Synergy between SCOSTEP and NSF's SHINE, GEM, and CEDAR Programs

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Solar-Terrestrial Research (STR) Program – Structure

- Core STR program
- SHINE (Solar Heliospheric and INterplanetary Environment) program



 Interface w/ MAG, Geospace Facilities, Space Weather, and others

STR Program – Goals



Solar-Terrestrial Research (STR) program at NSF has been supporting research projects which deal with improving present understanding of:

- 1. Fundamental physical processes that govern solar and space plasmas (*e.g.*, magnetic reconnection, turbulence, *etc.*); and,
- Physical drivers of Space Weather, namely flares, Coronal Mass Ejections (CMEs), and related phenomena (*e.g.*, SEP events).

The transport of magnetic flux, helicity, mass, and energy from the solar convection zone through the inner heliosphere is a fundamental area of research funded by the STR program!

STR Program – Goals (Contro)

STR program has been supporting research projects dealing with detailed understanding of physical processes governing the Sun-Earth system

• This requires extensive observations of the Sun and the solar wind, both remote sensing and *in-situ*, as well as complementary numerical modeling efforts that incorporate (or assimilate) these observations

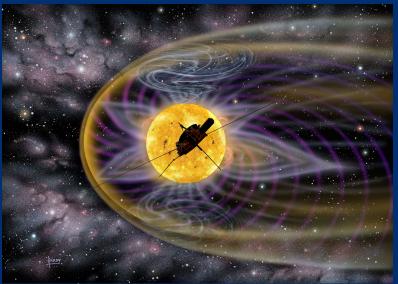
STR program has been supporting research and EPO activities in various ground-based facilities (BBSO, IfA, HAO, NSO, *etc.*), academic institutions (NMSU, MSU, *etc.*), and non-profit organizations (PSI, Helioresearch, *etc.*)

• The supported ground-based facilities have been providing state-of-the-art observations needed to drive those computational models (*e.g.*, at CCMC)

What is SHINE?



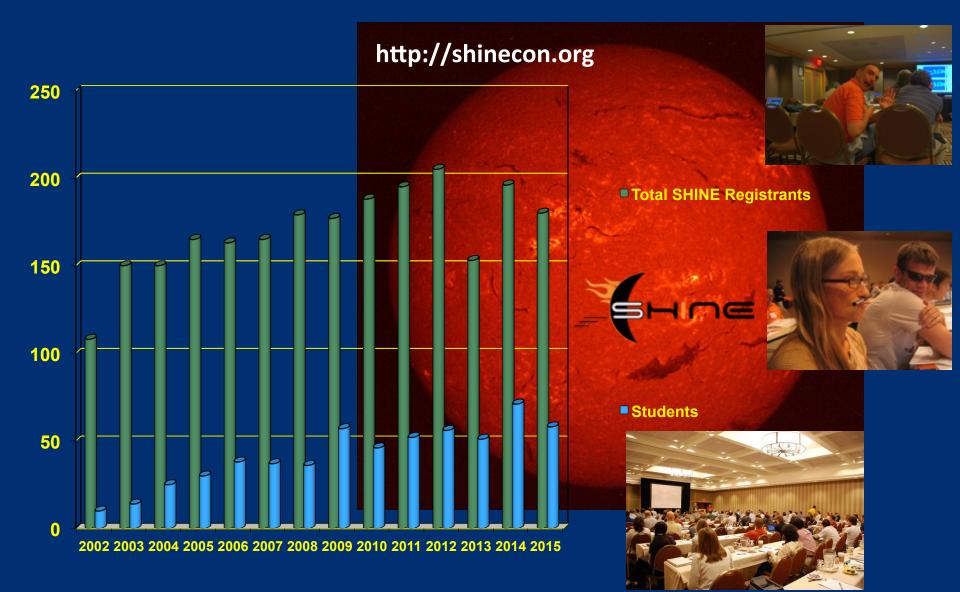
The SHINE research focuses in particular upon the connection between events and phenomena on the Sun and their relation to solar wind structures in the inner heliosphere. The goal of SHINE activities is to enrich and strengthen both physical understanding and predictive capabilities for these phenomena.



