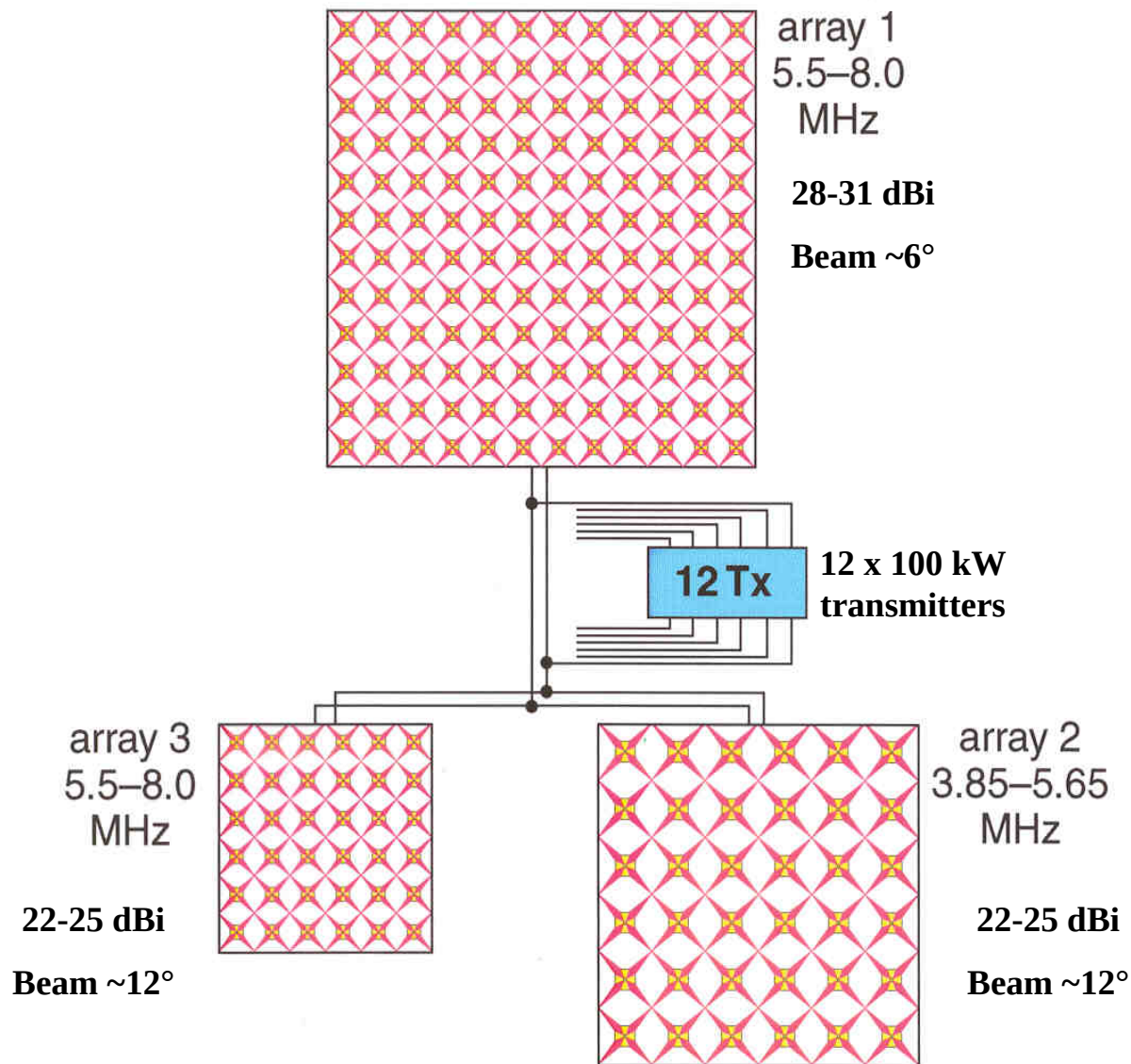
OLD EXCITER

Texas
Instruments
microcomputer
for modulation

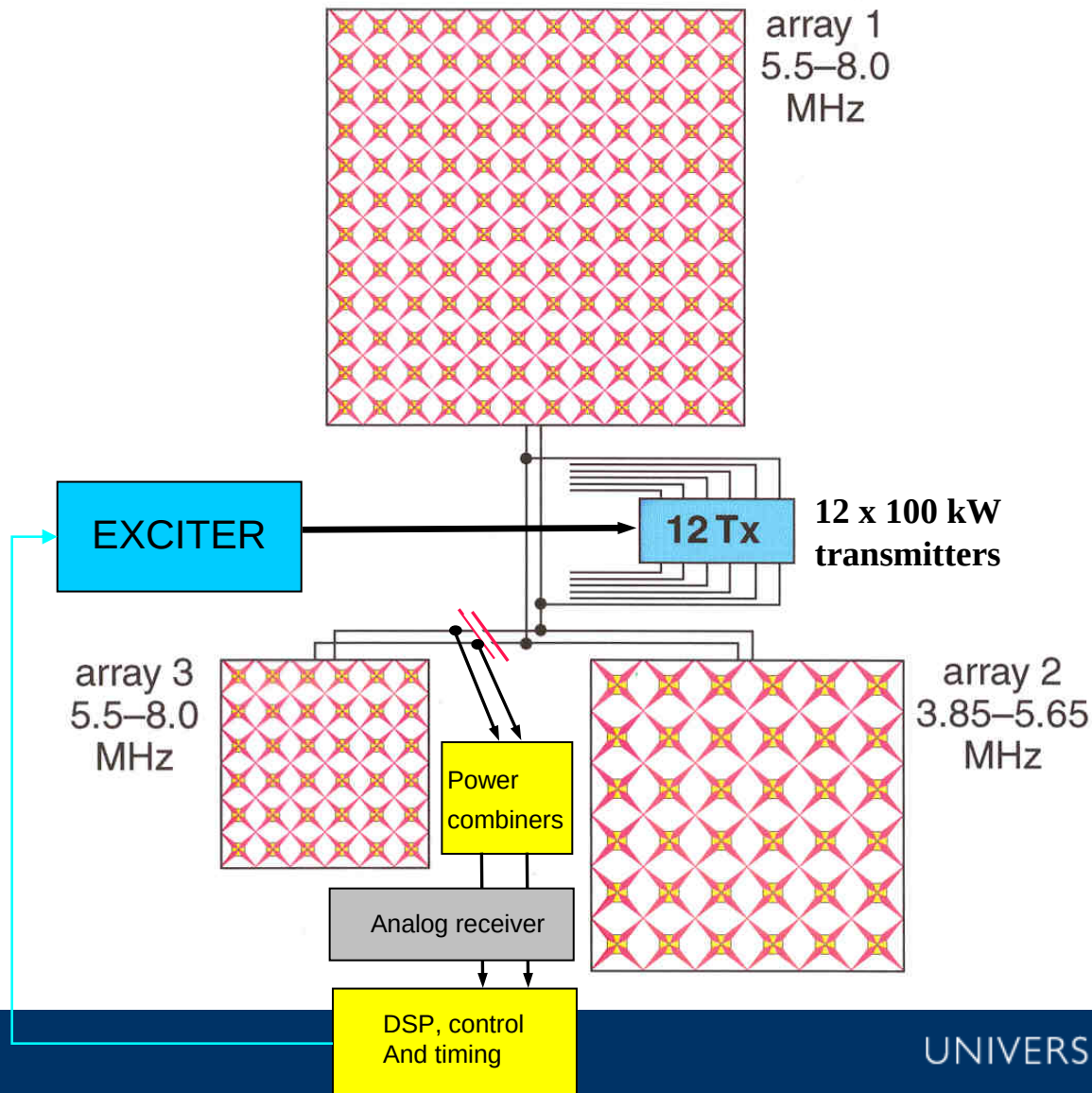
PC for
transmitter
control and
array phasing



