Space Physics at NSF

Upper Atmospheric Research Section
National Science Foundation

CEDAR
June 25, 2007

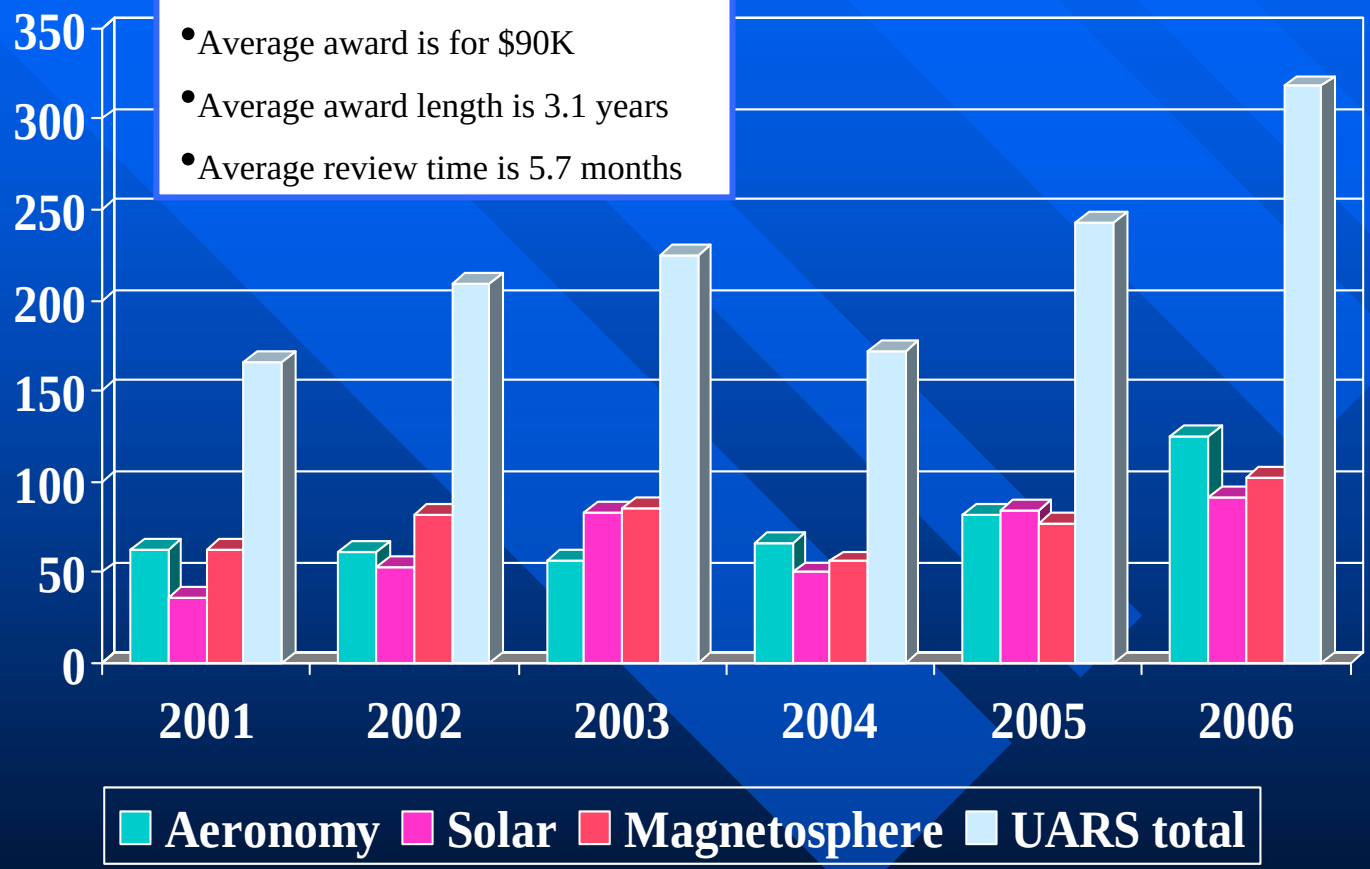
Upper Atmospheric research at NSF – What's new?

