

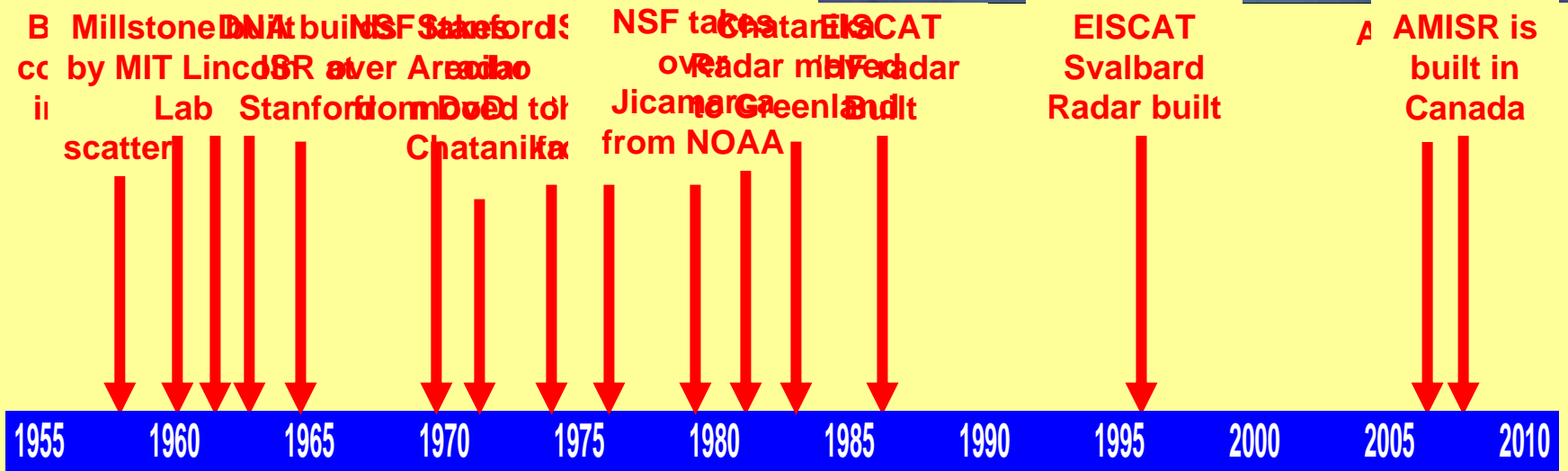
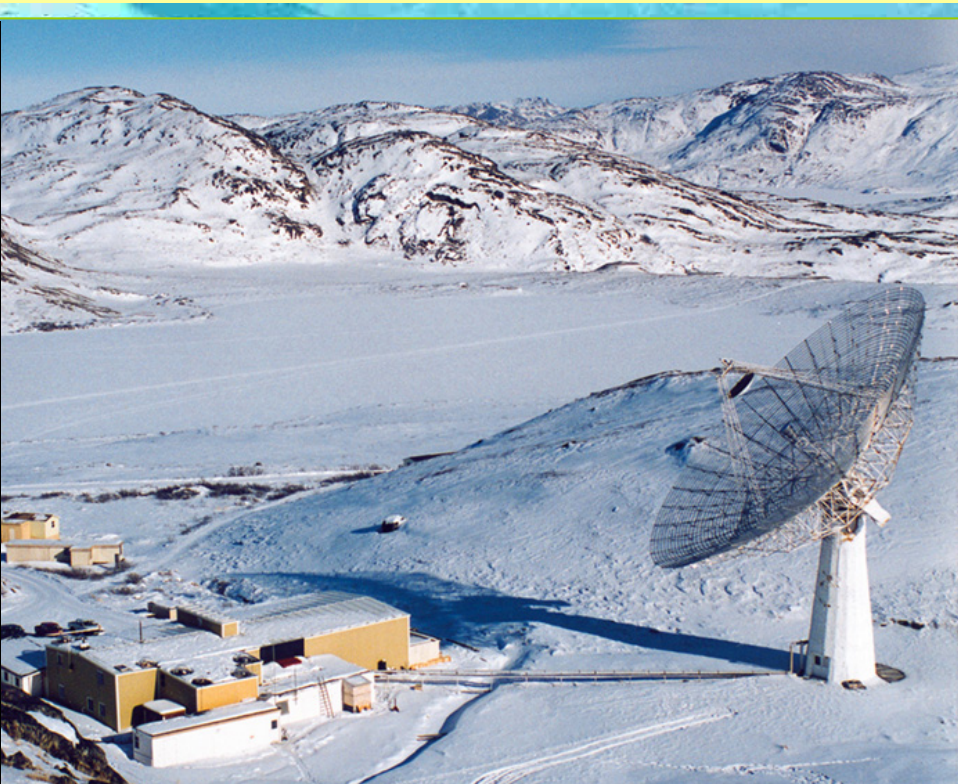
# Incoherent Scatter Radars