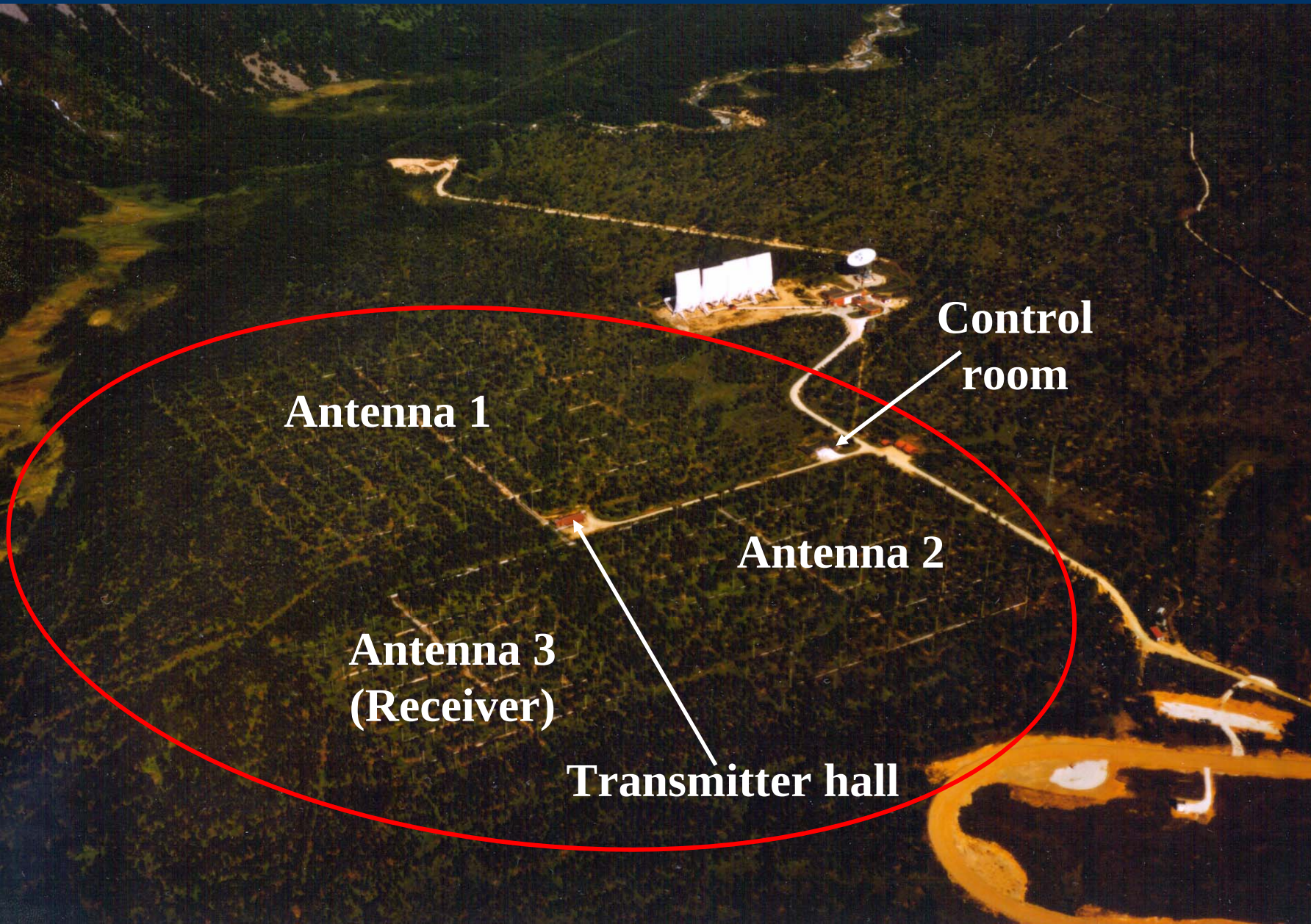
Original HEATING facility layout



HEATING Radar layout

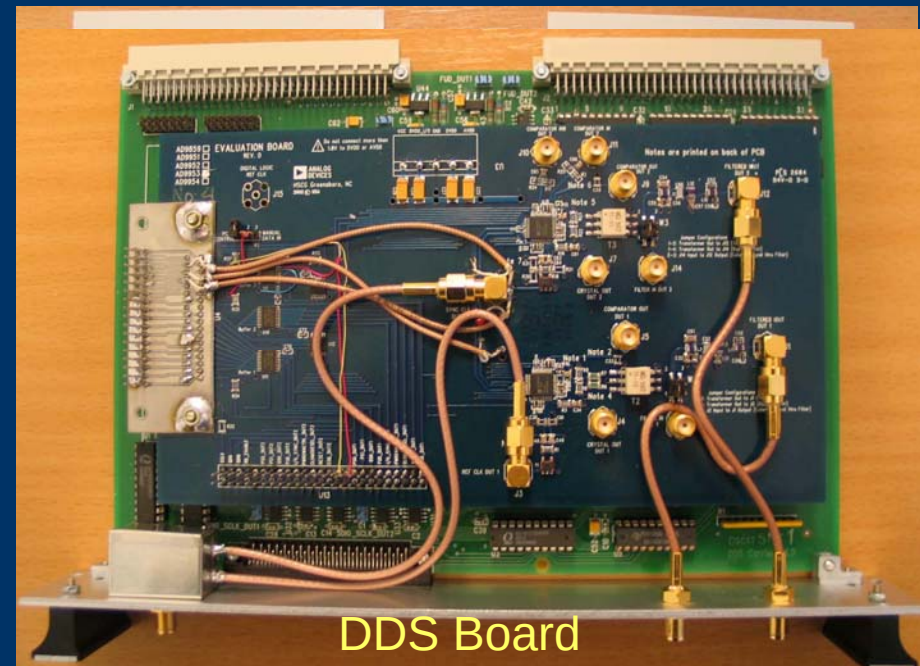
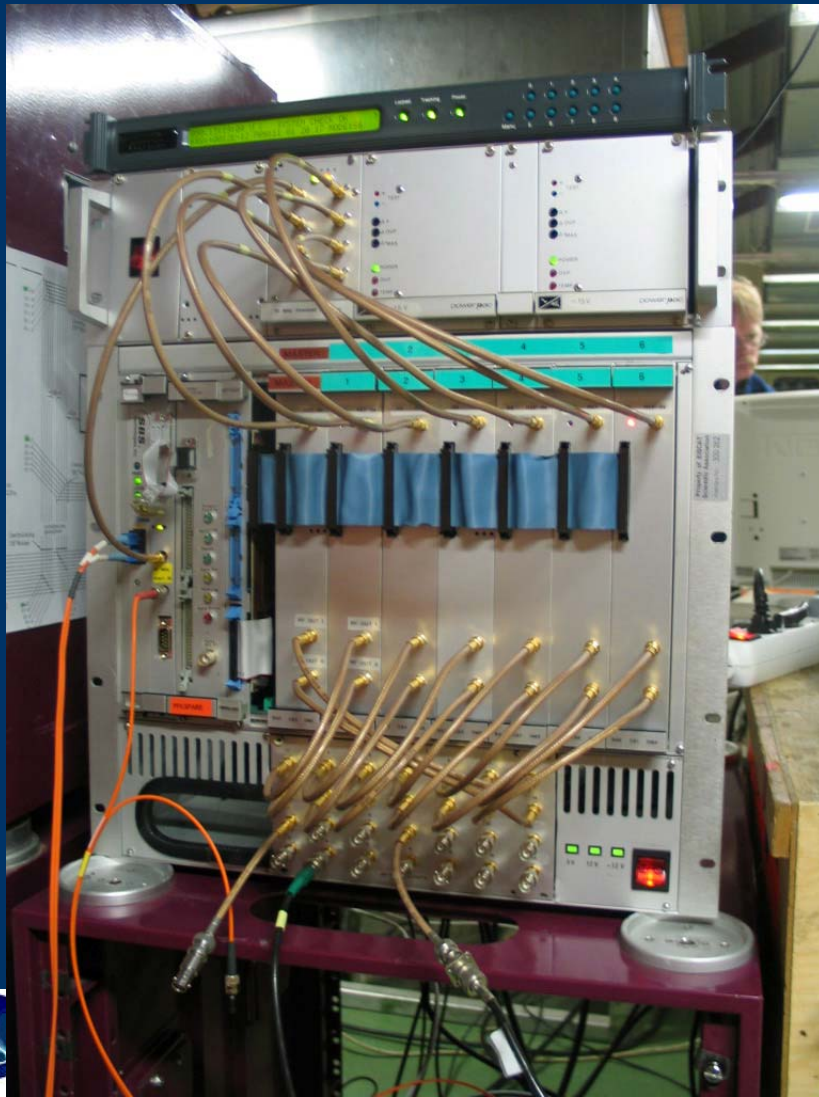
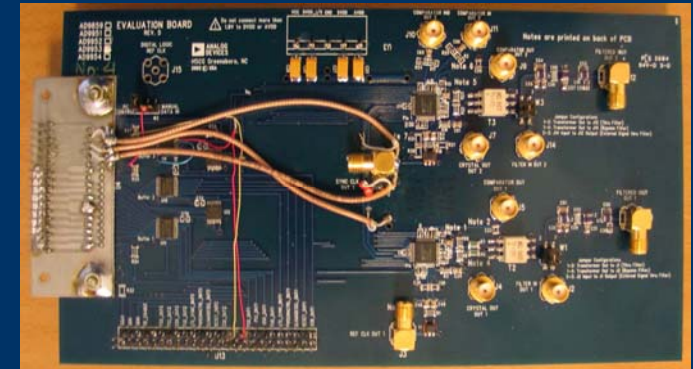


