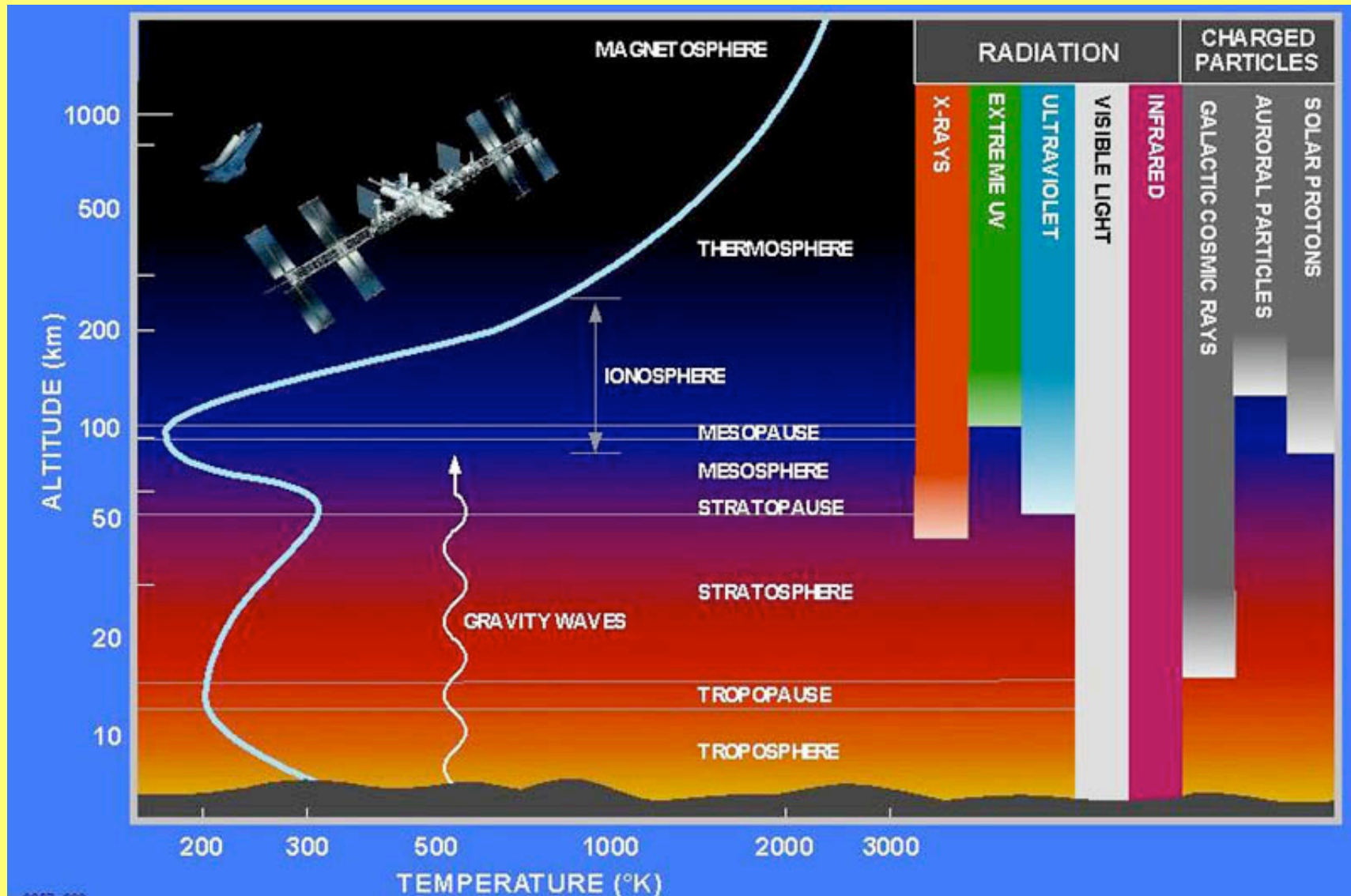


The Advanced Modular Incoherent Scatter Radar (AMISR) *Historical Perspectives*

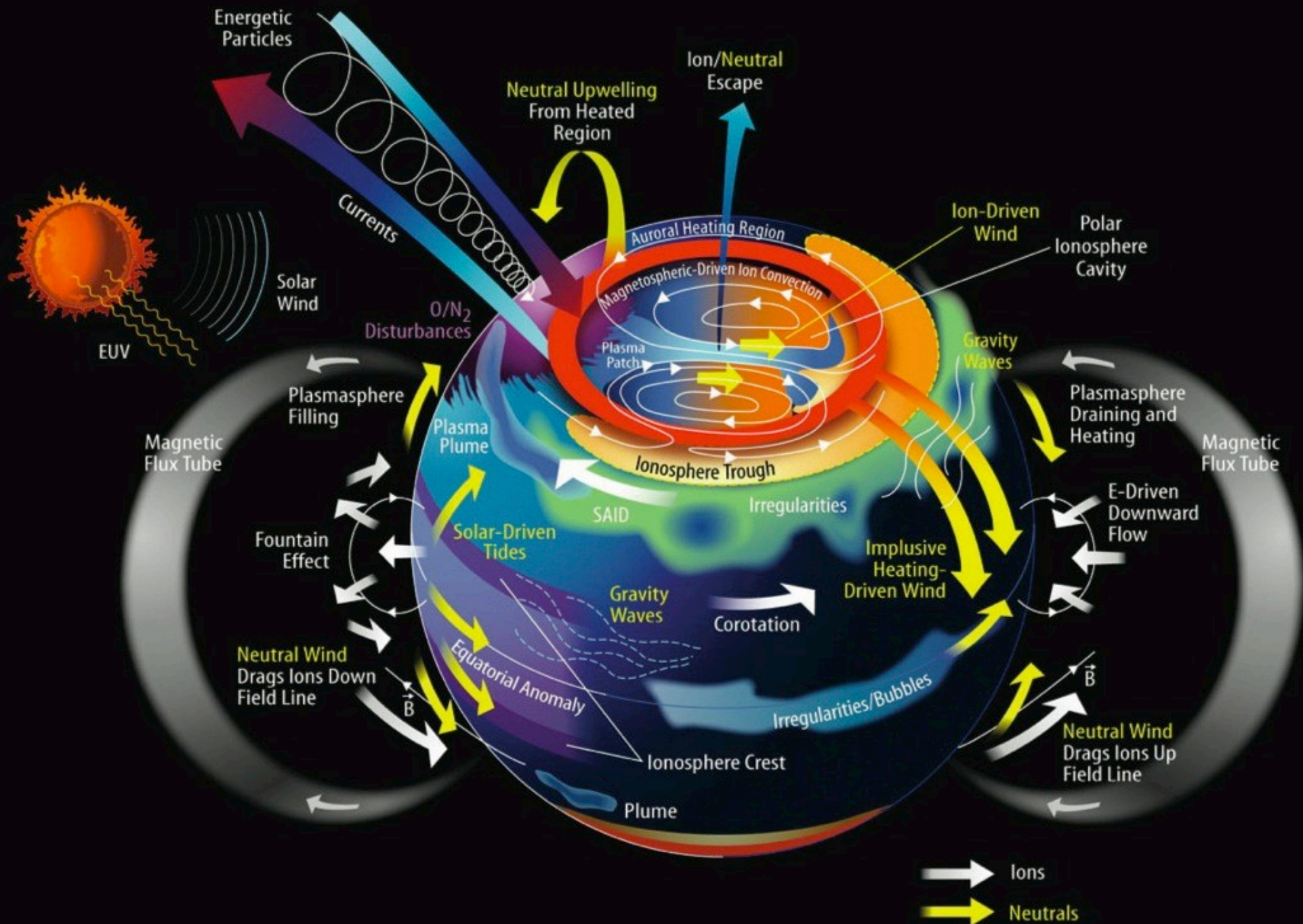


Bob Robinson
National Science Foundation

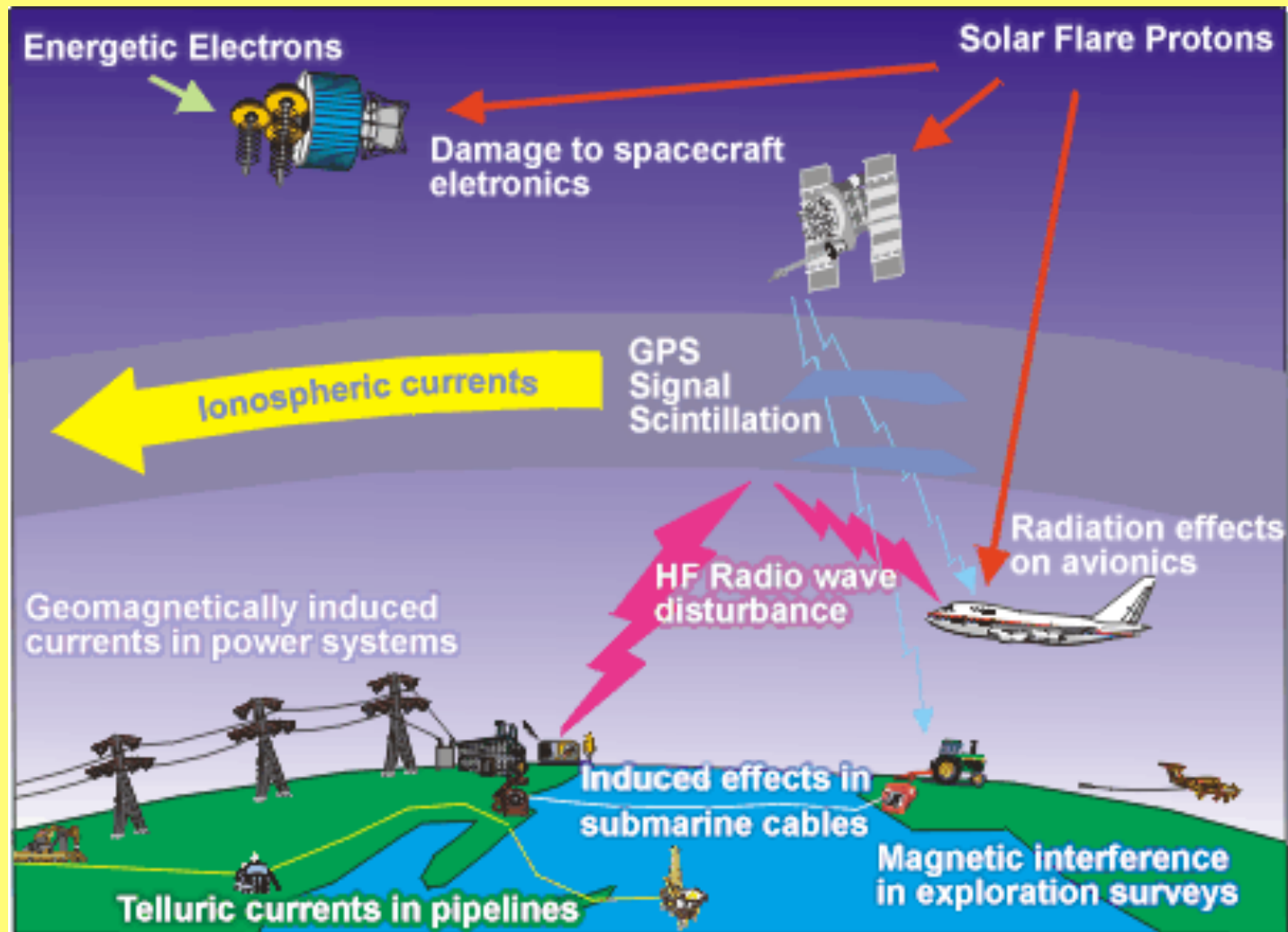
Earth's Atmosphere



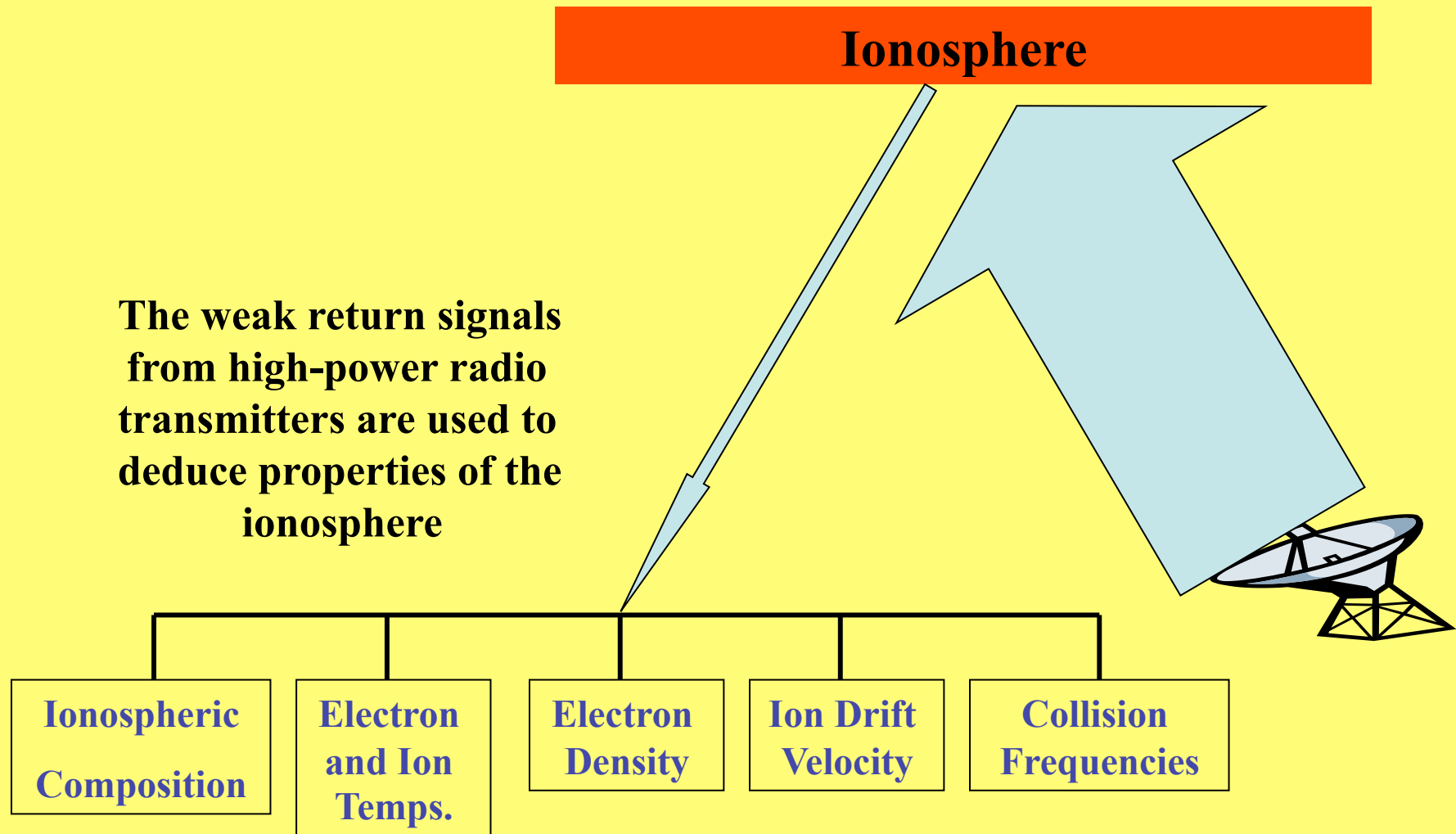