*A brief history and a quiz*



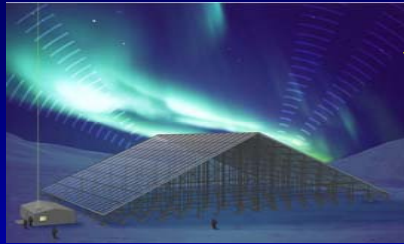
**Bob Robinson**

**National Science Foundation**





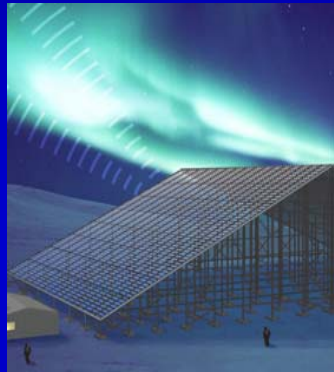
# The NSF Incoherent Scatter Radar Chain-2008



AMISR-  
Resolute Bay



Sondrestrom (SRF)



AMISR-  
Poker Flat



Millstone Hill (MH)



Arecibo (AO)

Jicamarca (JRO)



# History of AMISR

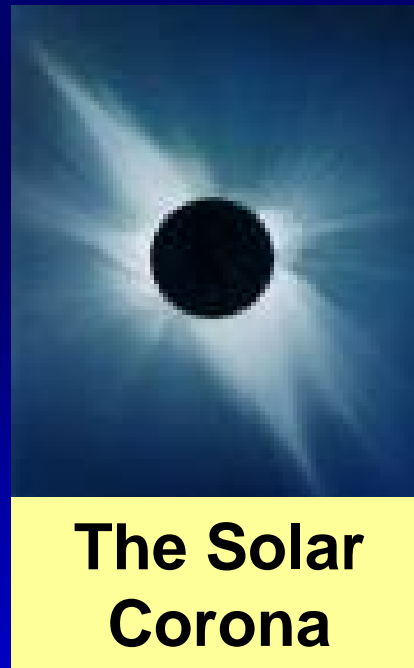
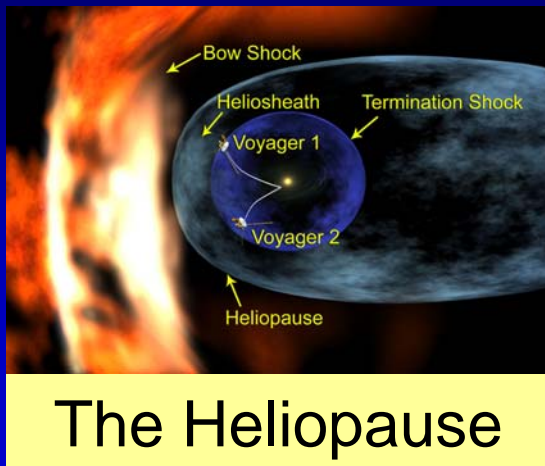
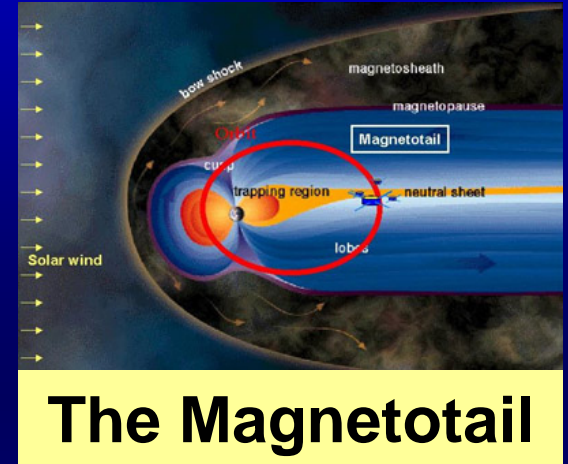
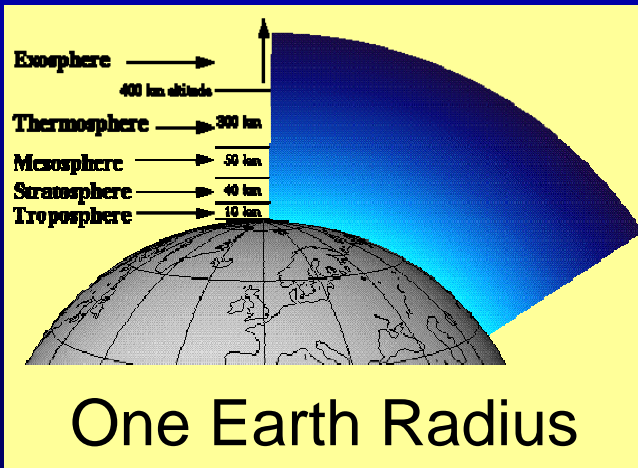
- 1989: Workshop to develop technical requirements for an ISR in the Polar Cap**
- 1995: Polar Cap Observatory proposal submitted by SRI**
- 1996: PCO approved for funding by NSF**
- 1997: Removed from NSF budget by Congress**
- 1998: Second Workshop convened to discuss scientific justification for a portable incoherent scatter; highest priority locations were Alaska and Arctic Canada**
- 2000: SRI submits proposal to build the Relocatable Atmospheric Observatory**
- 2002: Project rescoped and renamed AMISR**
- 2003: SRI proposal approved by the National Science Board**
- 2004: Construction begins**

