Geospace Science Update

M. Wiltberger

Geospace Section Head

NSF/AGS

Outline

- Section Update
  - Staffing
  - Need for Space Weather & Aeronomy Program Officers
- FY19 Activities
  - Budgets
  - Facilities Update
  - FY19 Solicitation Results
    - New CubeSats
    - DASI
    - FDSS
  - Leveraging other NSF programs
  - SWORM and NSB
  - PRF

Thanks for their service

Space Weather Research
S. Irfan Azeem

Geospace Expert
Sunanda Basu

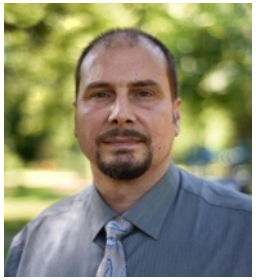
AGS and the Geospace Section

AGS Division Director
Anjuli Bamzai

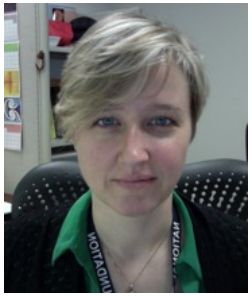
Section Head
Michael Wiltberger

Aeronomy
Roman Makarevich

Magnetosphere
Lisa Winter



Solar Terrestrial Research
Ilia Roussev



Geospace Facilities
Carrie Black

Expert
John Meriwether

Mangala Sharma
Space Weather

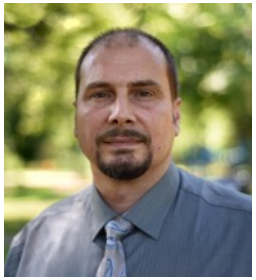
AGS and the Geospace Section

AGS Division Director
Anjuli Bamzai

Section Head
Michael Wiltberger

Aeronomy
We Need You!

Magnetosphere
Lisa Winter



Solar Terrestrial Research
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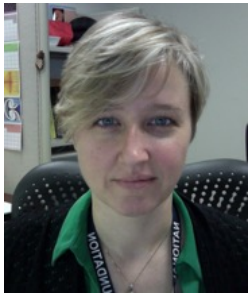


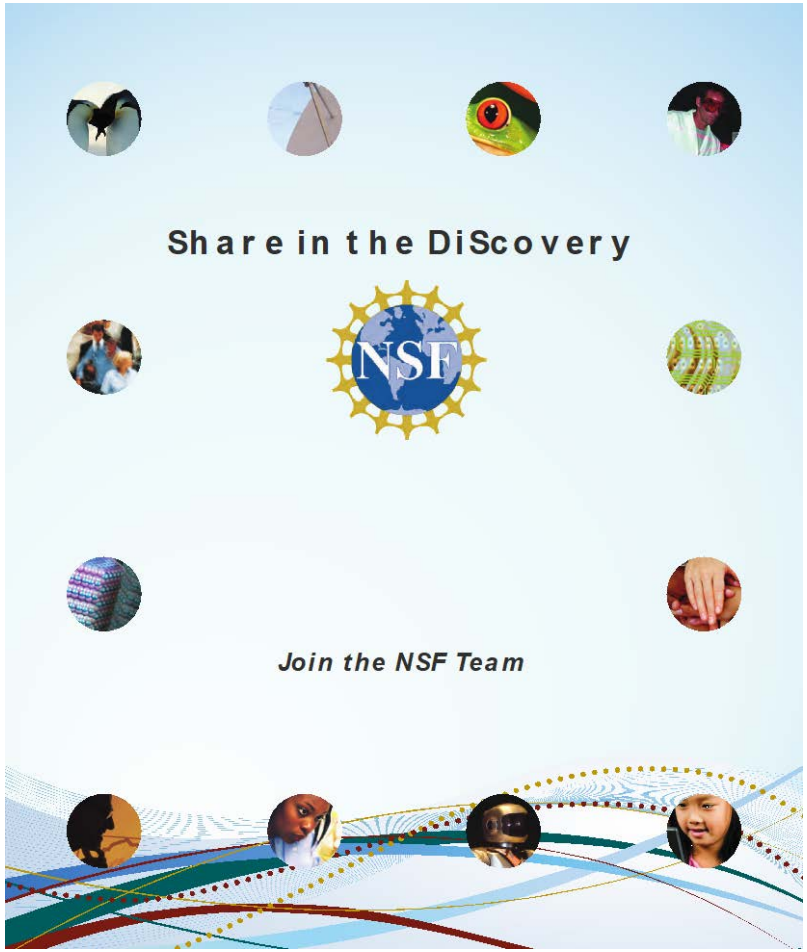
Geospace Facilities
Carrie Black

Expert
John Meriwether

Space Weather
We Need You!