The Ionosphere/Thermosphere/Mesosphere



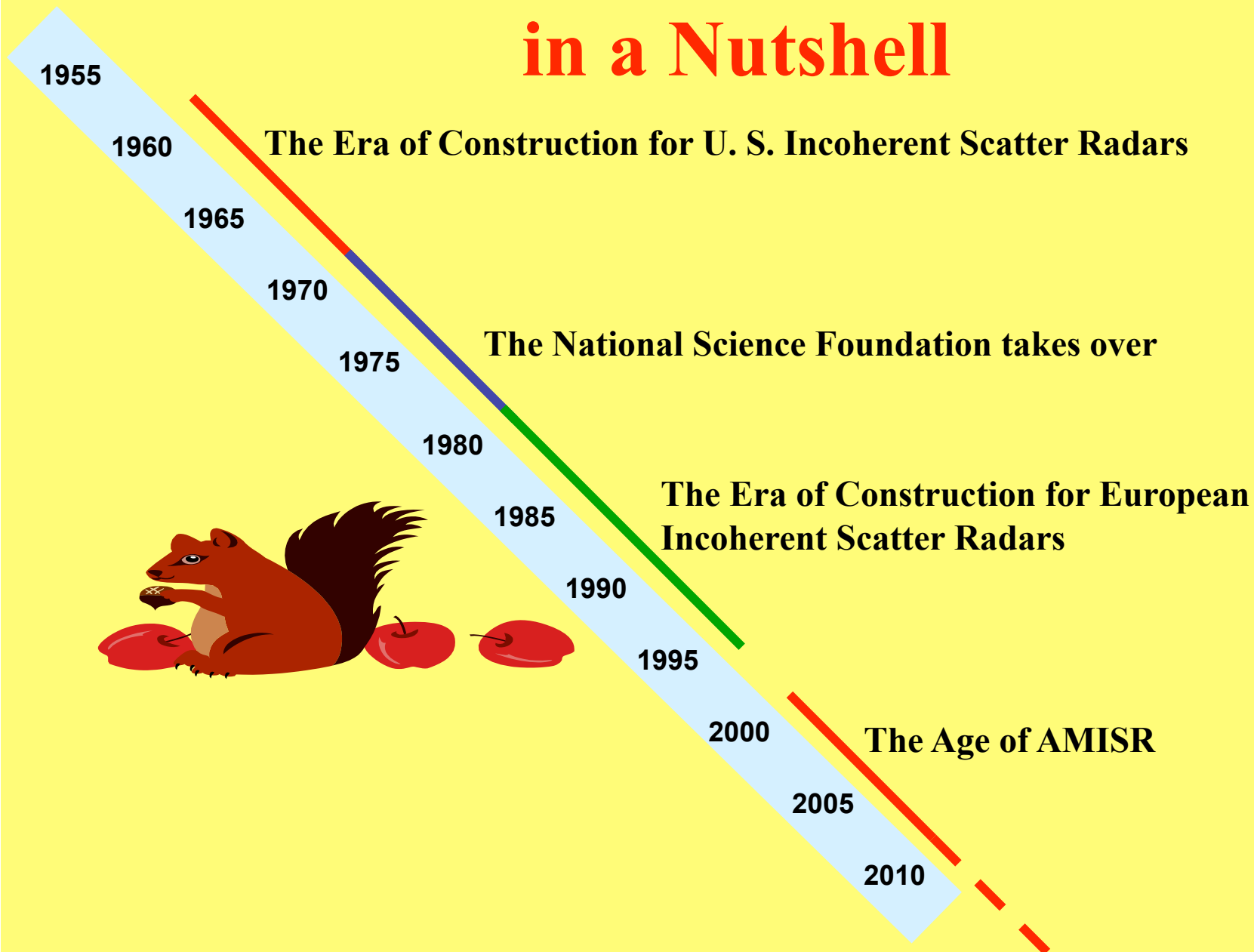
Space Weather Effects



Incoherent Scatter Radars: The most direct technique for routinely observing fundamental properties of the ionosphere and upper atmosphere.



The History of Incoherent Scatter in a Nutshell



1958-1959

**Bill Gordon
conceives of the idea
of incoherent scatter
and construction
begins at Arecibo,
Puerto Rico, with
funding from the
Defense Advanced
Research Project
Office (DARPA)**



1961

The Jicamarca Observatory is constructed near Lima, Peru, by the National Bureau of Standards.