**DILBERT**

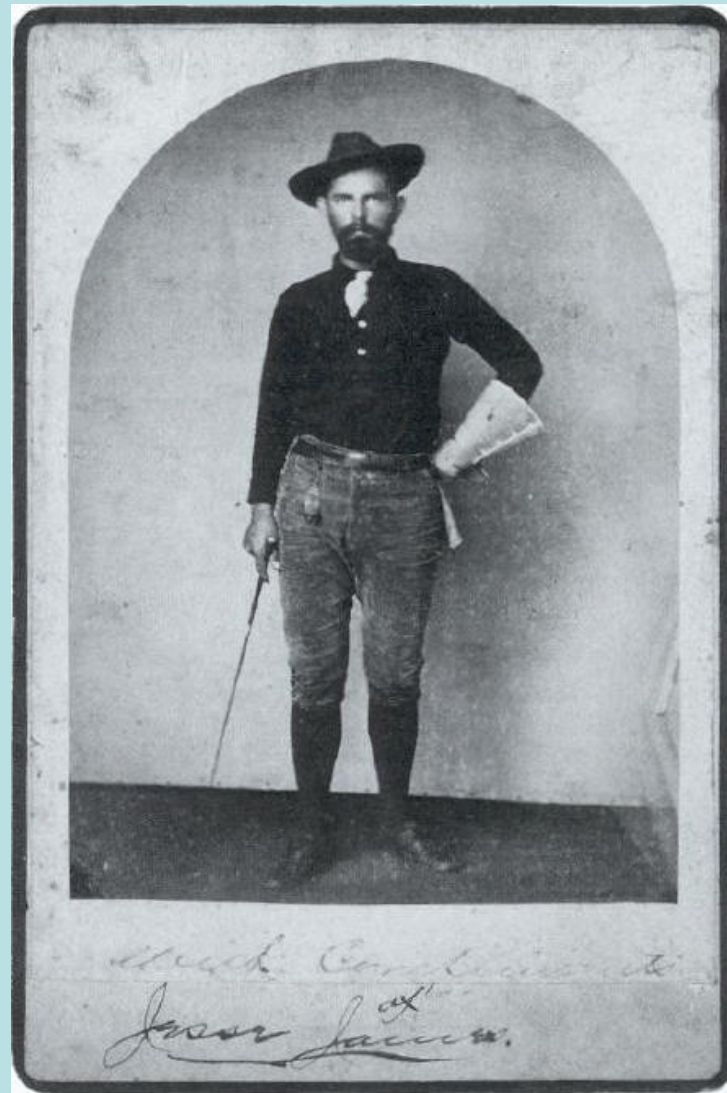
**BY SCOTT ADAMS**

Copyright © 1997 United Feature Syndicate, Inc.  
Redistribution in whole or in part prohibited.

# What is the highest altitude from which incoherent scatter returns have been detected?



# Who was Jesse James?



# How much did it cost to build the Arecibo Observatory?

- **B. \$10.0 Million**
- **E. The annual budget of all the U. S. incoherent scatter radars combined**



# Arecibo History Quiz

- Which young Arecibo scientist was married at the Observatory swimming pool?
- Which famous daredevil allegedly rode a motorcycle up the catwalk to the telescope platform?
- Which adventurous spelunker discovered an underground connection between two large caves in Puerto Rico?
- Which prominent NSF program officer, while visiting the Sondrestrom Radar, asked, “Where is the antenna?”
- Which well-known space scientist had the windshield of his car shattered by a falling mango within a month after coming to Puerto Rico?