- Origin and evolution of flares, CMEs, solar wind, IP turbulence, and SEPs
- Impact of solar drivers on near-Earth space environment
- Observational and instrumentation strategies
- Data and numerical modeling challenges

SHINE Workshop





Magnetospheric Physics (MAG) Program – Goals

Magnetospheric Physics (MAG) program at NSF has been supporting research on the physics of the Earth's magnetosphere and the coupling of the magnetosphere to the atmosphere and the solar wind.

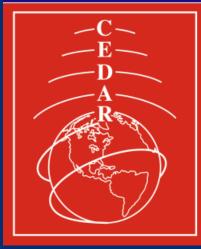
Some of the important elements are:

- Support research dealing with the dynamical and structural properties of the geospace environment
- Improve present understanding of the physical interaction of the solar wind with the Earth's magnetic field (*e.g.*, reconnection processes)

MAG Program – Structure

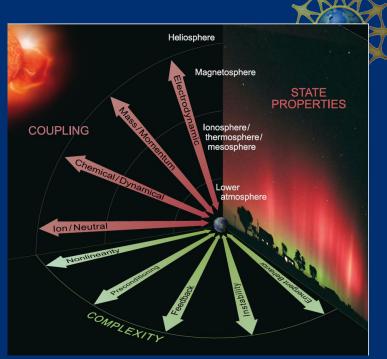
- Core MAG program
- GEM (Geospace Environment Modeling) program
- Interface w/ STR, Aeronomy, Geospace Facilities, Space Weather, and others





What is **GEM**?

The GEM's mission is to understand the physics of the Earth's magnetosphere and the coupling of the magnetosphere to the atmosphere and the solar wind.



- Support basic research into the dynamical and structural properties of geospace, leading to the construction of a global *Geospace General Circulation Model* (GGCM) with predictive capability
- Undertake a series of campaigns and focus groups, in both theory and observational modes, each focusing on particular aspects of the geospace environment

Aeronomy (AER) Program

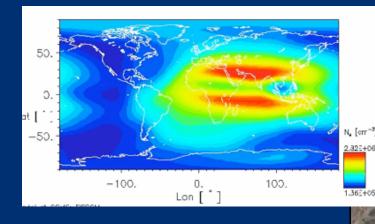
Aeronomy (AER) program at NSF has been supporting research on the mesosphere-thermosphere-ionosphere system, including ionization, recombination, chemical reaction, photo emission, and the transport of energy and momentum.

Some of the important elements are:

- Coupling of this global system to the stratosphere below and the magnetosphere above
- Plasma physics of the coupled ionosphere-magnetosphere system, including the effects of high-power radio wave modification

AER Program – Approaches

- Measurements/instruments
- Laboratory studies
- Data analysis
- Theory and modeling





AER Program – Structure

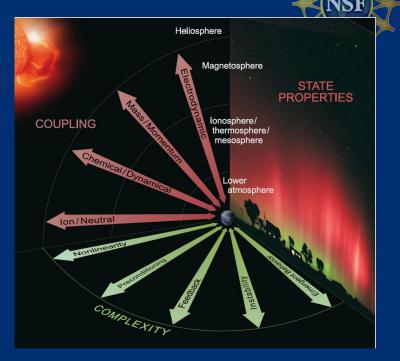
- Core AER program
- CEDAR (Coupling, Energetics and Dynamics of Atmospheric Regions) program

 Interface w/ MAG, Geospace Facilities, Space Weather, and others



What is CEDAR?

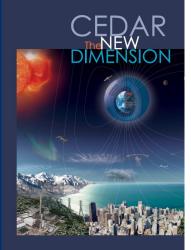
The CEDAR's mission is to understand the fundamental properties of the spaceatmosphere interaction region (SAIR); identify the interconnected processes that define the SAIR's global behavior, evolution, and influence on the Sun-Earth system; and, to explore the SAIR's predictability.