The Heating facility at Tromsø



Heating DDS TX- HW

DDS Module

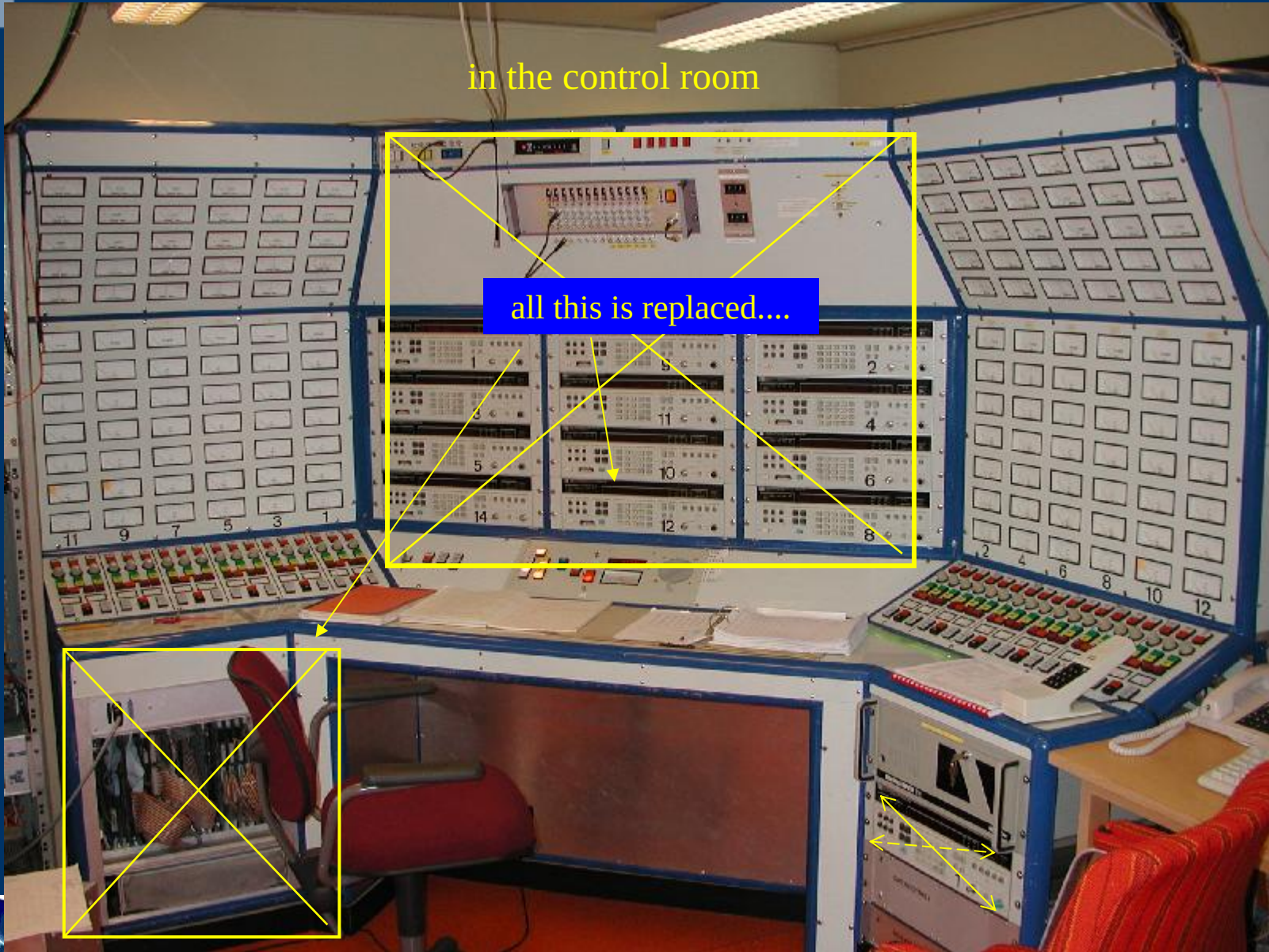


DDS Board

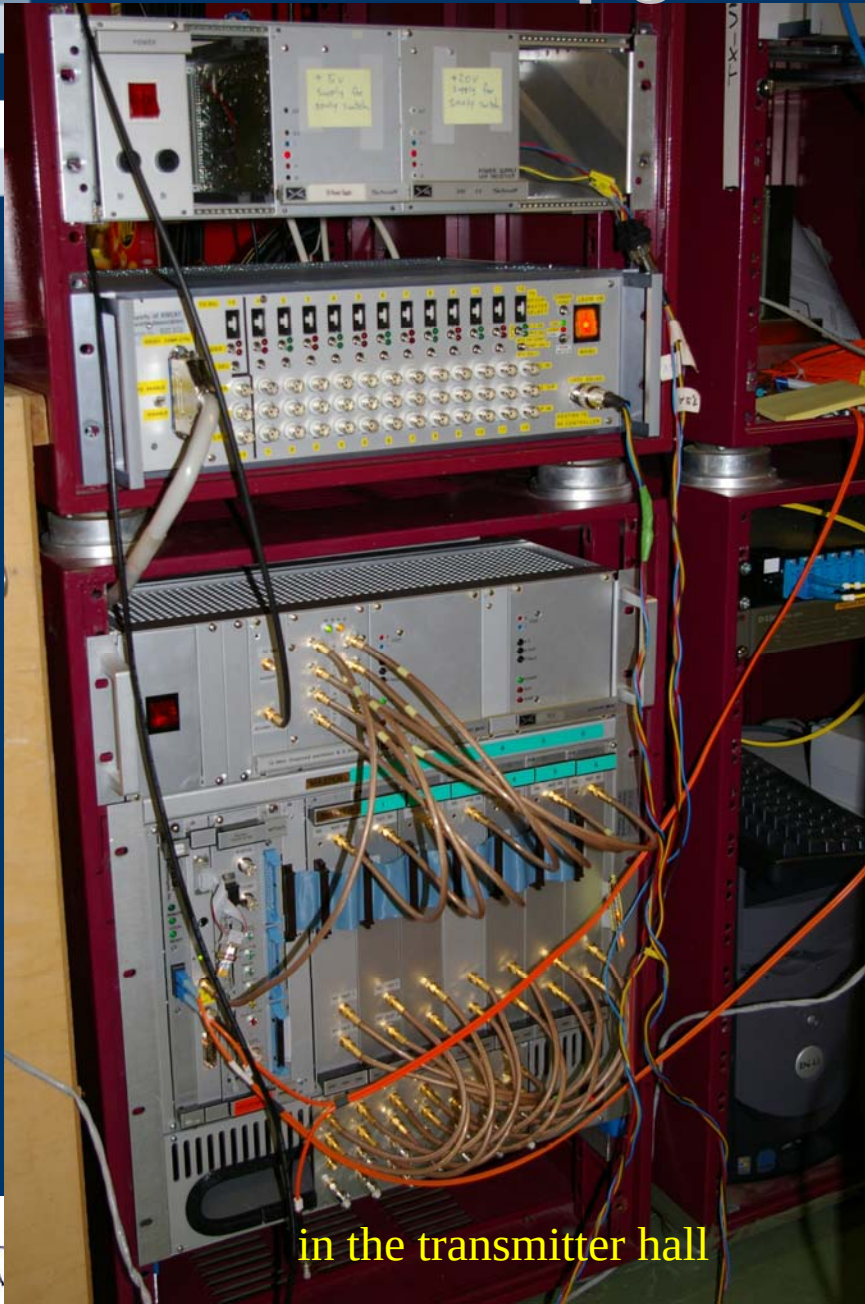
Upgraded Heater

in the control room

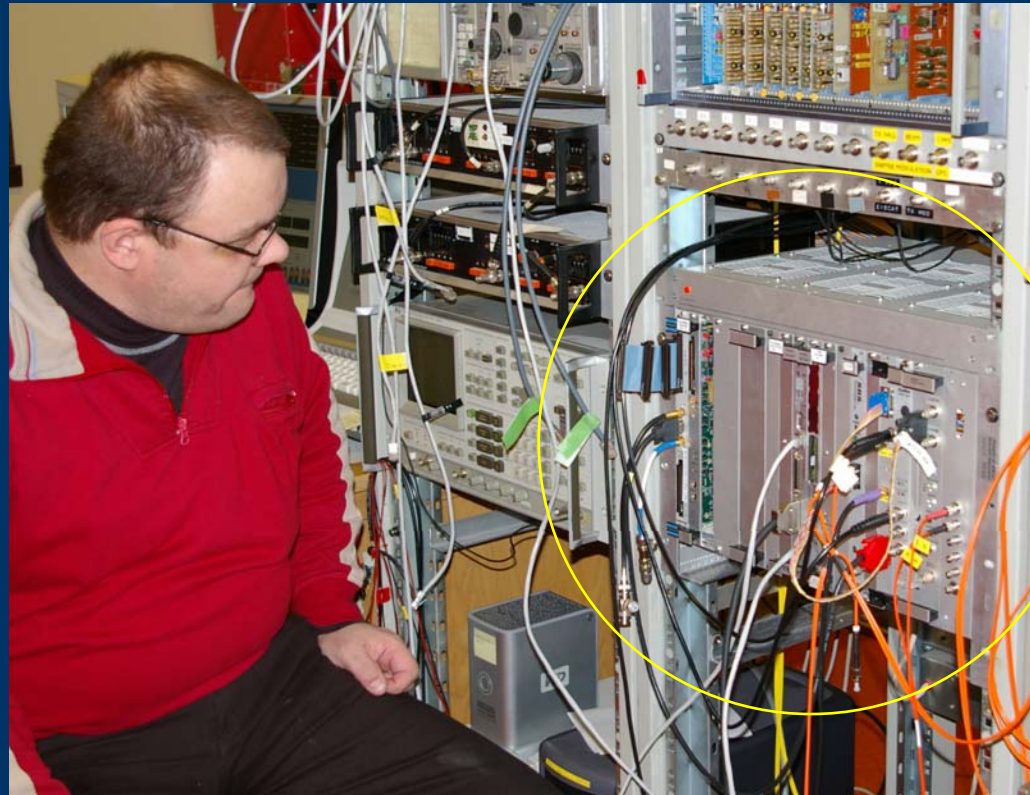
all this is replaced...



Upgraded Heater



in the transmitter hall