**Richard Behnke**

**Richard Behnke**

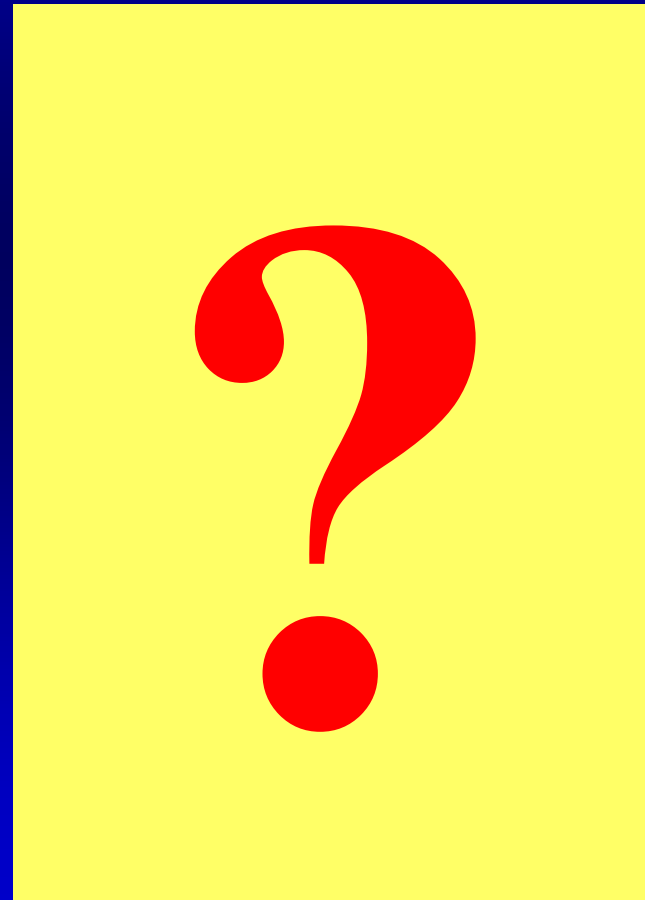
**Richard Behnke**

**Richard Behnke**

**Robert Kerr**

What is a chupacabra?

**The Arecibo Observatory has been featured in two movies. What other ISR has been featured in a movie?**





the University of Florida  
National Cohort of Students  
for Michael J. Scott  
Florida, Gainesville, FL 32611 USA  
<http://www.bio.ufl.edu/~mjs>

4

**INTERNATIONAL ASTRONOMY AND**

**Cornell University**

Exposure to Puerto Rican Culture

PCU / J...

and...

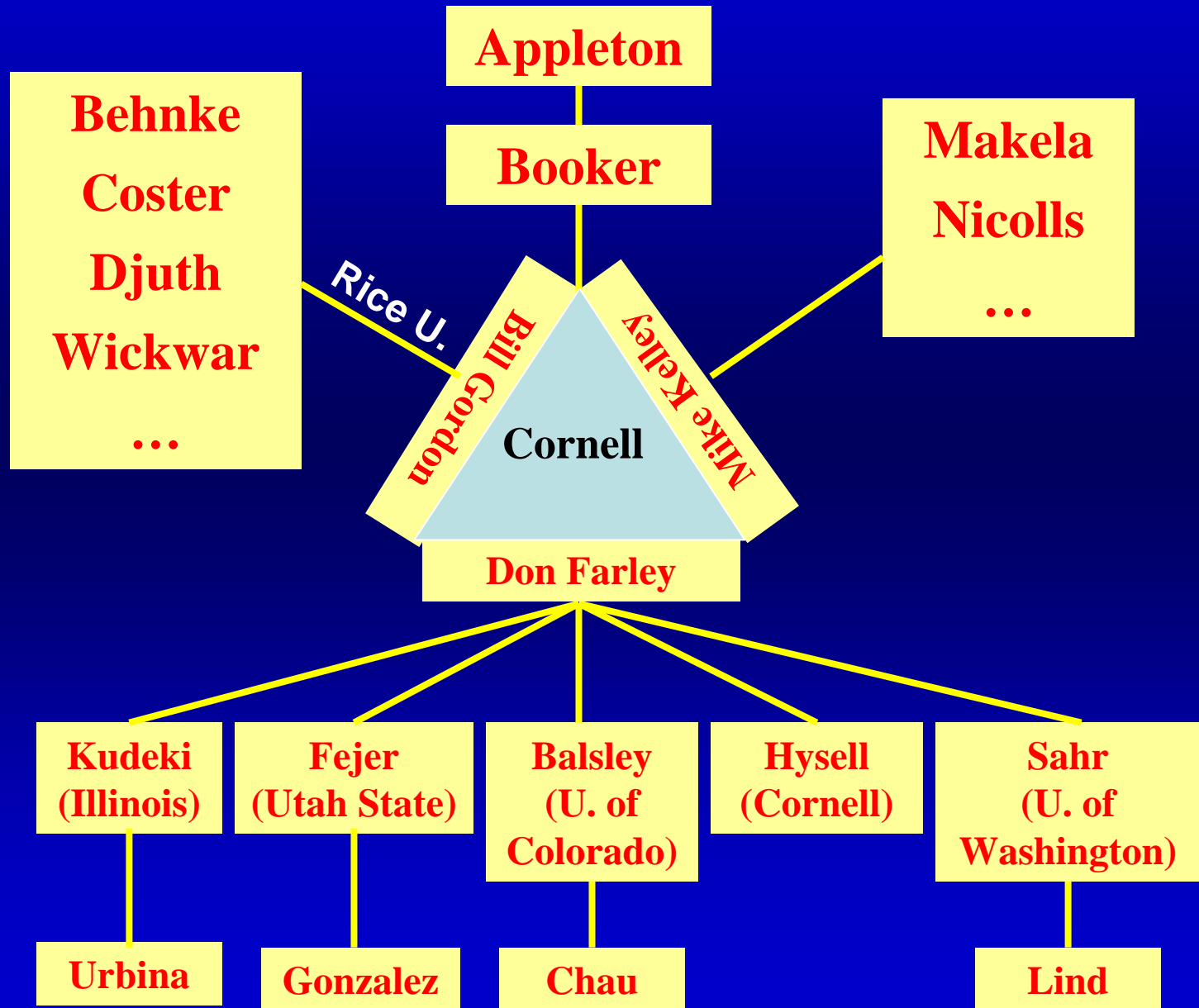
Black...