- Integrated system's perspective
- Exchange processes at boundaries and transitions in geospace
- Geospace evolution
- Observational and instrumentation strategies
- Cross-disciplinary in the geosciences data and models

AER, MAG, and STR Programs – Sources of Guidance

- NRC's Decadal Survey on Solar and Space Physics
- Geospace Section "strategic plan"
- GS Portfolio Review
- CEDAR, GEM, and SHINE plans



STRATEGIC VISION for the National Science Foundation Program on COUPLING, ENERGETICS AND DYNAMICS OF ATMOSPHERIC REGIONS

Geospace Sciences: The study of the space environr

A document by the Geospace Section of the 1 Geospace Sciences

Last updated April 2013

The space environment has had a profound role in sha and continues to influence the sustainability of moden The evolution of the primordial atmosphere is a result observation and the matter in the solar system. Even influenced by mutations caused by cosmic radiation. If systems are increasingly affected by physical processe environment. The space environment also serves as a environment. The space environment also serves as a losang advises processes that are otherwise inaccessible

Although research in geospace science and "space weather" has progressed dramatically over the past decade, many of the mouti important and imitinging phenomena at the Sun, in the solar wind, and in the Earth space environment cannot yet be fully explained or adequately predicted. We have now advanced to a point where further progress requires understanding of both basic space plasma physics and the way in which physical processes are coupled over a vast variety of temporal and spatial scales. We call this science that includes all aspects of the fundamental research needed to understand the Sm. Earth system: "Coespace science."

I. Overarching Goals

In the past decade, the research arena for the Geospace research community has expanded to include global change, space weakers, and space sintiational avacences. These studies that have been enabled by new technologies, such as cyberinffastructure, advanced communications, angior research instrumentation, major research facilities, and distributed instrumentation, anong others. With these tools, the community seeks answers to kroaker, more encompossing questions that involve the integrative role of the upper atmosphere in the entire planetary system. The focus is now on gaining a global perspective, where the geospace environment is analyzed as a mettire system in order to fully understand its response to external and internal stresses and its subsequent impact on other parts of the whole Earth system.



SOLAR AND

A Science for a Technological Society





Integrated NSF Support Promoting Interdisciplinary Research and Education

- Requires authorization from two *intellectually distinct programs* to apply
- \$1M awards (5 years in duration)
- Bold interdisciplinary projects
- In FY2016 co-funding from OIIA is 33% (was 50% in FY2015)

http://www.nsf.gov/pubs/2016/nsf16023/nsf16023.pdf

EarthCube



- NSF places significant emphasis on computational and data-rich science and engineering, with the goal of providing a sustainable, community-based and open cyberinfrastructure for researchers and learners.
- This goal is a major challenge because the number and volume of data sets have grown to proportions well beyond the range of applicability of traditional data handling tools.
- The vision of EarthCube is to transform the conduct of research by supporting the development of community-guided CI to integrate data and information for knowledge management across the Geosciences.

http://www.nsf.gov/geo/earthcube/

PREEVENTS



Basic purpose

 Better understand risks posed by GEO-relevant natural hazards and extreme events, *including space weather events*, through basic geoscience research, in order to help increase resilience and reduce impacts on life, society, and the economy

Primary targets (must address both to be eligible!)

- Enhance understanding of fundamental processes underlying natural hazards and extreme events on various scales, and variability inherent in such hazards/events
- Improve capability to model and forecast such hazards and events
- Subsidiary encouraged, but not required
 - Improve understanding of effects of natural hazards/extreme events
 - Enable development, with other support, of tools to enhance societal resilience

Part of NSF Risk & Resilience Activity

Risk and Resilience Funding by Directorate						
(Dollars in Millions)						
	FY 2015	FY 2016	FY 2017			
	Actual	Estimate	Request			
CISE	\$5.50	\$6.00	\$6.00	CRISP		
ENG	12.00	12.00	14.00	CRISP		
GEO	-	17.75	17.75	PREEVENTS		
MPS	-	0.50	0.50	CRISP		
SBE	1.84	4.90	4.90	CRISP		
Total	\$19.34	\$41.15	\$43.15			
Totals may not add due to rounding.						