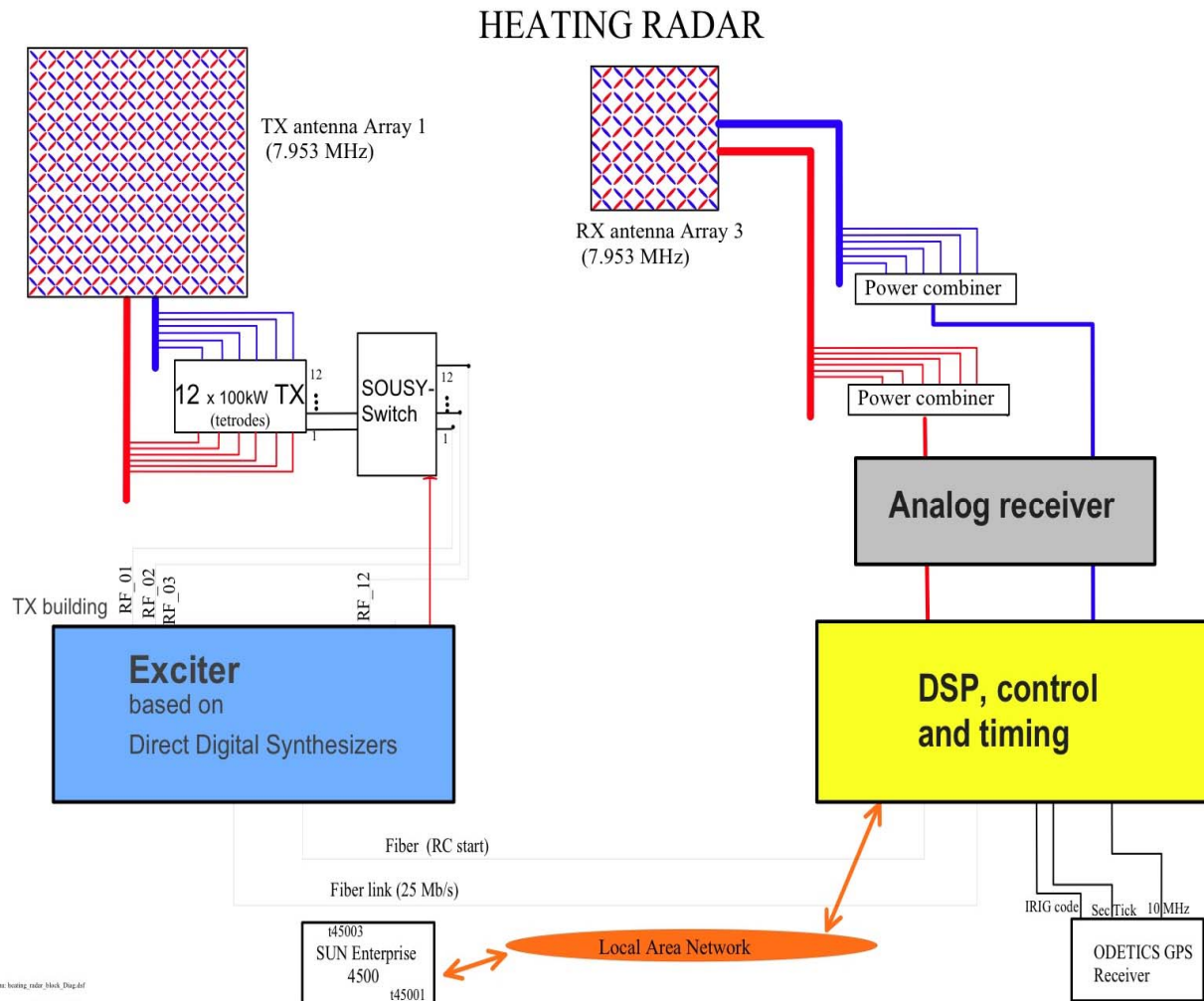
in the control room



Heating server, DSP and timing



Heating upgrade HW status



- HW
 - Exciter built, installed and tested
 - DSP installed and tested
 - GPS for receiver installed and tested
 - All cabling work done
- To be bought
 - Components for the analog receiver
- To be done
 - Analog receiver