- Cassandra Fesen is the new Aeronomy PD
- Therese Moretto help with CEDAR, Space Weather, Aeronomy
- NSF budget situation looks very good.
- AMISR at Poker working fantastically well
- Small satellites workshop and plans
- Arecibo situation
- Mid-size Account is being formalized
- DASI – NSF position
- Student Space Weather Competition

Number of Proposals

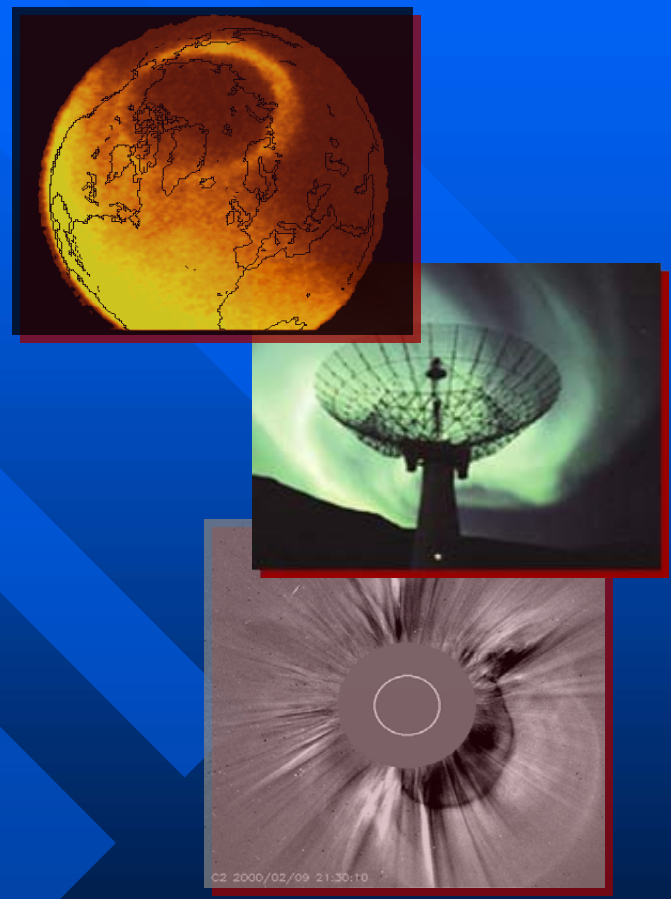
Some facts:

- Average award is for $90K
- Average award length is 3.1 years
- Average review time is 5.7 months