Healthcare Programs, Progra...

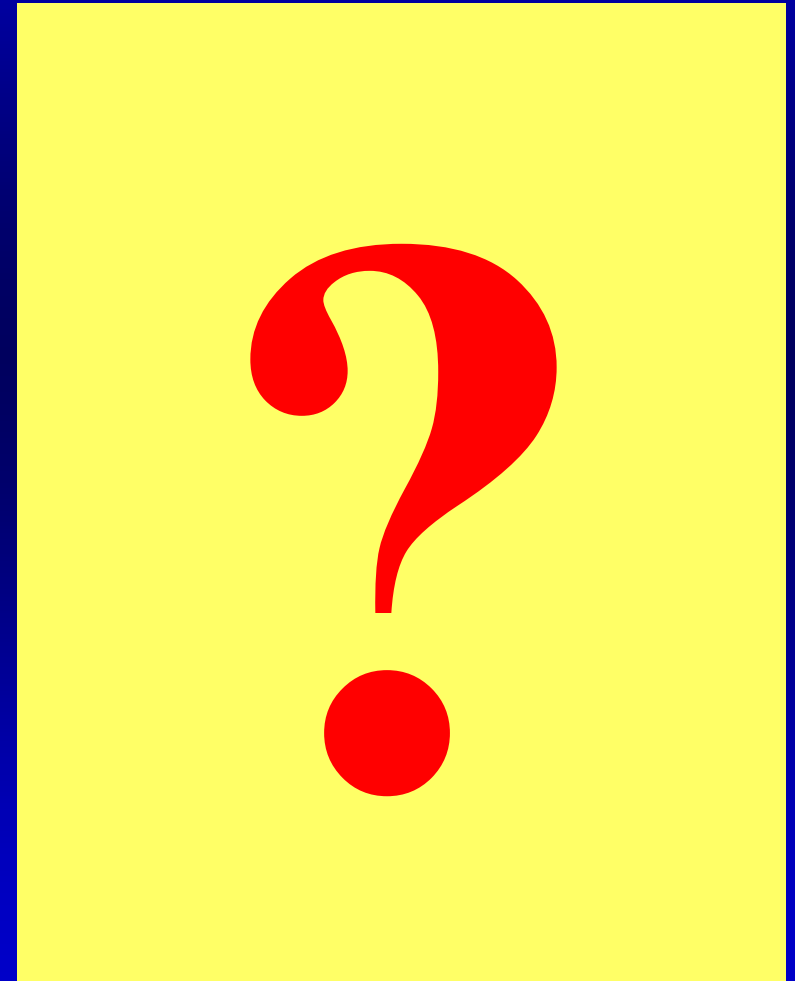
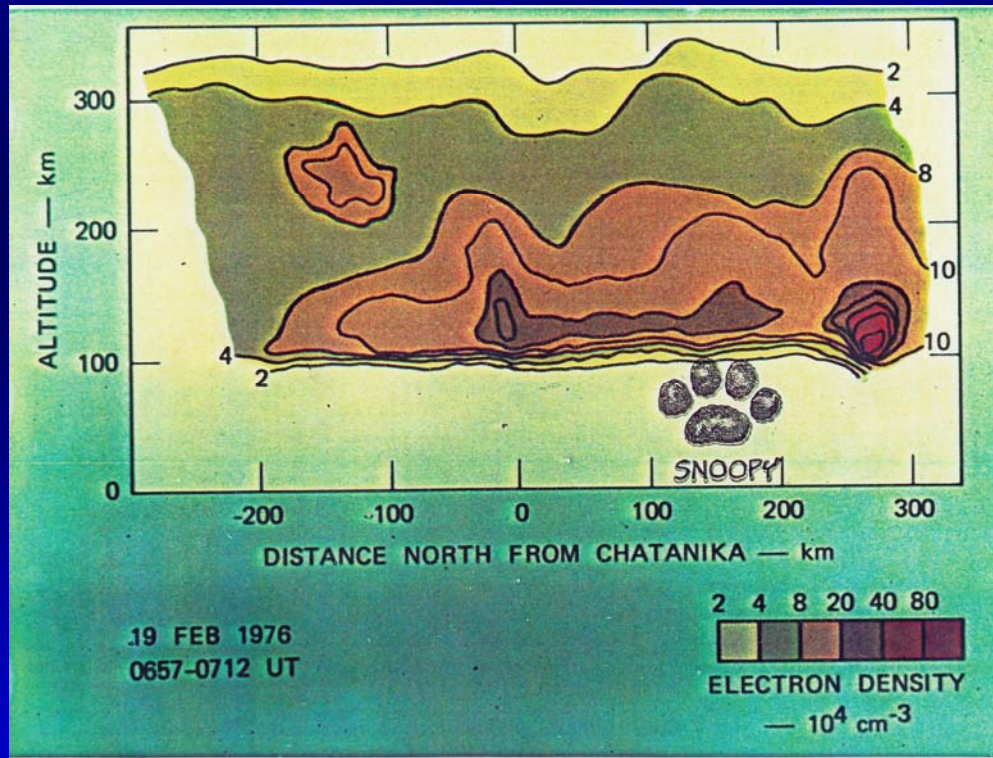