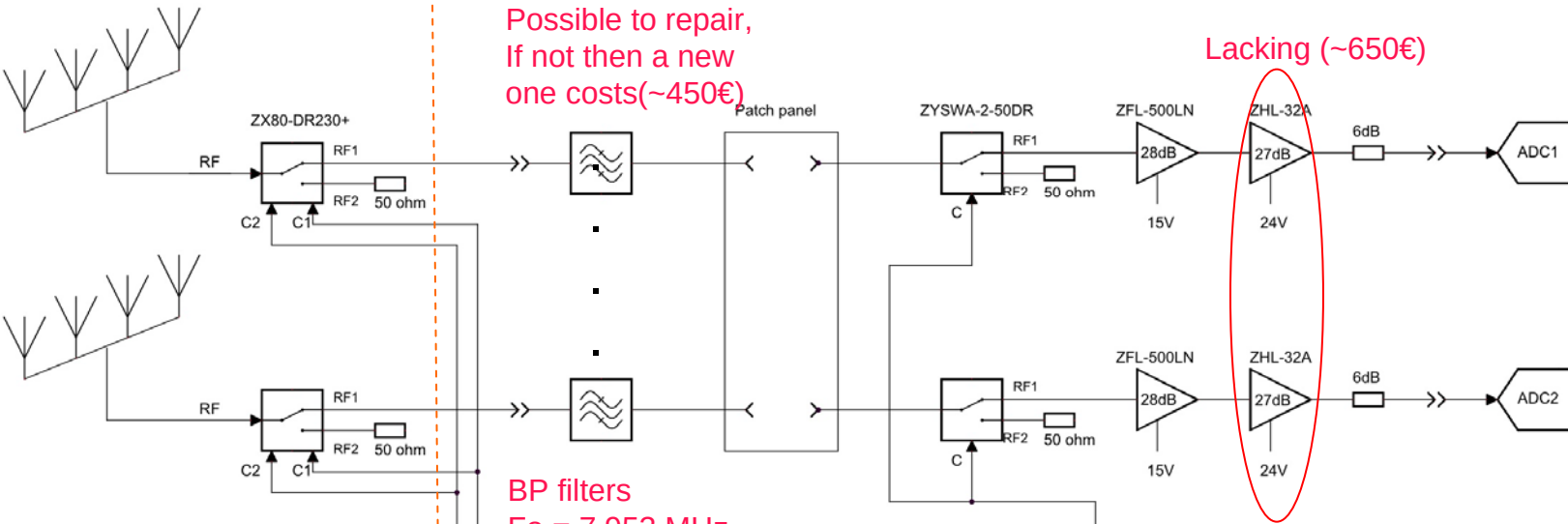
Heating upgrade analog receiver

TX hall

Heating control room

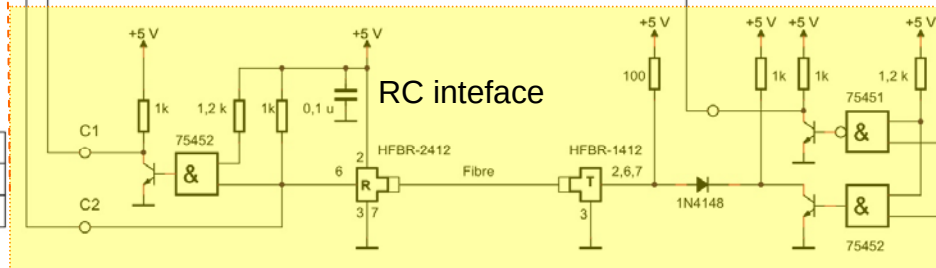
One BP filter faulty,
Possible to repair,
If not then a new
one costs (~450€)

Lacking (~650€)



BP filters
 $F_o = 7.953 \text{ MHz}$
or
 $F_o = 5.423 \text{ MHz}$
(bandwidth +/- ~50khz)

RxProt	Fibre	C2	C1	
"0"	Light	"0"	"1"	RF in - RF1
"1"	No light	"1"	"0"	RF in - RF2, Protect



RxProt	C	
"0"	"0"	RF in - RF1
"1"	"1"	RF in - RF2, Protect

Remaining HW investment costs 800 -1200€ + 2-4 weeks work

EISCAT Kiruna Heating Receiver		
Date 090205/LGV	Design	
Updated	Schematic	Page





The Heating upgrade

Markku, Jussi, Toivo, Mike, Assar, Gudmund

EISCAT

Annual Review Meeting, 11-12 February 2009, Finland

Heater upgrade

The full DDS hardware as well as the receiver hardware works (January 2009)

Features:

Split VME crate operation between Tx-hall and control room.

EROS control of the DDS boards, power-saving relays, transmitters (via old PET computer).

Still to do:

Finish some minor hardware related to the receiving (radar) part.

Write further software

MTR expects that some or all of the **next experiments in March will be performed with the new system.**

(We can still revert to the old system with about 1 hour's work)

MTR hopes to perform some radar experiments in the summer, both mesospheric and magnetospheric.

And more:

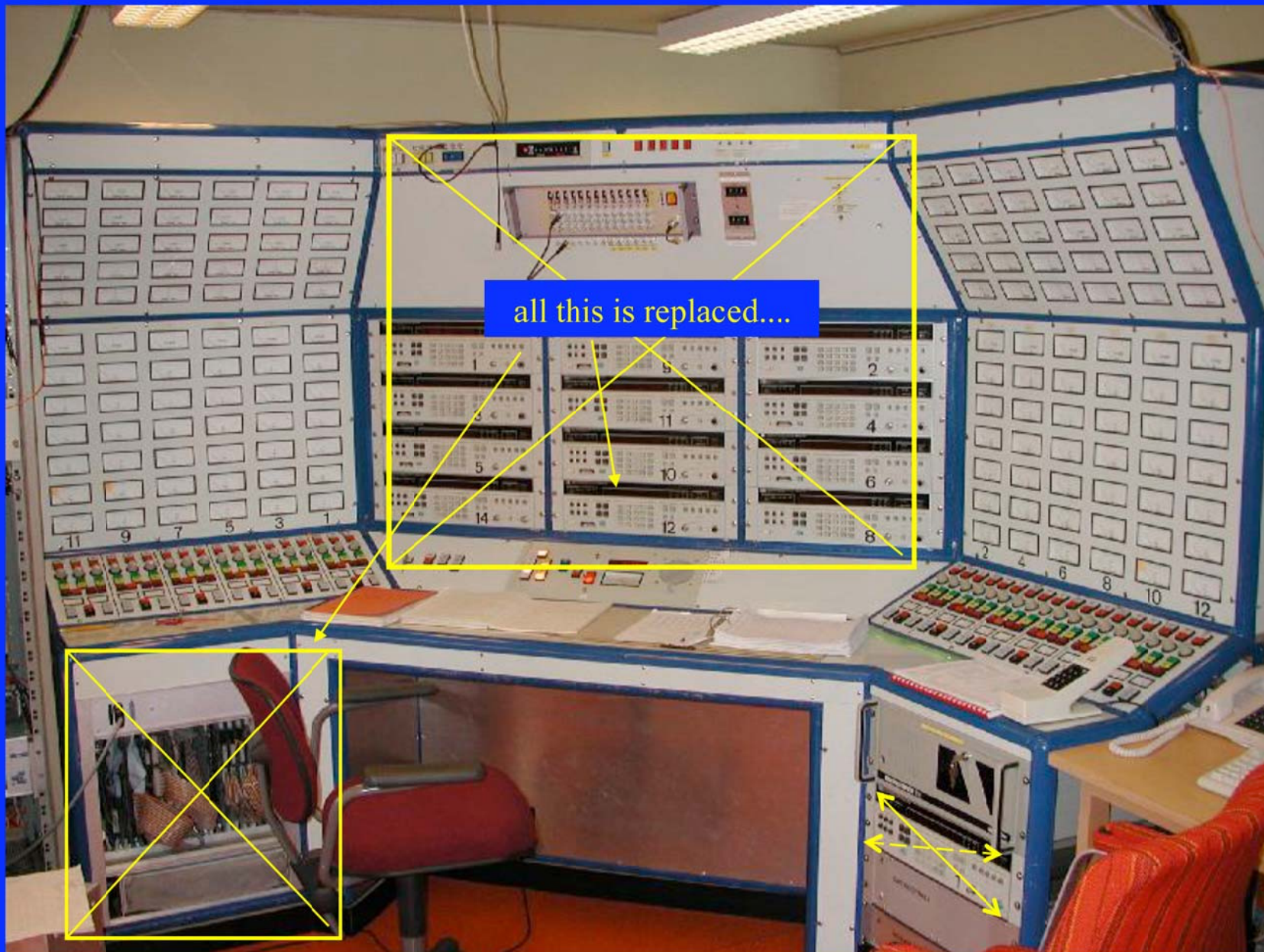
Start earnestly on a design for partial operation on 2.71 MHz.