Space Weather and Space Physics at NSF

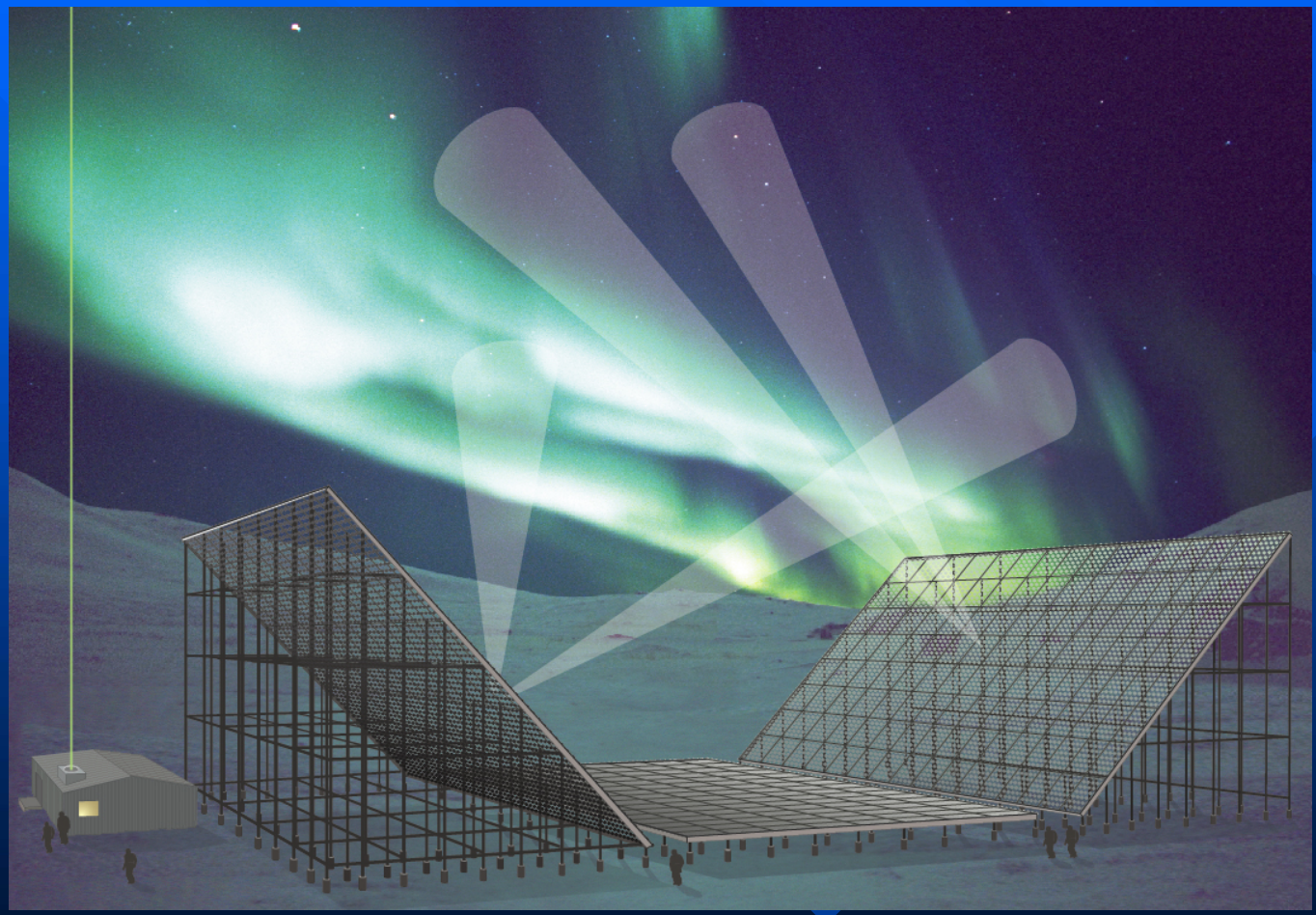
- Solar Physics
- Magnetospheric Physics
- Aeronomy
- Upper Atmospheric Facilities



NSF Budgets

- FY 2007
  - 6.5% increase to UARS programs
  - Possibility of Arecibo Heater ($800K being funded
- FY 2008
  - Possibility of 8% increase
- FY 2009
  - ??? (but early indications are very good)

AMISR



Advanced Modular Incoherent Scatter Radar (AMISR)

Initial observations at Poker Flat, Alaska, with 97 of 128 panels in place

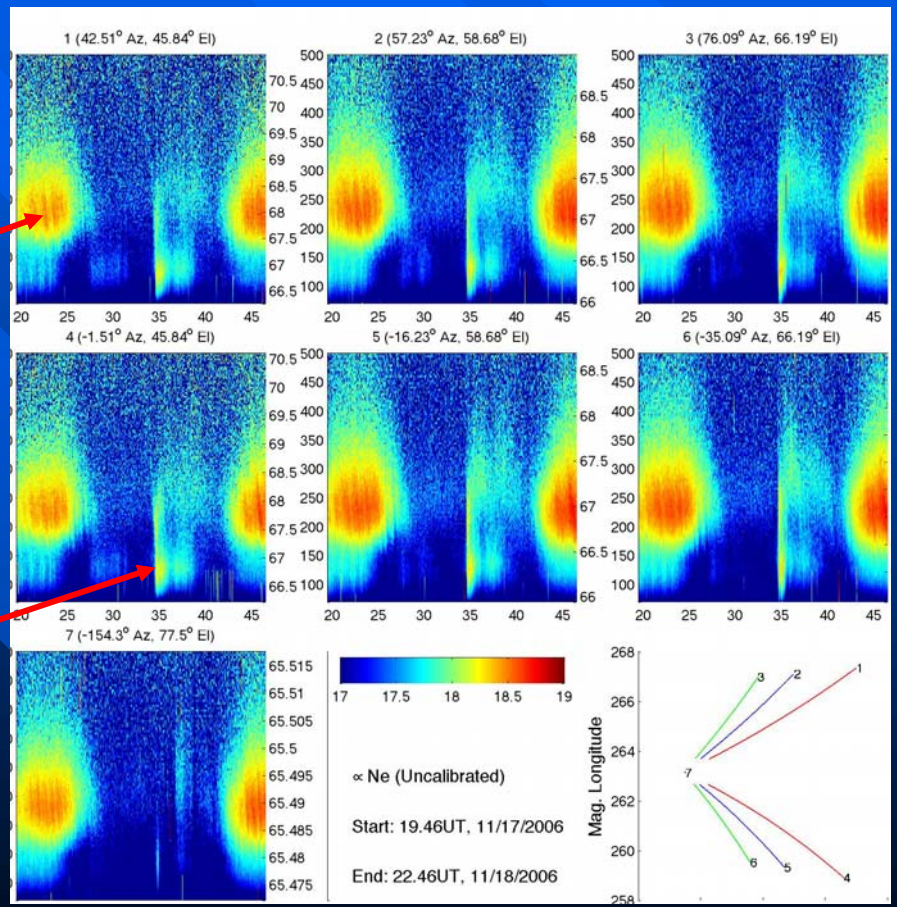
(10-second integration time)