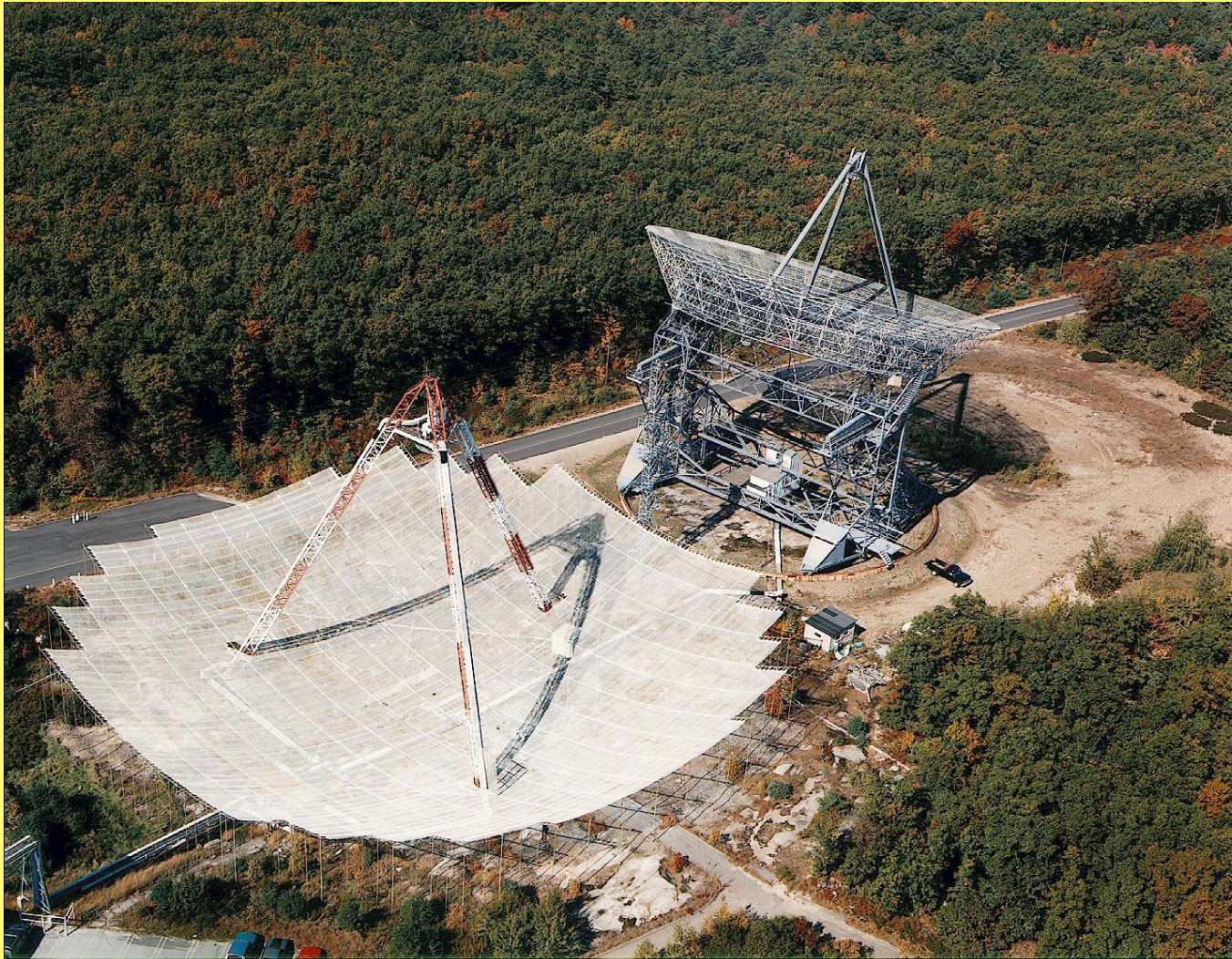
1962

Construction of Arecibo is completed.



1963

The Millstone Hill zenith antenna is constructed by MIT Lincoln Laboratories at a site near Boston, MA



1971

The Chatanika Radar is moved from Stanford University to a new site near Fairbanks, Alaska.



1982

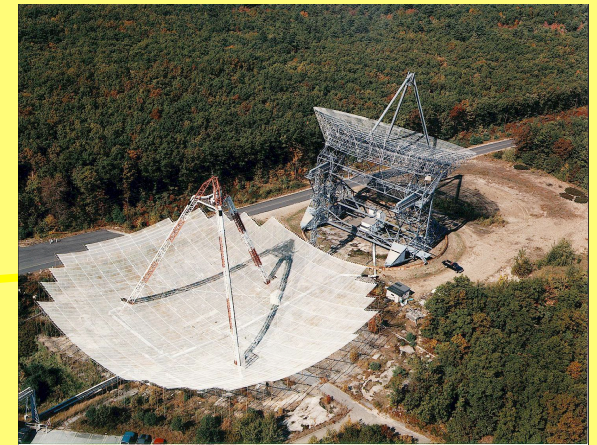
The Chatanika Radar is moved to a new location near Sondrestrom, Greenland,

1970 – 1980

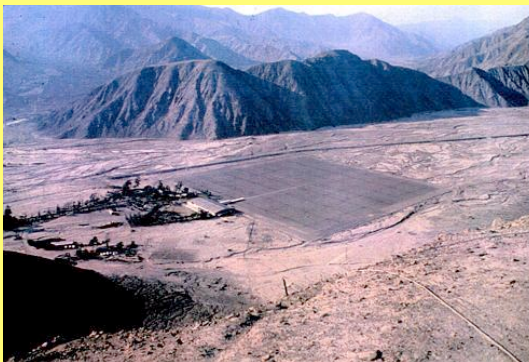
**The U. S. National Science Foundation takes
over operation of four incoherent scatter radars**



Sondrestrom



Millstone Hill



Jicamarca



Arecibo

1981

The European conquest begins with the construction of the EISCAT UHF system at Tromsø, Norway.



1985

The EISCAT VHF system begins operation at Tromsø.