Heater upgrade

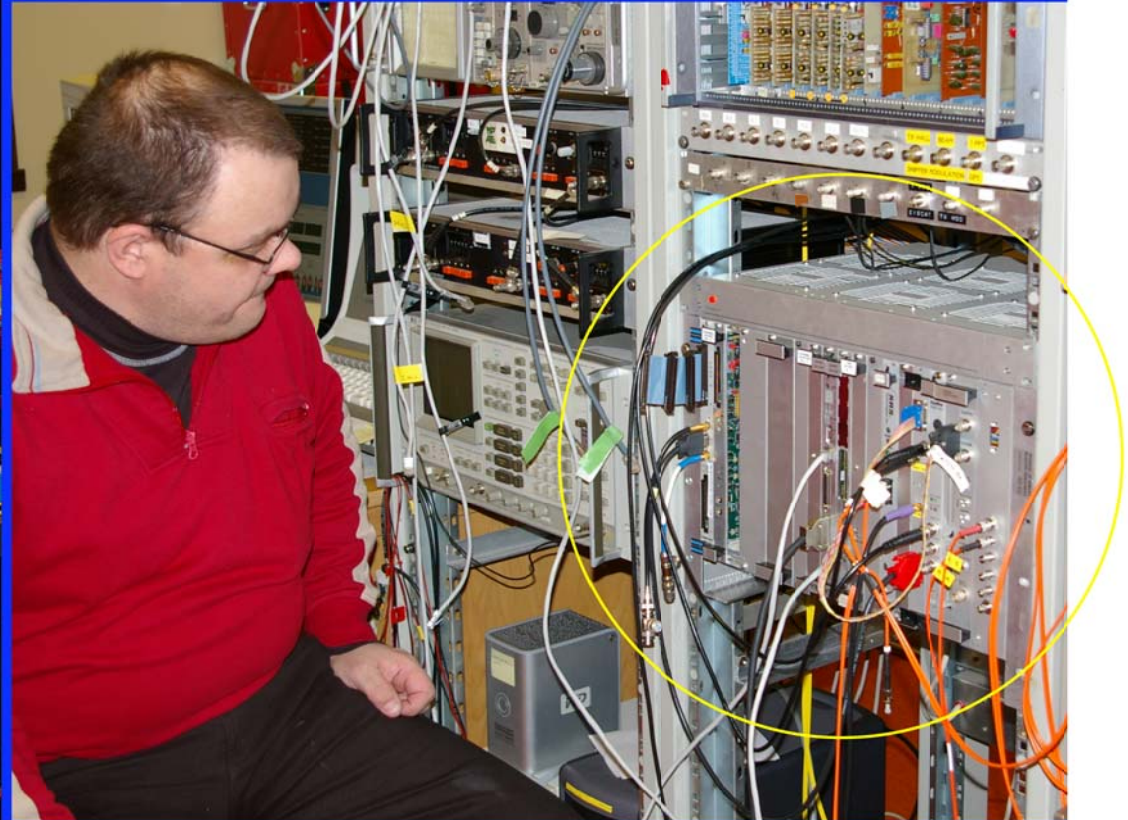
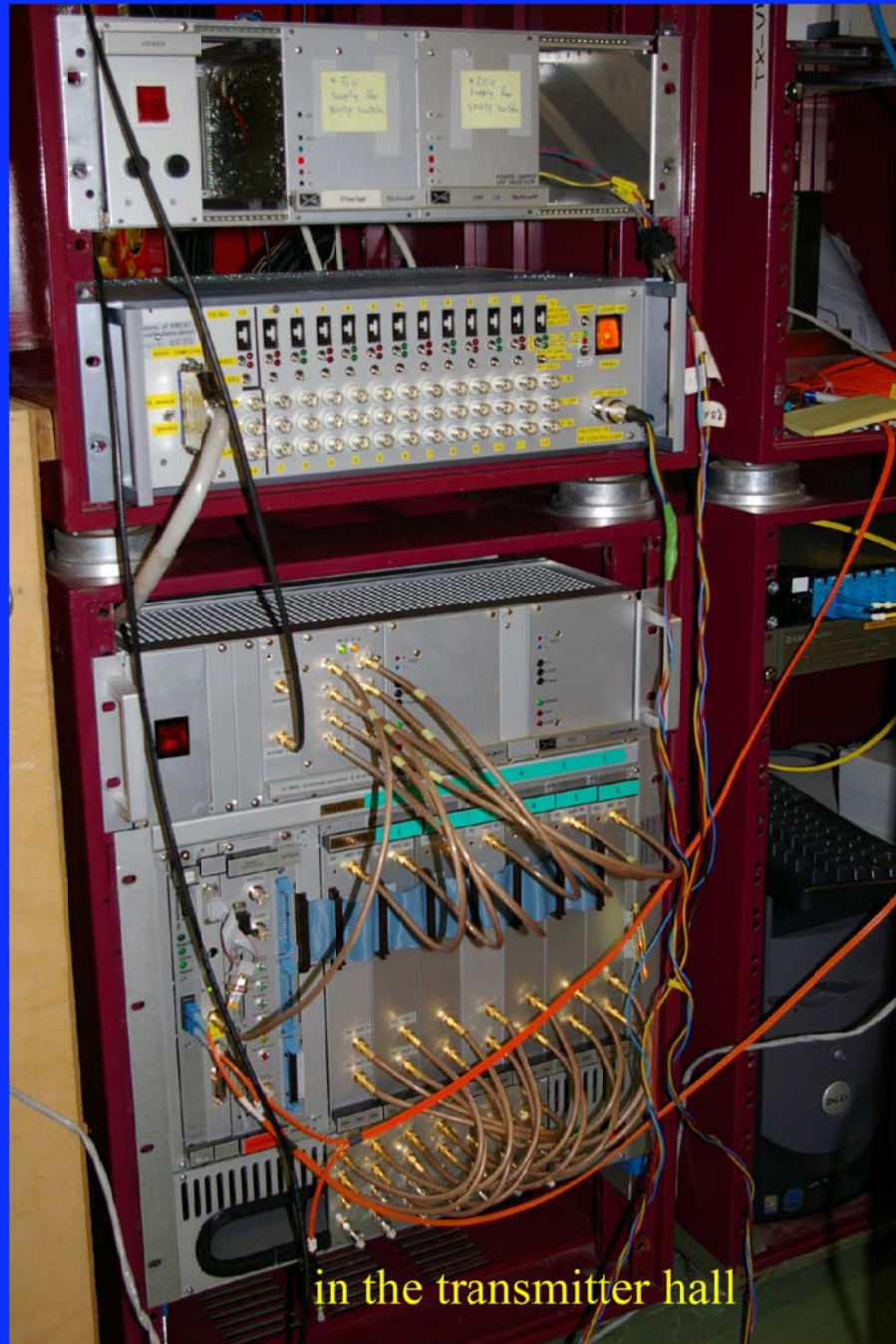
We can still revert to the old system with about 1 hour's work



Heater upgrade



by this...



in the control room

FIRST "FINE-TUNED" BEAM under EROS

Eros h windows, used to define
and start a vertical beam with
4 transmitters, circular polarization,
at 50 kW each



Background watermark: SOLARIS SOLARIS SOLARIS

xclock
Wed Jan 28 19:57:56 GMT 2009

elan (HOT)

28-Jan-2009 19:57:49

Tx	Frequency	Array	Phase	SWR	Power
1					
2					
3	5.4230000	1	+0	1.18	50
4	5.4230000	1	+88	1.04	48
5	5.4230000	1	-3	1.14	46
6	5.4230000	1	+90	1.17	47
7					
8					
9					
10					
11					
12					

messages (HOT)

19:56:26.0: HOT_PrintDDS f
19:56:33.1: HOT_PrintHF
19:56:44.0: HOT_PrintHF
19:56:55.0: HOT_PrintHF
19:57:06.0: HOT_PrintHF
19:57:17.0: HOT_PrintHF
19:57:30.0: HOT_PrintHF
19:57:42.0: HOT_PrintHF
19:57:53.0: HOT_PrintHF