Overarching goals

- Improve predictability & risk assessment, increase resilience
- Reduce impact of extreme events on life, society, and economy

Program Design



	Co-funding	Track 1 (workshops)	Track 2	
Purpose	Leverage other programs Provide additional support Flexibility on "extreme" New data collection OK	Workshops to foster new communities and interdisciplinary methods	Projects addressing both primary goals that don't fit existing GEO programs No support may be requested for new data collection	
Request	Internal memo only*	PREEVENTS solicitation every two years		
FY16 (\$M)	17.75**	-	-	
FY17 (\$M)	8.0	0.50	10 F	
FY18 (\$M)	8.0	0.50	18.5	
FY19 (\$M)	TBD	TBD	TBD	
FY20 (\$M)	TBD	TBD		

*Max co-funding per project: 50% of total project or \$1M, whichever is less. Under *exceptional* circumstances, the management team may elect to consider requests for up to \$1.5M per project.

**FY16 - \$9M for co-funding under management team, remainder distributed in Divisions for PREEVENTS-relevant work

Review and Funding



Co-funding via internal memo only

- Program reviews proposals, makes decision to fund or not
- MT reviews co-funding requests, makes decision to co-fund or not

Solicitation for workshops (or Track 1) and Track 2 proposals: http://www.nsf.gov/pubs/2016/nsf16562/nsf16562.htm

Track 2 proposals will have two-stage review

- Stage 1: thematic virtual panels + *ad hoc* gives disciplinary depth
- Stage 2: physical panel for all Stage 2 proposals gives overall breadth

Status and Plans



Co-funding Round 1 underway, Round 2 in mid June

- 17 requests received, 15 eligible, 2 had already been awarded \bullet
- MT sought clarification on five requests •
- MT ultimately recommended 14 for co-funding •

Timeline

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- Proposals any time after 1 August 2016 Track 1
- 29 July 2016 Track 2 LOIs required
 - 19 Sept 2016
- Nov/Dec 2016 •
- Jan/Feb 2017
- Mar 2017 •

- Track 2 Proposals due
- Track 2 Stage 1 review
- Track 2 Stage 2 physical panel
 - Track 2 Award recommendations to DGA





Portfolio Review of Geospace Section of AGS (Feb 2015 – Apr 2016)

- Final Report accepted and released by NSF's Advisory Committee for Geosciences on Apr 14, 2016
- NRC assessment of GS Portfolio Review due in Oct of 2016

http://nsf.gov/geo/geoac_subcomm_rpts.jsp



PR Recommendations (Cont.) (New Elements)

Redirect funding to 5 new program elements by 2025

- **Grand Challenge Projects:** *Element of* **Integrative Geospace Science (IGS)** *grants program together with* **SWM**
- Data Systems: Facilities to exploit emerging information technologies for integrated software and data analysis tools, geospace data mining and data assimilation. Peer-reviewed projects receiving support from this program are expected to become Class 2 facilities by 2025
- **Distributed Arrays for Scientific Instruments (DASI):** Development of distributed measurement systems. Peer-reviewed projects receiving support from this program are expected to become Class 2 facilities by 2025

PR Recommendations (Cont.)



Redirect funding to 5 new program elements by 2025

- Innovation and Vitality: Peer-reviewed grants for innovations in facilities and models and upgrades (as needed) to maintain state-of-the-art
- European Incoherent Scatter Scientific Association (EISCAT): Begin forging a partnership with the EISCAT consortium to use new EISCAT-3D capability and EISCAT-Svalbard as a replacement for Sondrestrom

Recommended GS Portfolio



2015 2020 2025 33% Core Core Core Core Grants Grants Grants 14.38 14.4 14.4 **Targeted** 30% **Targeted** Targeted Grants Grants Grants Strategic 6.7 8.7 8.7 IGS SWM 1.5 IGS CubeSat | FDSS 2.1 3.0 5.0 CubeSat | FDSS 1.6 CubeSat | FDSS 1.6 Class 2 **I&V** Facilities 2.7 3.83 Development 36% Class 2 5.8 Class 2 Facilities 4.8 2.7 Class 1 Class 1 Class 1 Reserve 7.4 13.05 8.4 0.4 0.43

Questions?

than you