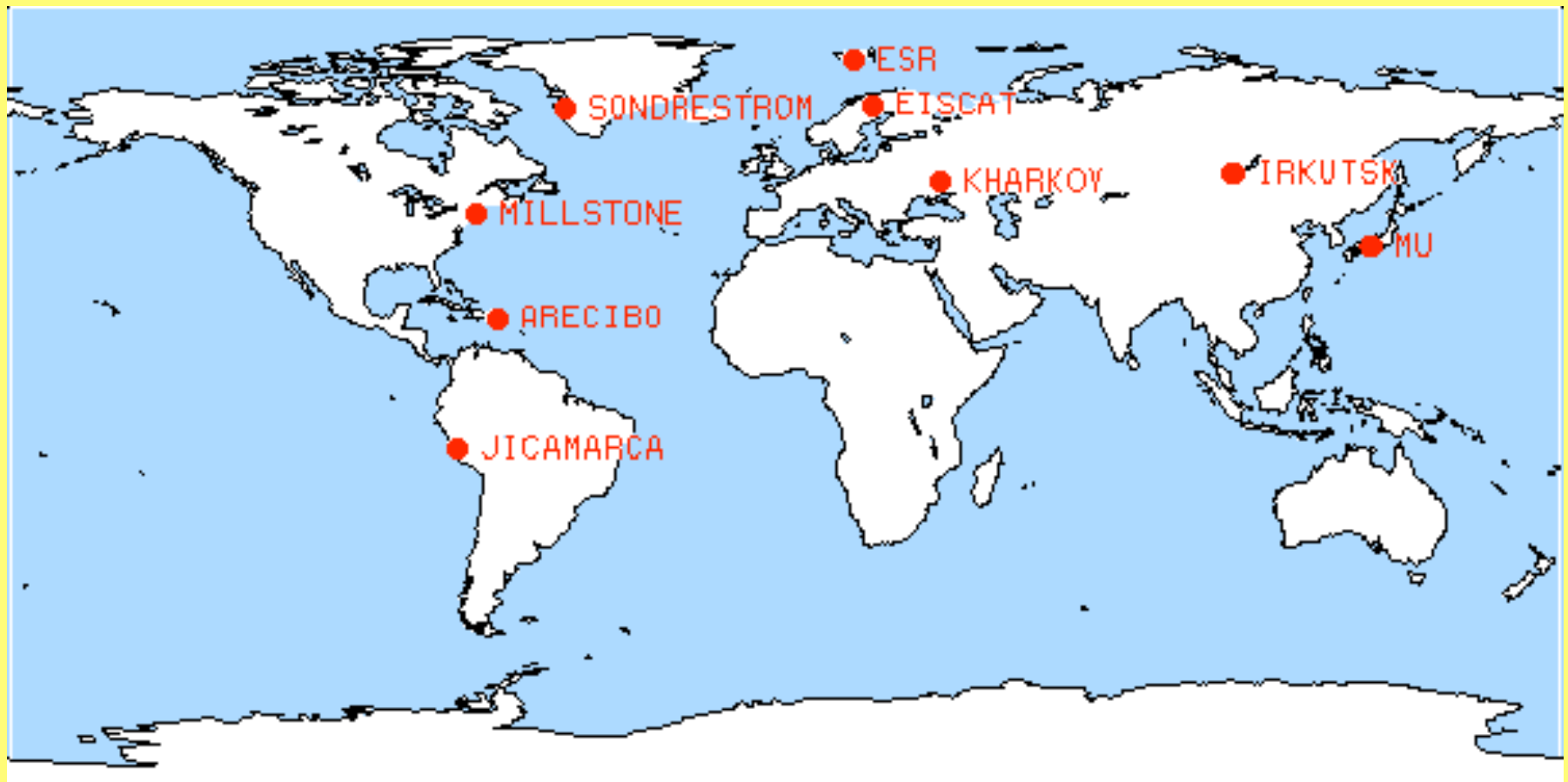
1996

**The EISCAT Svalbard Radar is constructed
near Longyearbyen, Norway.**

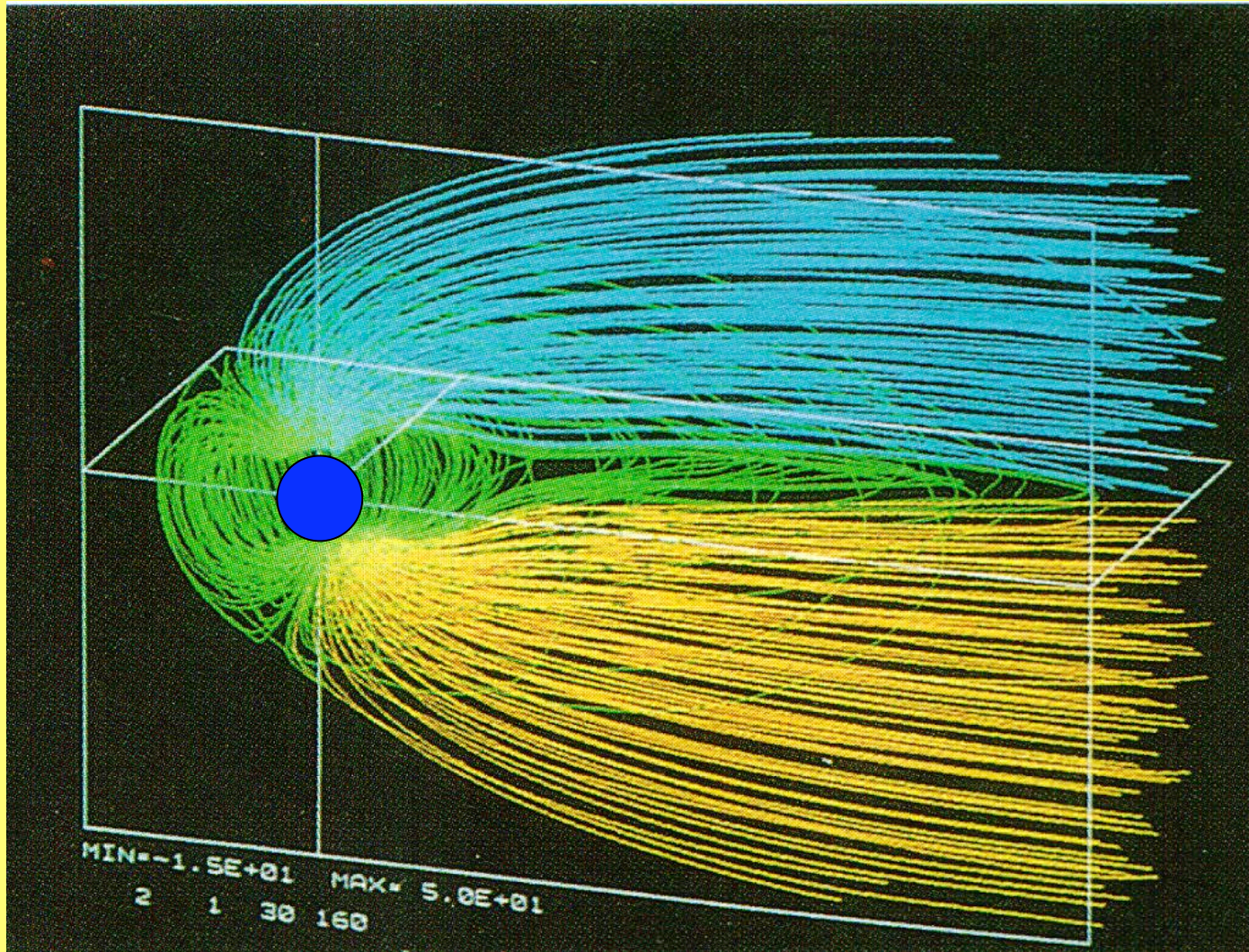


2007