EROS console (HOT)

t1	0.1000	4.040000	44.4
t2	0.1000	4.040000	263.3
t3	0.3700	5.423000	233.2
t4	0.2500	5.423000	253.0
t5	0.2500	5.423000	125.0
t6	0.2800	5.423000	185.0
t7	0.1000	4.040000	358.9
t8	0.1000	4.040000	205.0
t9	0.1000	4.040000	238.9
t10	0.1000	4.040000	80.1
t11	0.1000	4.040000	94.4
t12	0.1000	4.040000	293.1

m1	0.3162	5.423000	0.0
m2	0.3162	5.423000	0.0

I

BEAM FINE-TUNING (interactive under EROS 5)

```
MAIN {} {
  set X /kst/eros5/eros/exp/heating/hot2
  ri @rf_on [file join $X rf_on_tra.tbin]
  ri @rf_off [file join $X rfoff_tra.tbin]
  SYNC -5
  beam define -n beam0
  SYNC 5
  gotoblock IDLE E
}

BLOCK testbeam {} {
  beam set -n beam0 t3,4,5,6 -f 5.423MHz A1 B3
  set x [beam print -n beam0 -def]
  DISP -hms "testbeam: $x"
  gotoblock IDLE now "using t3,4,5,6"
}

BLOCK IDLE { {Msg "---"} } {
  DISP -hms "IDLE: $Msg"
  AT lm
  DO forever {
    SYNC 60
    DISP -hms "IDLE: $Msg"
  }
};# block IDLE
```

```
BLOCK rf_on {} {
  DISP -hms "rf_on ..."
  stopradar trans
  loadradar tra -prog1 0 -f @rf_on
  armradar tra -prog1 -l 5 -s 0
  startradar now 5s
}
```

```
BLOCK rf_off {} {
  DISP -hms "rf_off ..."
  stopradar trans
  loadradar tra -prog1 0 -f @rf_off
  armradar tra -prog1 -l 5 -s 0
  startradar now 5s
  gotoblock IDLE now "rf turned off"
}
```


BEAM FINE-TUNING (interactive under EROS 5)

```
BLOCK beam_up { {Name beam0} } {  
    DISP -hms "beam_up: Starting $Name ..."  
    stopradar all  
    AT now+2  
    beam start -n $Name  
    AT now+28  
    gotoblock IDLE now "beam_up: $Name started"  
};# block beam_up
```

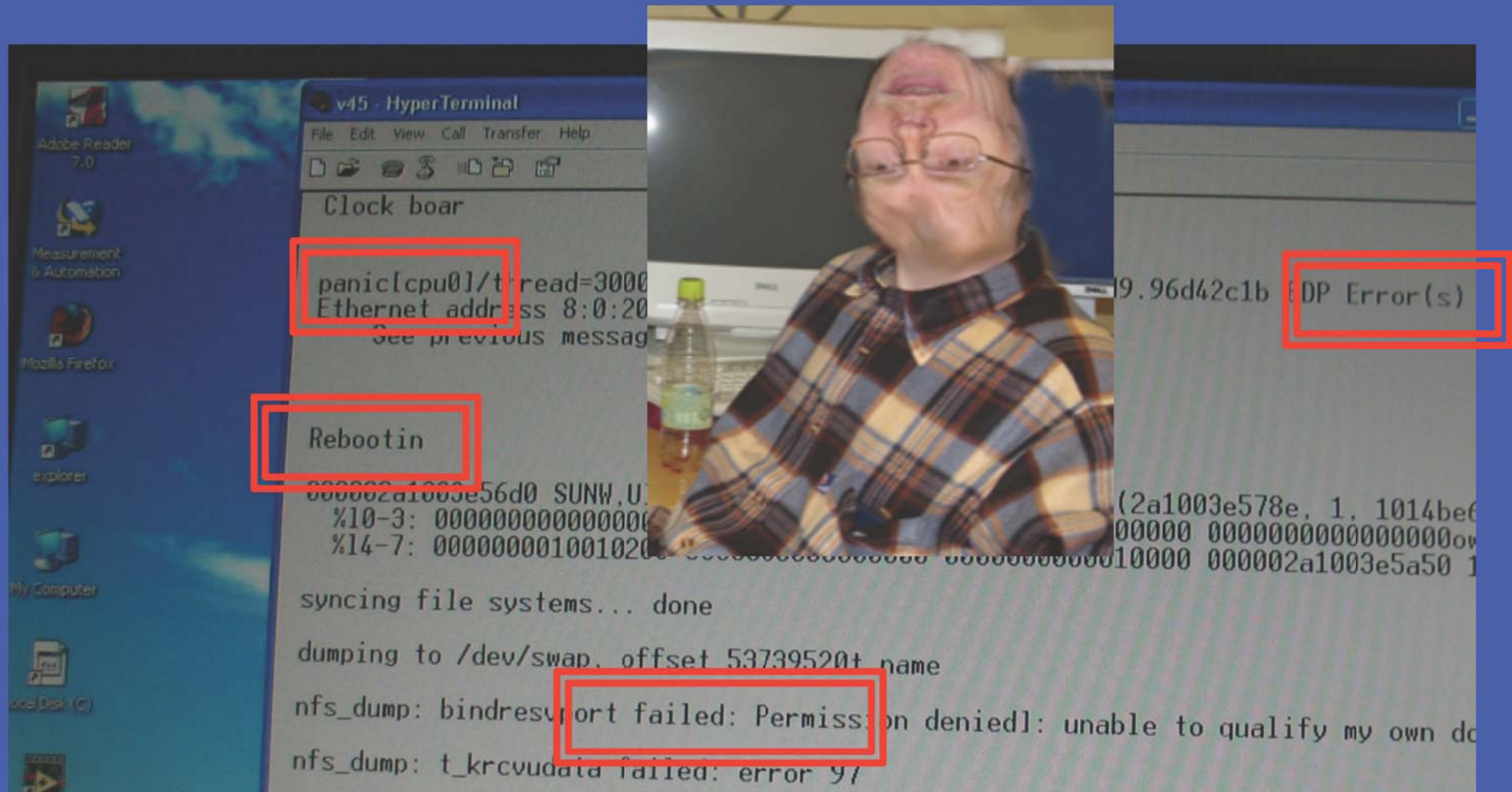
BEAM FINE-TUNING (interactive under EROS 5)

```
BLOCK beam_adjust {} {
  DISP -hms "beam_adjust: doing setcap ..."
  if [eGet SIMU] petclearcommandqueue
  if [ catch {setcapacitor -n "___started"} result ] {
    gotoblock IDLE now "beam_adjust: ERROR: $result"
  }
  SYNC 5
  set OK 0
  for {set k 0} {$k < 10} {incr k} {
    if { [llength [petls caps_ok]] > 0 } {
      set OK 1
      break
    } else {
      DISP -hms " beam_adjust: caps not yet ready ..."
      SYNC 5
    }
  }
  if { ! $OK } {
    DISP -hms. "beam_adjust: ERROR: setcap timed out"
    EngineMsg [list "BLOCK beam_adjust: setcap -- timeout"]
    gotoblock IDLE now "beam_adjust: setcap timed out"
  } else {
    DISP -hms. "beam_adjust: capset OK"
    set msg "Turn HV on and goto powerup"
    consolemessage $msg
    gotoblock IDLE now $msg
  }
};# block beam_adjust
```

BEAM FINE-TUNING)

```
BLOCK powerup {} {  
  
    # Get txlist from the definition of the started beam  
  
    if [ catch {beam get -n ____started -def} result ] {  
        gotoblock IDLE now "powerup: ERROR: $result"  
    } else {  
        set txlist [dict get $result tx]  
    }  
  
    DISP -hms "powerup: $txlist ..."  
  
    # start an RC program to turn all SOUSY switches off  
  
    DISP -hms "powerup: calling rf_on ..."  
    callblock rf_on  
    DISP -hms "powerup: rf_on done"  
  
    # print tx  
  
    if [eGet SIMU] petclearcommandqueue  
    if [catch {printtx} result] {  
        DISP -hms "powerup: ERROR: $result"  
    } else {  
        DISP -hms "powerup: \n$result"  
    }  
  
    # enter an infinite loop to do the fine-turning  
  
    DISP -hms "powerup: entering the fine-turning loop"  
  
    DO forever {
```


There has been an occasional bad moment also ...



What will the upgrade achieve ?

1. Improve reliability

replaces failing analogue synthesizers

replaces ageing long cables between control room and transmitter, less RF leakage and coupling

improved monitoring and logging

What will the upgrade achieve ?

2. Improve the flexibility of HF modulations:

Allow fast frequency changes (to investigate gyroharmonic effects)

Allow arbitrary pulse sequences with precise timing

Allow fast and flexible precisely-timed beam-swinging (north-south)

Allows easier operation of groups of transmitters, e.g. 10 tx for heating and 2 tx as a diagnostic radar, or two groups at different frequencies for non-linear beating experiments

Maybe ... or maybe not ...

What will the upgrade NOT achieve ?