# Where do incoherent people like Sixto come from?



# What famous cartoon dog appeared in a data plot from one of the incoherent scatter radars?



# What is AMISR?

- **A very cheap person**
- **The first incoherent scatter radar built by NSF**
- **The first U. S. incoherent scatter radar built for basic research**
- **The first phased-array, solid-state incoherent scatter radar**
- **The first incoherent scatter radar with no moving parts**
- **The first relocatable incoherent scatter radar**
- **The first reconfigurable incoherent scatter radar**
- **All of the above**



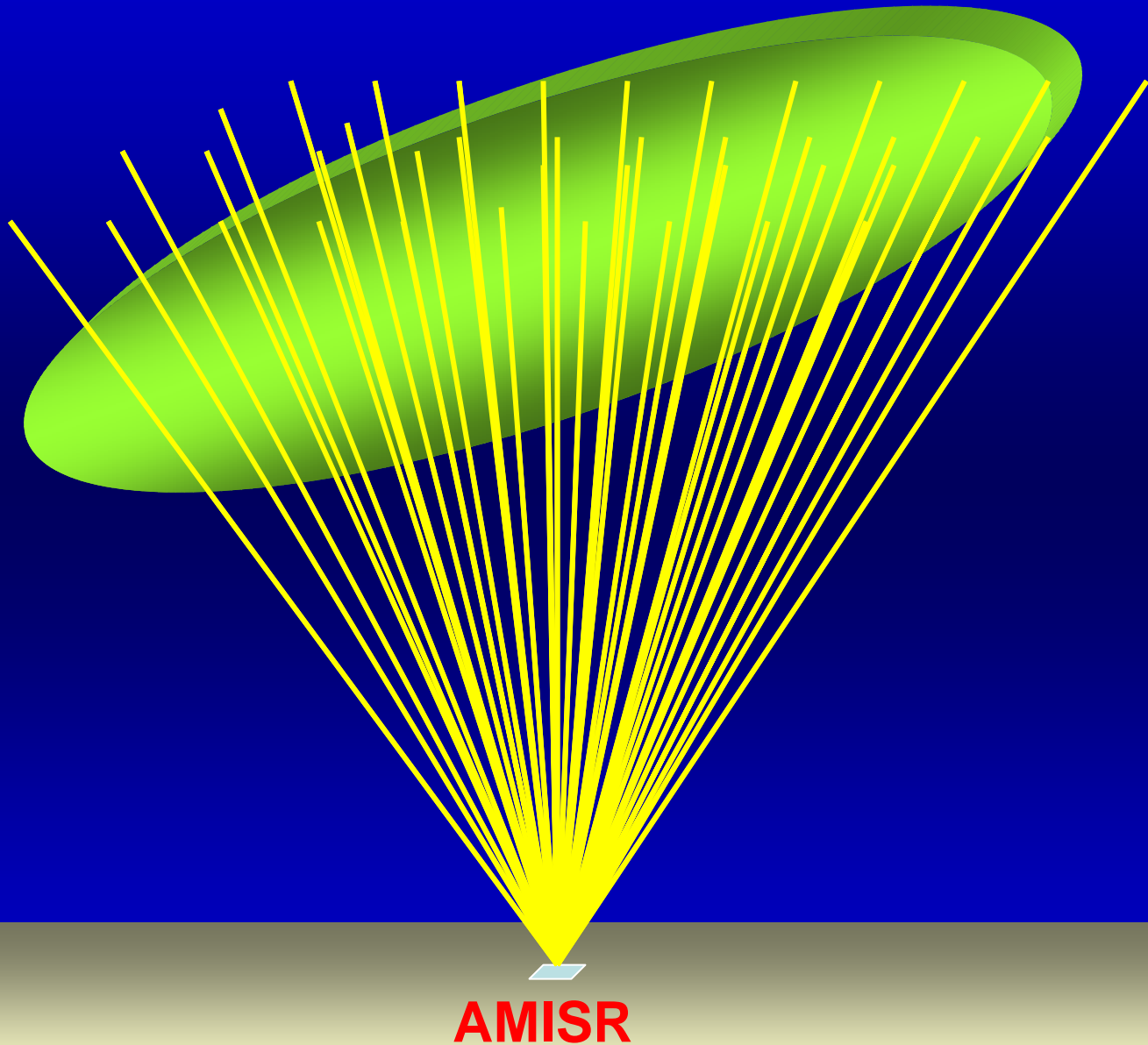
# AMISR at Poker Flat, Alaska

## *The Poker Flat Incoherent Scatter Radar (PFISR)*

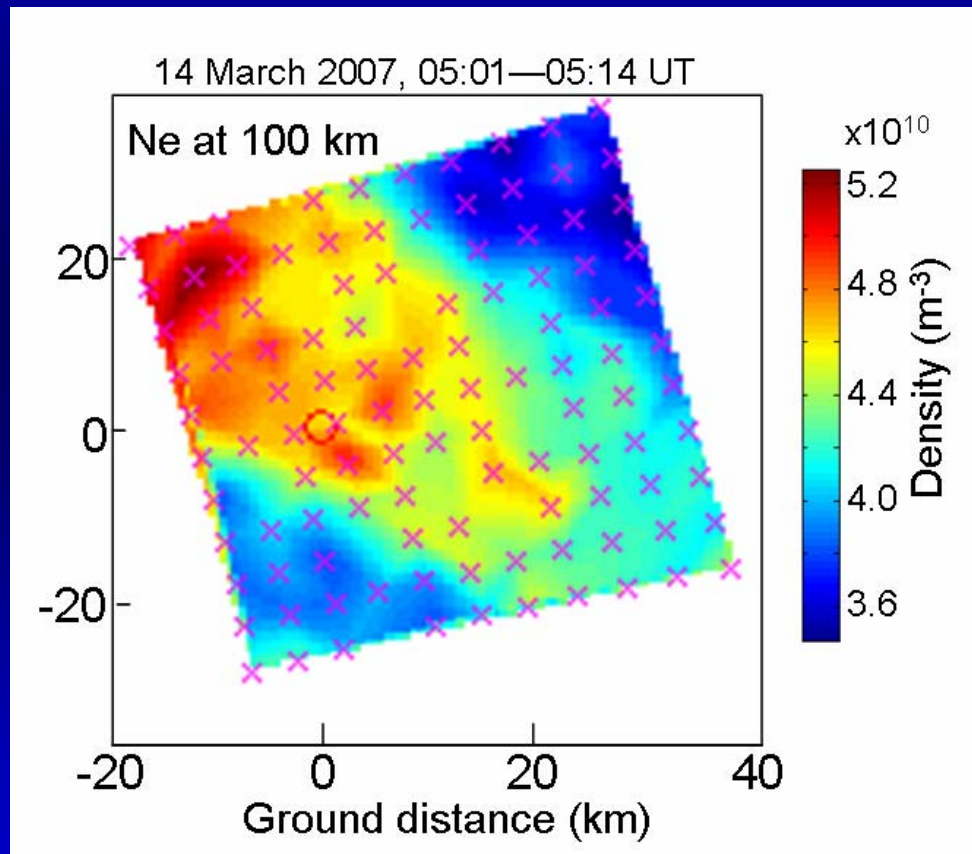