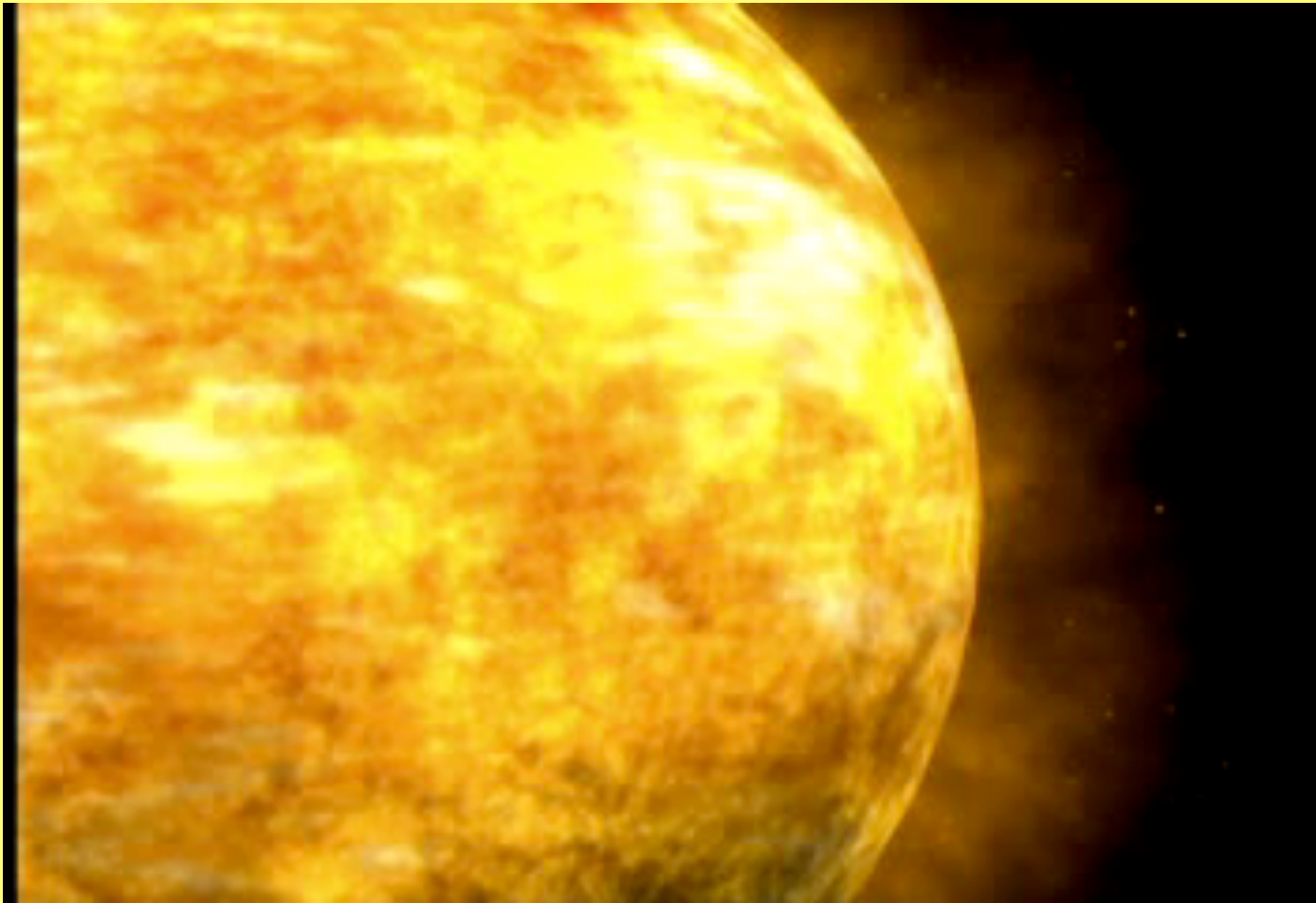
The Global Array of Incoherent Scatter Radars

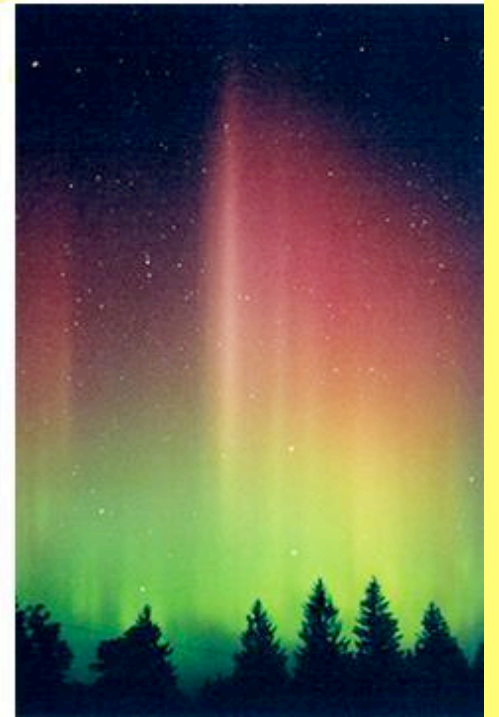
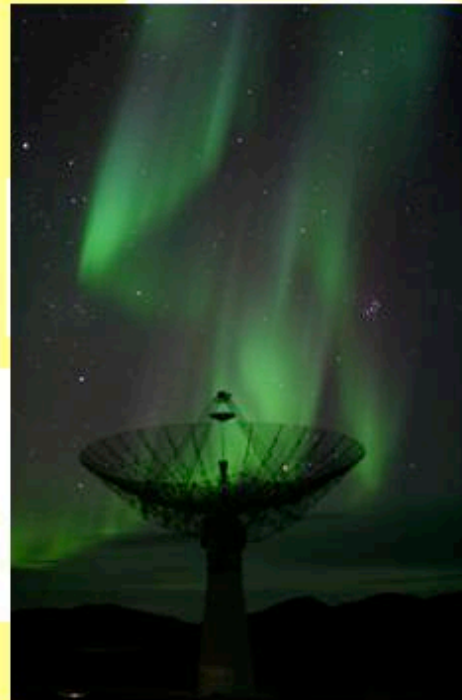