Many modulations/modes that were possible, probably no more are ...

```
1 % hot3_tra.tlan
2 % For heating TX
3 %
4 % 5-Jul-2008 JM
5 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
6
7 % RC PROG 1 for 318 Hz square wave
8
9 AT      2      TRSWON,STMC*,RFON*
10 AT      1572.3  UPD*
11 AT      3144.6  REP          % 5sec IPEI
12
13 % RC PROG 2 for 678 Hz square wave
14
15 AT      2      TRSWON,STMC*,RFON*
16 AT      737.5   UPD*
17 AT      1474.9  REP          % 5 sec IPI
18
19 % RC PROG 3 for 1170 Hz square wave
20
21 AT      2      TRSWON,STMC*,RFON*
22 AT      427.3   UPD*
23 AT      854.7   REP          % 5 sec IPI
24
```

```
# Heating DDS amplitude RAM loader script
# Generated Tue Jun 10 20:53:54 2008 for board0
#
# Modulation type PULSE
# Frequency 1 Hz Period 1000 ms
# Number of samples 2 Sample interval 0.5 s
# Amplitude 0.5 Depth 100%
# Scale 1

# Board selection

/kst/bin/mpv_write -b 80 -d 0x38

# DDS1

/kst/bin/mpv_write -b 88 -d 0xfa # Dummy write to init write strobing
/kst/bin/mpv_write -b 80 -d 0x30 # Select ASFRAM1

#Load amplitude number 0 value 0x1000 (dec 0.25)
/kst/bin/mpv_write -b 48 -d 0x02 # 1 ASF instruction
/kst/bin/mpv_write -b 72 -d 0x00 # ASFRAM1 addr 0x0000 MSB
/kst/bin/mpv_write -b 64 -d 0x00 # LSB
/kst/bin/mpv_write -b 88 -d 0xF9 # Strobe
/kst/bin/mpv_write -b 48 -d 0x20 # 2 ASF amp value D14-D8
/kst/bin/mpv_write -b 72 -d 0x00 # ASFRAM addr 0x0001 MSB
/kst/bin/mpv_write -b 64 -d 0x01 # LSB
/kst/bin/mpv_write -b 88 -d 0xFA # Strobe
/kst/bin/mpv_write -b 48 -d 0x00 # 3 ASF amp value D7-D0
/kst/bin/mpv_write -b 72 -d 0x00 # ASFRAM addr 0x0002 MSB
/kst/bin/mpv_write -b 64 -d 0x02 # LSB
/kst/bin/mpv_write -b 88 -d 0xF9 # Strobe

#Load amplitude number 1 value 0x0 (dec 0)
/kst/bin/mpv_write -b 48 -d 0x02 # 1 ASF instruction
/kst/bin/mpv_write -b 72 -d 0x00 # ASFRAM1 addr 0x0003 MSB
/kst/bin/mpv_write -b 64 -d 0x03 # LSB
```

What will the upgrade achieve ?

3. Allow radar operation

Radar measurements of many phenomena, like turbulence, at multiple wavelengths illuminates the physics,

UHF 16cm, VHF 67cm, HF 40-80 m

Artificial Bragg scatter

Magnetospheric radar (ion-acoustic echoes, conjugate hemisphere echoes)

Mesospheric radar (PMSE, etc)

Lunar radar ?

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Notes on the EISCAT Annual Review Meeting 11.-13.2.2009 Hotel Pallastunturi, Pallas, Finland

In general the site and project presentations were comprehensive and gave a good overview of the current status of the EISCAT facilities and operations. The visiting lecturer Juha Vierinen from Sodankylä gave an inspiring and motivating presentation about the new achievements on Moon mapping and other new applications. First maps of the radar reflectivity of Moon with resolution down to 600 m, measured by the EISCAT UHF radar, were shown to the EISCAT staff by Mr. Vierinen.

Year 2008 showed several important achievements, which together set EISCAT to stand in a very good position for the future, specially taking into account the challenges we will be facing with the need of renewing the mainland radar systems in the coming few years. Although the US radar PFISR and soon RISR in Canada are currently successfully using the next generation phased array technology to produce volumetric radar images of the ionosphere, EISCAT is by no means stepping behind to stay second, but is pushing forward an own development of an even better phased array system, which we hopefully will get into routine operation gradually by 2013-2015 in Northern Scandinavia.

The clearly positive issues brought up during the meeting were:

- 1) Successful operations 2008. The radar use was at a planned level and a multitude of different scientific applications appeared. Continuous measurements during the International Polar Year ended in March 2008, but the data is surely going to produce several publications in the coming years
- 2) New applications appeared. The radar was used in a novel way and new applications appeared. One of them is the mapping of radar reflectivity of the Moon.
- 3) New international projects were approved on ESFRI Roadmap of large European research infrastructures for the next 30 years. Both EISCAT mainland and Svalbard operations in the future will be secured and developed due to the political decision at EU member state level to include the EISCAT 3 D proposal and the Svalbard Integrated Arctic Earth Observation System, SIOS, on the roadmap.
- 4) The EISCAT 3D Design Study advanced well during the year. Although a lot of documentation and report writing still awaits before the end of the project in April 2009 we should be ready go to the next step, the actual implementation study on how the radar is built in practice and how the construction of sites is started for the final science application of the EISCAT 3D. The work done with the demonstrator receiver array at the Kiruna site was remarkable. Although the final tests with the Tromsø VHF transmitter still need to be done because the software beamforming is not yet finished, the whole signal path from antennas to EISCAT receivers is now demonstrated in hardware.
- 5) The upgrade of the Tromsø heating facility, to replace the old analog hardware with digital one, is well advanced and can be finished before the coming summer. Heating upgrade will provide opportunity for new experiments, including the radar application of the heater, where new interesting physics is expected to be investigated.

As negative side of the happenings in 2008, two major things came out:

- 1) Quite many faults appeared in 2008. Although these in general were promptly and appropriately repaired, this is a sign of need of more attention to carry out preventive maintenance. Problem here is clearly the resource in the amount of manpower: staff has been reduced during the last years so that extra efforts outside the normal operations are difficult to organize without overloading the staff, the number is clearly driven to minimum at sites.
- 2) EISCAT is soon losing the frequency allocations of the present radars at mainland. The current frequency permissions run for the next 2 years. Once earlier in the history of EISCAT we have had a 2 year operation permit. Although there is no obvious reason given that we would not be able to renew the permits, they can't be continued too far into the future. The Tromsø protection area for UHF is announced to be not renewed after 2013, which gives only 4 years possible time for monostatic UHF operations Tromsø. The remote sites Sodankylä and Kiruna will suffer from releasing the band for mobile communication operators already starting from next year and in Norway there is a threat of Digital Audio Broadcasting being discussed to maybe need the VHF band already after the next 2 years. EISCAT Headquarters asked for negotiation of the overall situation with the Norwegian authorities during the spring, but currently there is no answer to this request yet.

Action items noted by the director:

- 1) Increase communication at all levels.
 - Regular meetings at all levels need to be arranged, in order to increase communication
 - Site leader meetings need to be re-established. This could be twice a year, well before the council meetings.
 - Teleconferencing and web-based videoconferencing should be used when technically feasible. This has already successfully been used for EISCAT 3D.
 - EISCAT scientists should also gather for a general operations and planning meeting
- 2) Staff complement plan
 - Web pages, a short term employment for a web designer will be announced by HQ
 - EISCAT 3D project manager at senior scientist level. This will be a time-limited position at HQ, to be announced very soon. The task is to write the application to EU for the EISCAT 3 D implementation study.
 - Tromsø site has a staff complement plan with the associated and presently short-term hired persons. This may need re-evaluation when we know how the operations will evolve after the coming 2 years.
 - Remote sites Kiruna and Sodankylä were heavily involved in the EISCAT 3D design study. Staffing in the future will depend on the need of the development type work done at the sites. This is a topic which also depends on the interests of the host institutes, and is to be discussed by the director with the host institutes urgently.
 - ESR staff development is depending on the evolution of the SIOS ESFRI project, and possible sharing of the work between operators UNIS, UiT and EISCAT.
- 3) Practicalities

When the EISCAT 3 D project starts running fully, we inevitably need a joint project calendar. Some steps towards joint scheduling, in the form of open or joint calendars should be taken already before the EISCAT 3 D next phase.