# AMISR "All-Sky" Mode

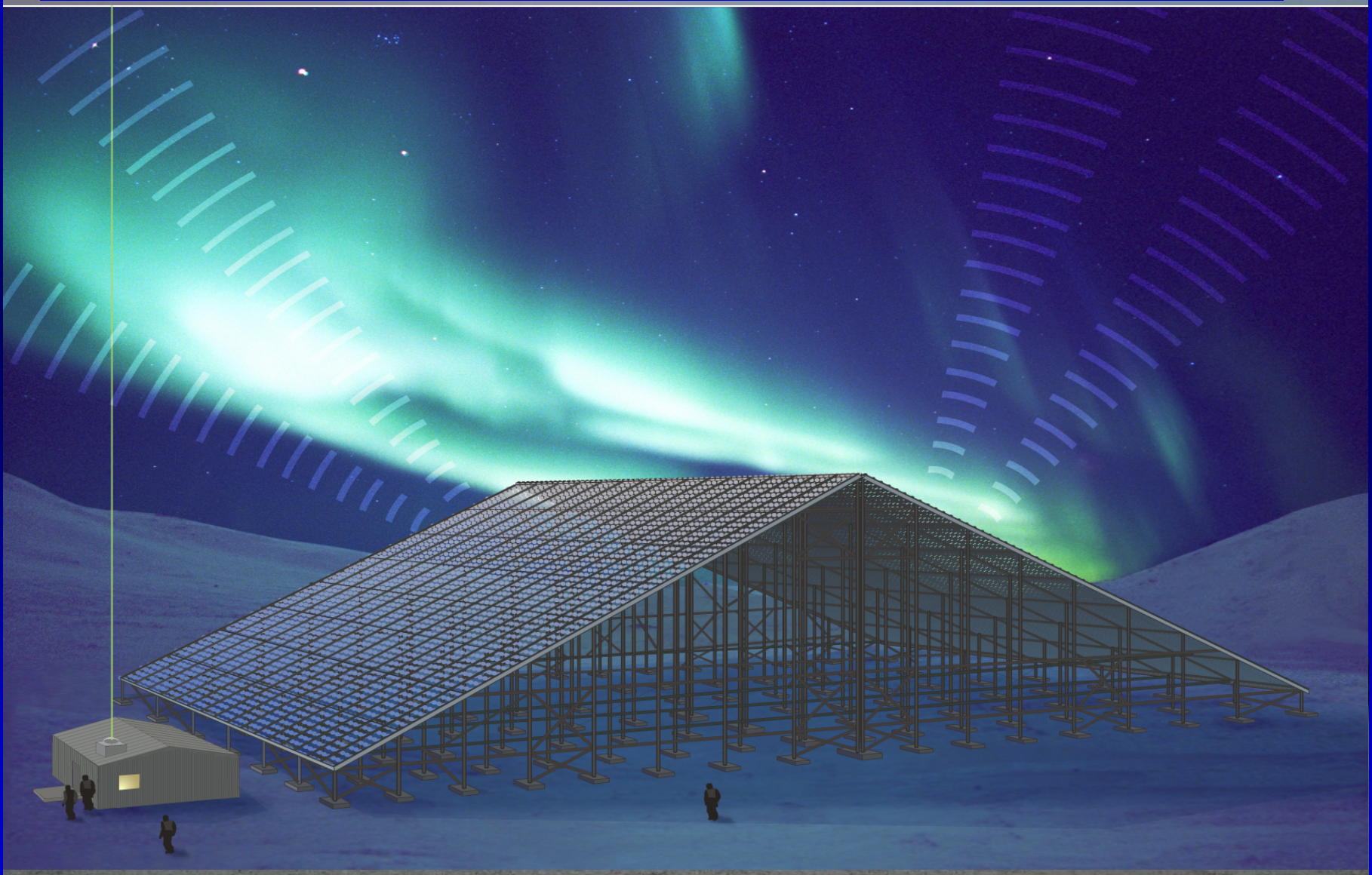


# The first 3-D image of the aurora



# What's next?

## The Resolute Bay Incoherent Scatter Radar





# What is the future of ISR?





# Or:



- The global chain of ISRs will continue to grow
- ISRs of the future will be lower cost, with the ability to run routinely for many hours
- Each ISR site will include a cluster of advanced radiowave and optical instrumentation for comprehensive observations of the upper atmosphere
- The ISR network will be fully integrated, with smart, interactive, autonomous operation
- Barriers between ISRs will disappear, allowing users and students greater versatility, flexibility and ease in conducting experiments
- Most importantly, the next generation of radar users will be knowledgeable and skilled in all aspects of ISR operation and data analysis, leading to new discoveries and improved capabilities

# What does incoherent mean?

- **Dictionary: Lacking coherence**
  - **Rambling, random, disconnected, incomprehensible**
- **Example 1: Incoherent scatter is the process by which radiowaves are randomly scattered by electrons in the ionosphere**
- **Example 2: This talk**
- **Incoherent scatter, like this talk, depends on the weak connection between its parts, and contains useful information when sufficiently sensitive detecting systems are applied**

# Bonus Question

- What is the most important aspect of incoherent scatter radars that have kept them at the forefront of ionospheric and atmospheric research?



**The End**