Earth's Magnetosphere

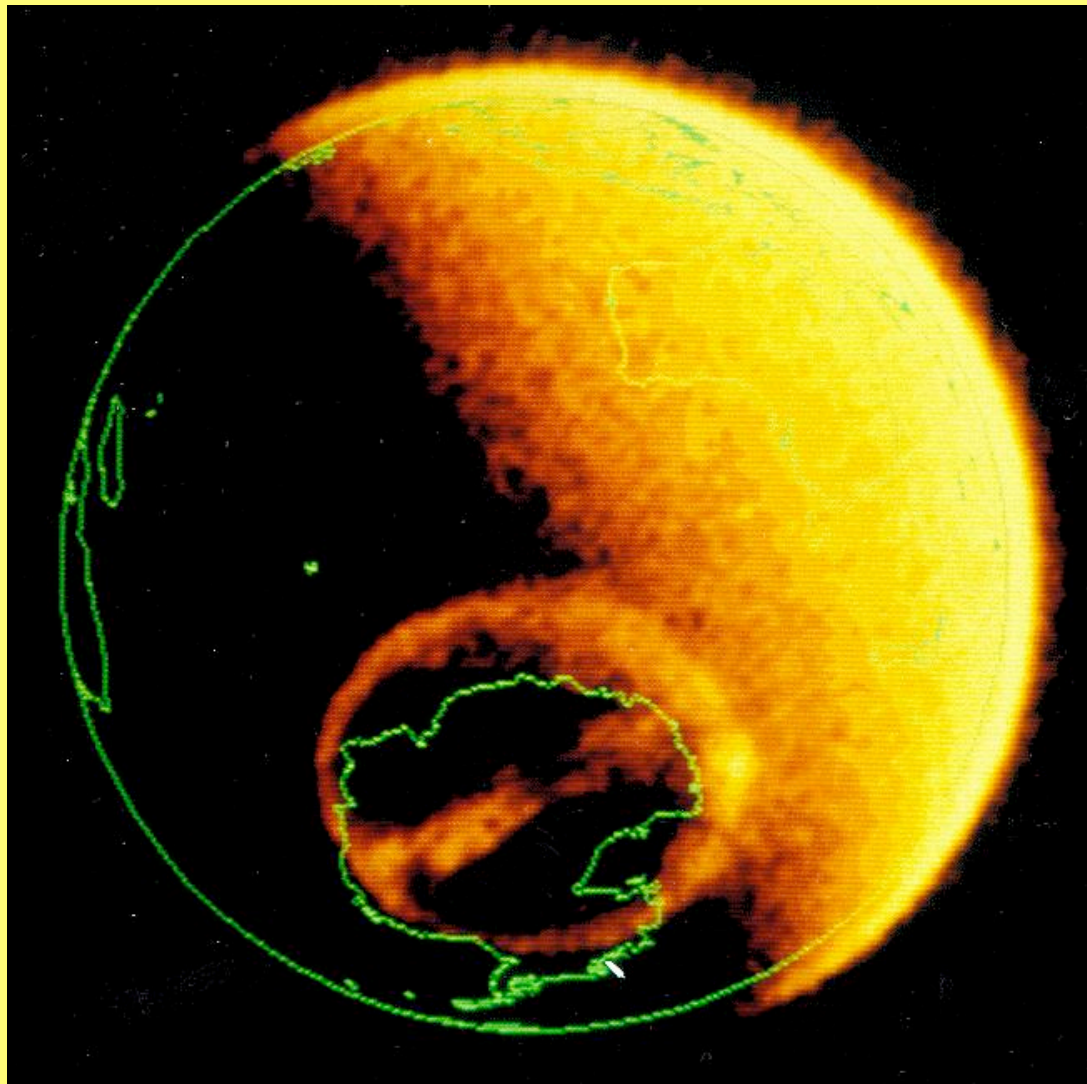


The Sun-Earth System





Theta Aurora



The Plight of the Polar Cap Observatory

- **1987 workshop to develop technical requirements for an ISR in the Polar Cap**
- **Three design studies funded by NSF**
- **Funding provided for the Early Polar Cap Observatory**
- **Polar Cap Observatory proposal submitted by SRI**
- **Proposal reviewed with excellent ratings and strong recommendation for funding**
- **PCO project put forward for funding under NSF Major Research Equipment program**
- **Removed from NSF budget by Congress in August 1997**

AMISR: The Polar Cap Observatory Resurrected

- **To avoid conflicts originating from radar location, NSF recommends a portable facility**
- **Workshop convened in 1998 to determine the most favorable locations for early deployment of a portable system**
- **NSF/ATM sets aside \$44M for construction of a relocatable ISR**
- **SRI submits a proposal to build the Relocatable Atmospheric Observatory**
- **NSF approves funding of the proposal, but the name is changed to the Advance Modular Incoherent Scatter Radar**

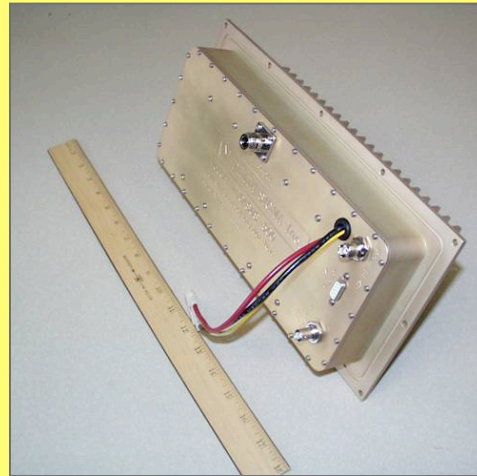
The Advanced Modular Incoherent Scatter Radar (AMISR)

Parts List



Antenna Element Unit
(12288 pieces)

+



Solid-State Power Amplifier
(12288 pieces)

+



AMISR panel (384 pieces)

+

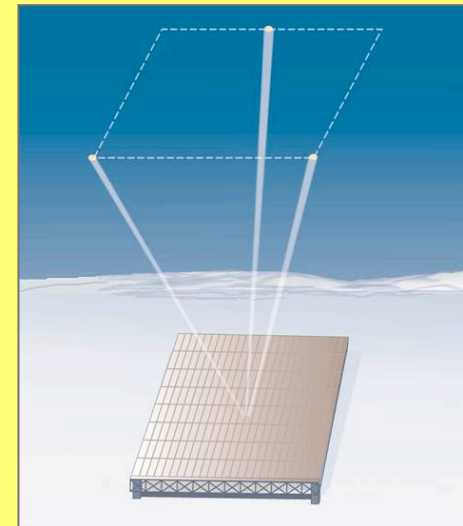
**384 Panel
Control
Boards**

+



AMISR Support Structures
(3 pieces)

