The EISCAT 3D Project

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EISCAT Scientific Association

Background
Project Status
Opportunities
What is EISCAT 3D:

New generation atmospheric radar:
  multi-static phased array radars
  advanced digital processing

EISCAT community heritage:
  radar instrumentation
  radar codes
  inversion techniques
Why EISCAT 3D:

Need to

replace existing system
change observation frequency
expand research theme
stay competitive
When EISCAT 3D:

2001 -

    discussions within EISCAT user community

2006 – 2009

    FP6 design study

2010 – 2014

    FP7 preparatory phase

Need investments

Need to start construction
Results of the Design Study (2005 – 2009)

Performance Specification
Site surveys
Frequency allocations
Science Case
Antennas
Front End
Beam-forming
Imaging system
Transmitter
Data system
EISCAT 3D

ESFRI Roadmap*

2008

ESFRI:
European Strategy Forum on Research Infrastructures
to develop the scientific integration of Europe
to strengthen its international outreach

*EISCAT 3D for the environment
EISCAT 3D

preparatory phase
October 2010 – September 2014
FP7 call: “Construction of new infrastructures”

Aim:

ensure that the EISCAT_3D project will reach a sufficient level of maturity with respect to technical, legal and financial issues so that the construction of the EISCAT_3D radar system can begin immediately after the conclusion of the phase.
EISCAT_3D_2 Preparatory Phase

Funded by the European 7th Framework Programme

- Application submitted Dec. 2009
- Accepted April 2010
- 4.2 M€ contract signed September 2010
- 4 year project started 1st October 2010
- 14 work packages: **UiT/IFT**
  - WP1: Management and reporting
  - WP2: Legal and logistical issues
  - WP3: Science planning
  - WP4: Outreach activities
  - WP5: Consortium building
  - WP6: Performance specification
  - WP7: Signal processing
  - WP8: Antenna, front end and timing
  - WP9: Transmitter development
  - WP10: Aperture synthesis imaging
  - WP11: Software theory & implementation
  - WP12: System control
  - WP13: Data handling & distribution
  - WP14: Mass-production & reliability

EISCAT_3D

A European Three-Dimensional Imaging Radar for Atmospheric and Geospace Research

Application for Preparatory Phase Funding under the European 7th Framework
EISCAT 3D Preparatory Phase

Project Structure

Projects partners:

- EISCAT Scientific Association
- Tromsø University
- Luleå University
- Swedish Institut for Space Physics
- Oulu University
- Swedish Research Council
- National Instruments
- Rutherford Appleton Laboratory
EISCAT 3D Preparatory Phase
Project Structure

**General Assembly**
- one member from each partner
- two members from coordinator
- Meets twice per year and makes major decisions
EISCAT 3D Preparatory Phase

Project Structure

Executive Board Members

- Esa Turunen: EISCAT (coordinator)
- Henrik Andersson: EISCAT
- Thomas Ulich: Oulun Yliopisto (UOULU)
- Jonny Johansson: Luleå Tekniska Universitet (LTU)
- Ian McCrea: Science and Technology Facilities Council (STFC)

Weekly telecon, Physical Meeting 4 x per year
EISCAT 3D Preparatory Phase
Project Structure

TAC members:
Frank Lind, MIT Haystack (technical coordinator)
Werner Singer, IAP Kuehlungborn
Tom Grydeland, Norut Tromsø
Jan Geralt Bij de Vaate, Astron, Dwingeloo

First meeting 15. September 2011
Plans two physical meetings per year
Project & Users

Science group meetings twice per year
Project All Hands meeting (once per year)

National meetings
Discussions during other EISCAT meetings
Project Status

FP7
progress in different workpackages
need more coordination of technical efforts
first periodic report in March 2012

Swedish 2 year Planning Grant 2012-2013
Timeline* EISCAT 3D

Preparatory Phase 2011-2014

2008

2011
- Consolidation
- Work on new agreement

2012
- Decisions
- First commitments

2013
- Site works commence

2014
- Manufacturing and/or
- Prototype build

2015
- Installation

*reported to ESFRI September 2011
Basic EISCAT 3 D

cost of order 120 M€
plan modular construction
adjust to funding scheme
start at available sites
initial site for prototype
proof of concept & first science
### Basic EISCAT 3 D

**Core:**
- mono – static transmitter/receiver array
- plus outlier receiver array

**4 Remote sites:**
- receive-only arrays

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<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Centre frequency</td>
<td>233 MHz</td>
</tr>
<tr>
<td>Peak output power</td>
<td>10 MW</td>
</tr>
<tr>
<td>Instantaneous –1 dB power bandwidth</td>
<td>5 MHz</td>
</tr>
<tr>
<td>Pulse length</td>
<td>0.5–3000 $\mu$s</td>
</tr>
<tr>
<td>Pulse repetition frequency</td>
<td>0–3000 Hz</td>
</tr>
<tr>
<td>Wave modulation</td>
<td>Arbitrary waveform</td>
</tr>
</tbody>
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<td>Centre frequency</td>
<td>233 MHz</td>
</tr>
<tr>
<td>Instantaneous bandwidth</td>
<td>$\pm 15$ MHz, at distant sites $\pm 5$ MHz</td>
</tr>
<tr>
<td>Overall noise temperature</td>
<td>$&lt;50$ K referenced to input terminals</td>
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<tr>
<td>Spurious-free dynamic range</td>
<td>$&gt;70$ dB</td>
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Basic EISCAT 3 D

Core: mono – static transmitter/receiver array
      plus outlier receiver array

4 Remote sites: receive-only arrays

Supporting Instruments:
  heating facility
  CCD cameras with filters
  imaging spectrometer
  digital ionosondes
  platform for further instrumentation
EISCAT 3 D – basic site configuration

- Core site: 69°N, 20°30'E
- D region sites: ≈ 90 – 120 km
- F regions sites: ≈ 220 – 280 km

- F2 region
- F1 region
- E region
- D region

Baseline and altitude axes are shown in the diagram.
Wishlist what core site location should permit:

- studying atmospheric phenomena at low altitude that appear east of the Scandinavian mountain range
- observing together with supporting optical instruments which requires clear skies
- measuring along the geomagnetic field lines that are followed by the downleg path of sounding rockets

→ optimum core site ≈ 69° N 20.5° E
need to keep $\approx 40$ km distance from DAB transmitters
EISCAT 3D will be

**advanced laboratory** to study plasma phenomena on small spatial scale ($\approx 100$ m)

**flexible observatory** for space weather and atmospheric studies (seconds to years)

**key facility** in multi-instrument and global campaigns

**data provider** for Earth system modelling

($\approx$ TB/s, store $\approx 1000$ TB/yr)
Expanding Community
Data handling & processing
Atmospheric Modelling
Education
Collaborations in Nordic Region

Opportunities
Opportunity:

(contributions from France, Russia, Ukrania)

.........expand membership