November 2006

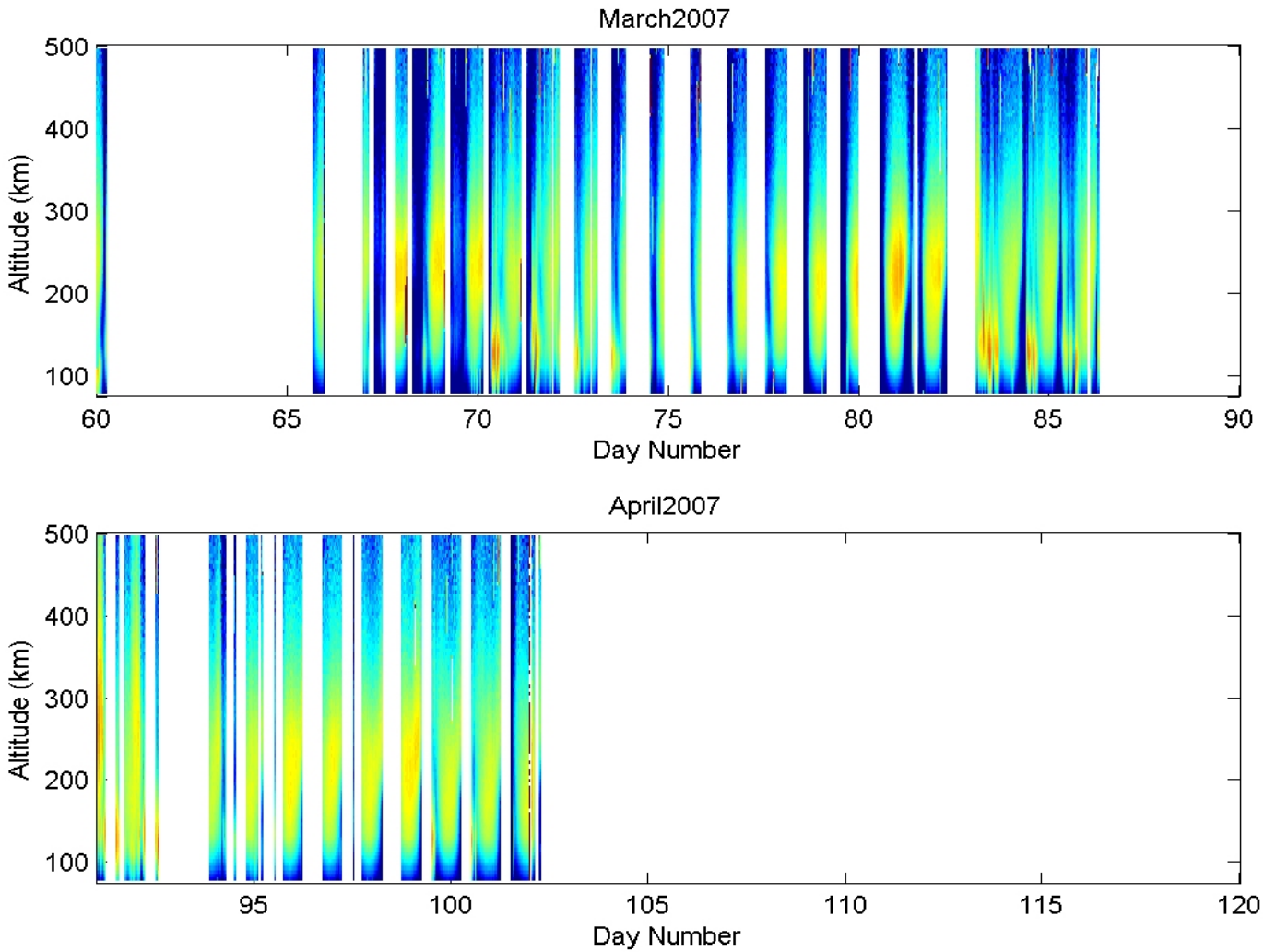
Dayside enhanced F-region ionization

Striations due to gravity wave effects or convecting ionization enhancements

Aurorally-produced E-region ionization



AMISR allows for continuous data



Current Plans for AMISR Deployment

- First face at Poker Flat operating as of January 2007
- 2nd and 3rd faces to be constructed at Resolute Bay, Canada, beginning in Spring of 2008.
- Operations at Resolute Bay to start by end of 2008
- One face to be relocated around 2011; location TBD

The Poker Flat Incoherent Scatter Radar (PFISR)

400 tons of steel on the sun-kissed beach of Resolute Bay

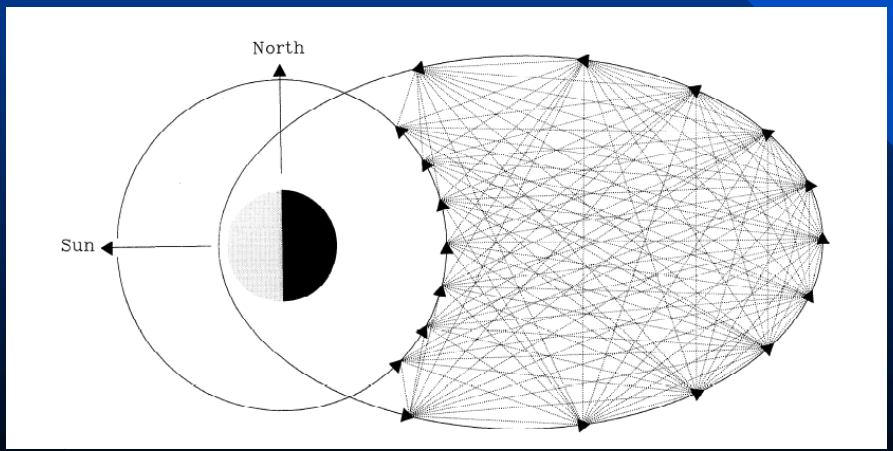
NSF and Small Satellites

- Recommended by Assessment Committee for National Space Weather Program
- Builds on NSF's successful participation in COSMIC Program
- Strong potential for interagency cooperation
- Enthusiastic response from academic community
- Progress in private sector efforts resulting in more cost effective access to space

NSF and small satellites

- **Dedicated nanosats and cubesats, especially in swarms, have the potential to make critical global atmospheric and space weather measurements (plasma density, magnetic and electric fields, and neutral winds).**

One example:



Faraday Rotation Tomography of the magnetosphere would be a revolutionary technique for providing both magnetospheric densities and magnetic field strengths.[Dyrud and Murr, J. Geophys. Res., 2006]

The educational element of a small satellite program is compelling

- One example of student interest in building satellites is the CubeSat (10 cm on a side)
  - over 60 universities and one high school (the Thomas Jefferson School of Science and Technology in Annandale, Virginia) participate in the CubeSat program
- More than a dozen universities are interested in building scientific instruments that can be flown on more powerful nanosats (10 – 20kg)

Students at the summer 2006 CubeSat Workshop at USU

Small satellites: The way ahead

- Partnerships
  - ONR and possibly AFOSR and DARPA
- NSF (ATM) sponsored a workshop May 15-17, 2007, to investigate the scientific potential and cost of launching, operating and accessing the data from cubesats, nanosats, and other small satellites
- NSF share of a vibrant program would be about $5M to $10M