=

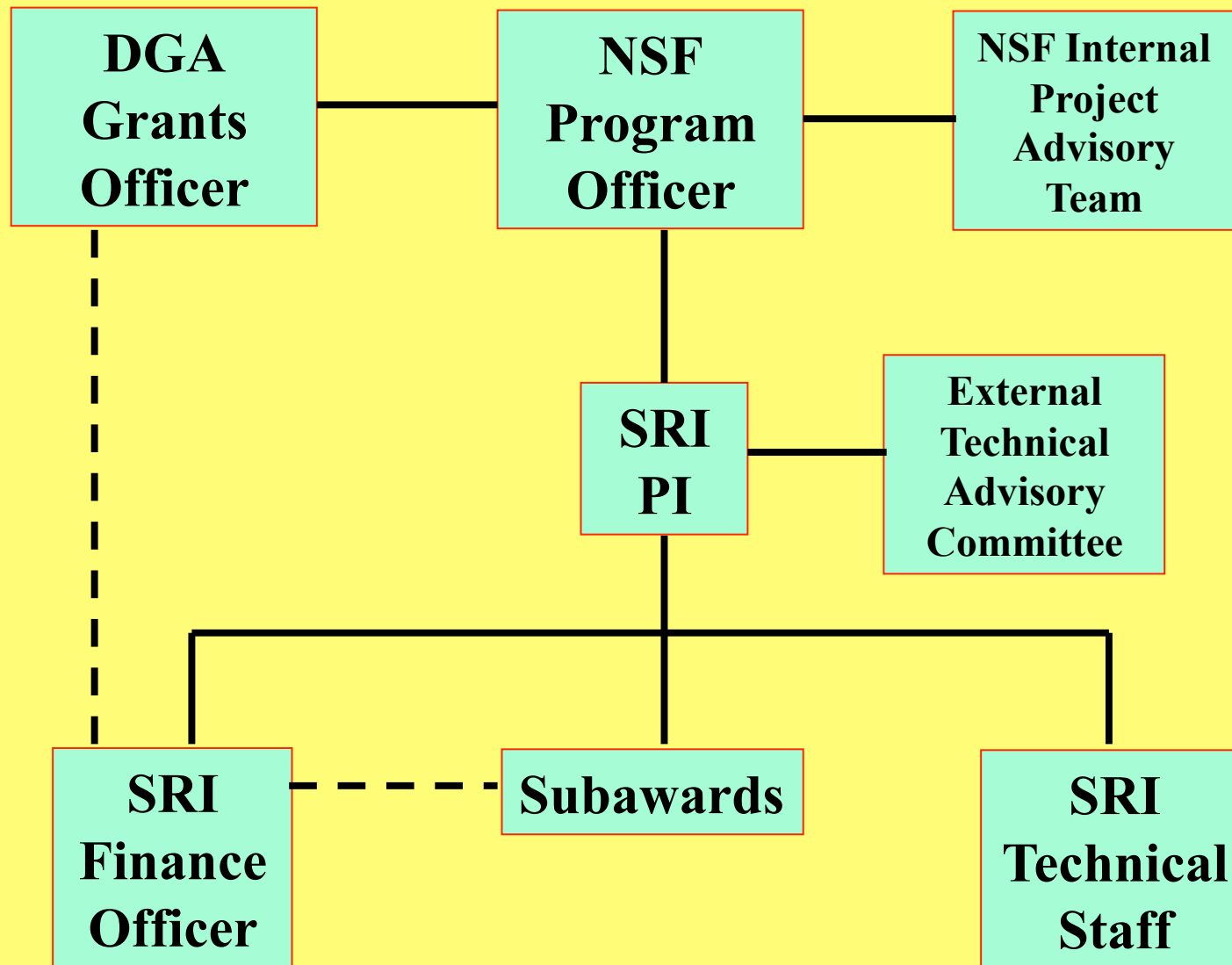


AMISR Faces (3 pieces)

AMISR Prototyping and Risk Reduction Activities

- **Antenna element design and development**
- **64 test units constructed and two antenna panels assembled**
- **Design testing conducted in collaborations with USAF at Air Force test facility in Massachusetts**
- **Funding provided for “Design for Manufacturing” activities in collaboration with electronics firm Sanmina-Sci**
- **Another award made for manufacture and assembly of 512 AEUs used to assemble 16 panels; two 8-panel systems to deployed for testing in Alaska and Peru**
- **Numerous technical reviews by external experts**
- **Reasonable and sound contingency plan developed**
- **Early Polar Cap Observatory provided experiences in Arctic environment**

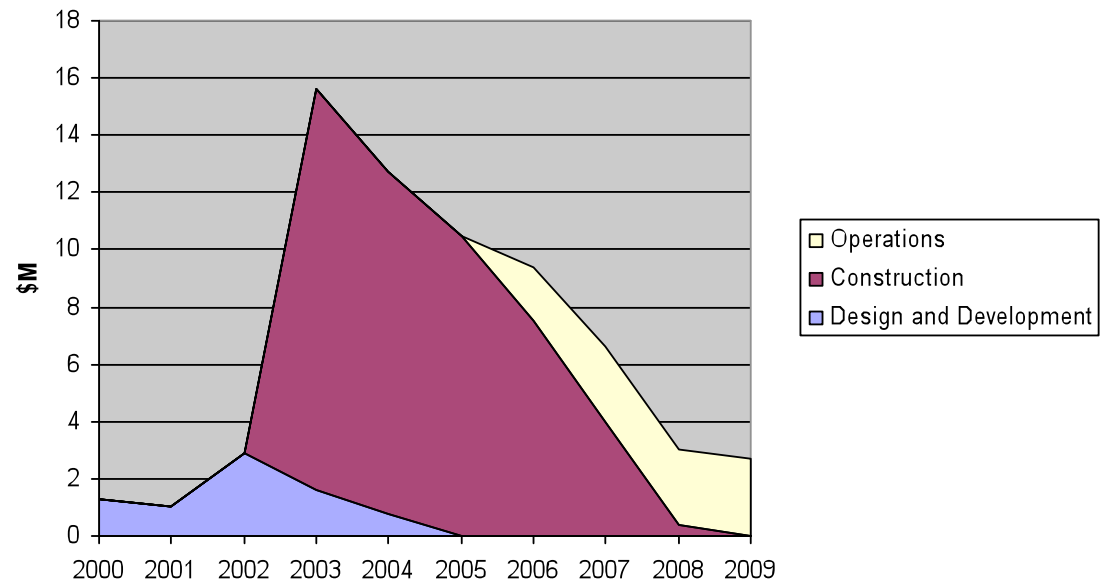
AMISR Management Structure



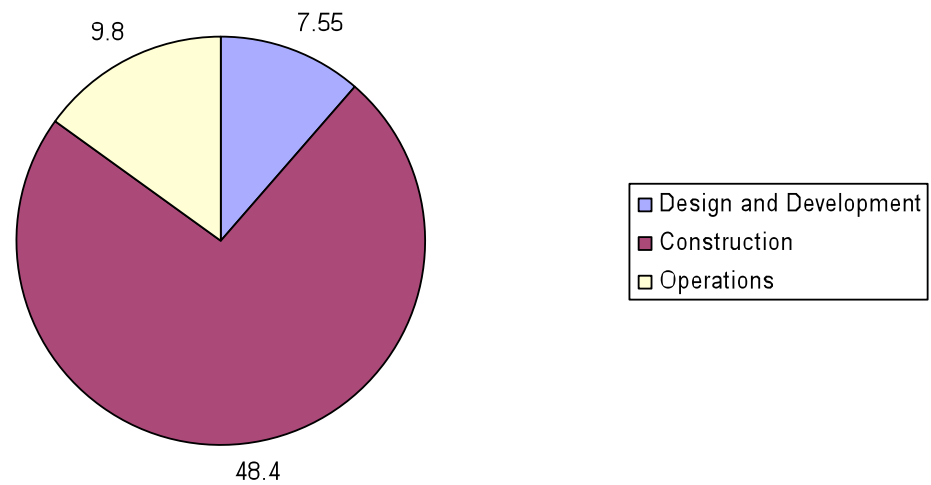
AMISR Management Challenges

- **Oversight of subawards**
- **Funding allocations not matched with construction schedule**
- **Discontinuation of critical components; changes in manufacturing processes**
- **Establishing and maintaining agreements with industrial and international partners**
- **Trade-offs between schedule, cost, and project scope**
- **Overlap between construction and operations**
- **Incorporating ancillary instrumentation**

AMISR Life Cycle Cost through 2009



Total AMISR Costs to Date (\$M)



U. S. incoherent scatter radars--2009



**AMISR- Resolute
Bay (RISR)**



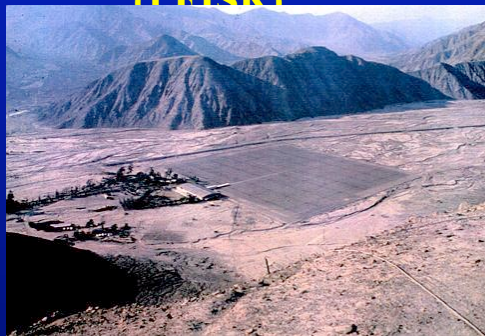
Sondrestrom



**AMISR-
Poker Flat
(PFISR)**



Millstone Hill



Jicamarca



Arecibo

What's new about the Advanced Modular Incoherent Scatter Radar (AMISR)?

- **First incoherent scatter radar built by NSF**
- **First U. S incoherent scatter radar built for basic research**
- **First phased-array, solid-state incoherent scatter radar; allows for remote access without the need for on-site staff**
- **First incoherent scatter that allows for continuous, low duty cycle observations**
- **First modular incoherent scatter radar designed for easy dismantling and relocation**
- **First reconfigurable incoherent scatter radar**