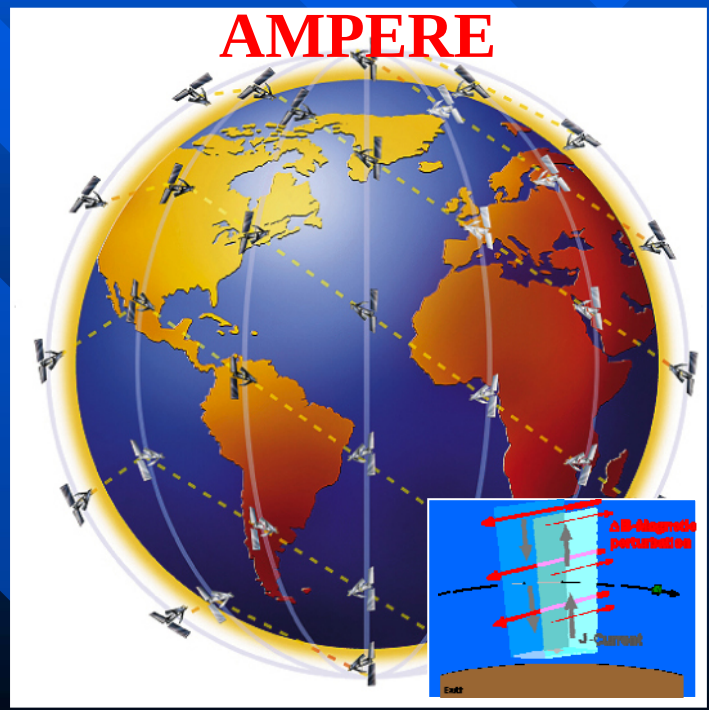
The Arecibo Observatory – What is the story anyway?

Midsize Account – What is that?

- ATM has set aside $8M for midsize infrastructure
- First project from this account was AMISR
- $800K reserved for Arecibo Heater in FY2007
  - Contingent on a favorable review of the proposal
- FY 2008 and beyond will be based on a Project Solicitation – we are working on finalizing the ground rules.

Future Facilities and Initiatives

- Frequency Agile Solar Radiotelescope (FASR)
- Arecibo Heating Facility
- Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE)
- Mileura Widefield Array Low Frequency Demonstrator
- COronal Solar Magnetism Observatory (COSMO)
- Small Satellites



But we also need DASI
Distributed Arrays of Small Instruments

- GPS Receivers
- Optical Imagers
- Interferometers
- Magnetometers
- Passive Radar
- Riometers
- Neutron Monitors
- Scintillation and VLF Rx
- Tomography Receivers

Technology: ITR, Miniaturization
EPO Opportunities

Issues

- What is the scientific focus?
- What are the operating costs?
- Workshop on Friday
- It will take time

A Collegiate Space Weather Competition

Goals

- Determine the performance of present space weather forecasting technologies.
- Include students in space weather forecasting.
- Create visibility and excitement for space weather.

Current Status

- Initial committee assembled
  - Includes Universities, NOAA, NASA, and NSF
  - Led by Thomas Zurbuchen, University of Michigan for definition phase
  - Competition will be run by independent party
- White paper written
  - Preparation Phase
  - Competition Phase
  - Analysis/Reward Phase
- Anticipated first run-date: March-April 2009.

Preparation Phase

- Define metrics
  - Ideally: Done by CEDAR, GEM and SHINE
- Provide better explanatory tools for CCMC
  - Vodcasts of key tools: providing modern online lessons on models and their use
  - Blogs about lessons learned: providing interactive communities of users and their experiences with the models
- Develop web-interfaces for submission and dry-run

Competition Phase

- Include as many university groups as possible/feasible
- Predict key quantities in four areas
  - Sun
  - Heliosphere
  - Magnetosphere
  - Ionosphere/Thermosphere
- Exact predictions to be determined

Summary

- New exciting capabilities to observe the sun, solar wind, magnetosphere and ionosphere from the ground are planned and will happen.

- NSF will get into the small satellite business