Call for rotators

- Need to fill in remaining position with IPA rotators
  - Initial term is 1 year with options for up to 4 years in total
  - Checkout
    - DCL – AGS 19-002
    - Google NSF Rotators for more information
- Looking for scientists with expertise in space weather
- Seek out me or any GS PO for more information



Quick Facts about FY19

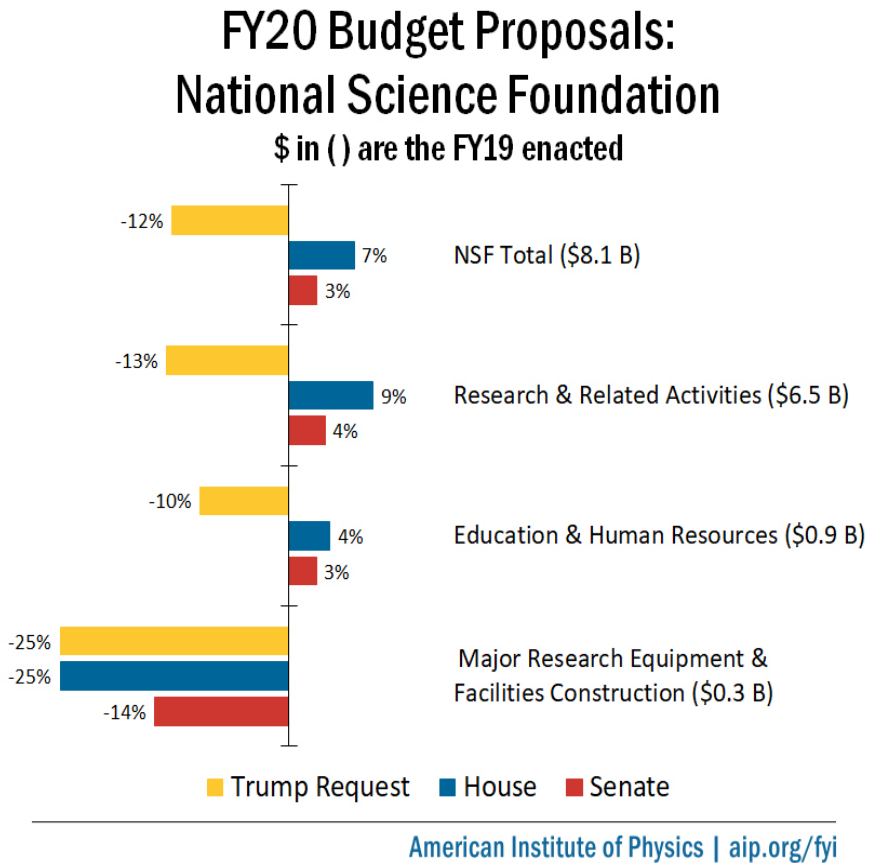
- Overall spending in section was $50.9M up 1% from FY18
  - Reflects a leveling off in budget after several positive years

AER	MAG	STR	SWR	FAC
9.0M	8.1M	8.4M	9.4M	15.4M

  - SWR funded 4 CubeSats reflecting payback of “loans” made to it in FY18
- Additional facts about AER, MAG, STR, SWR grants in 2019
  - 116 new award actions
  - Over 65% new awards made as standard grants
  - Section mortgage rate is under control

NSF and AGS Budgets

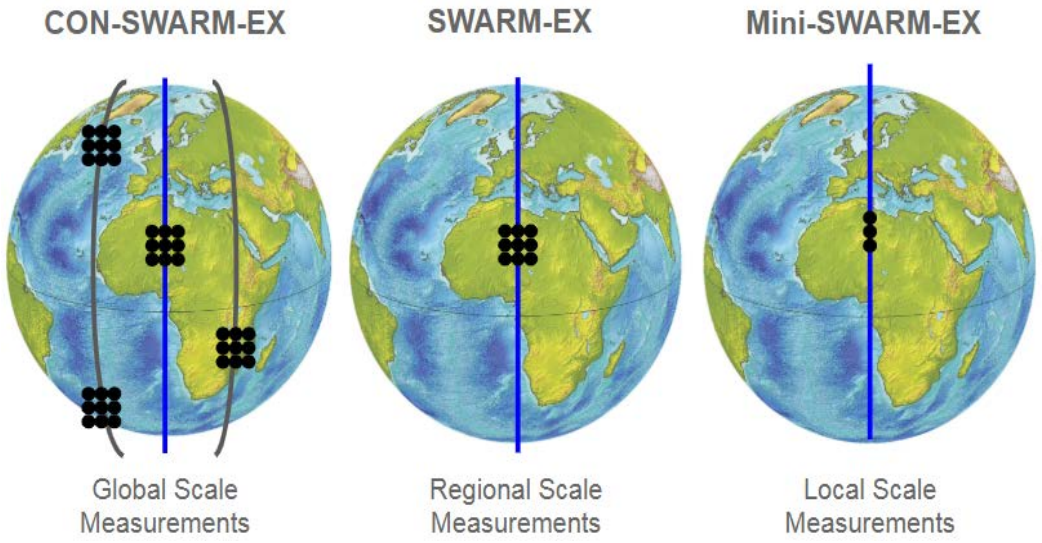
- We are once again operating on a CR
  - Funded through Nov 21
  - Our work to reduce mortgages provides flexibility
- AGS is down 19.6% from the FY18 Actual levels in the FY20 Request
- Google NSF FY20 Request for full details



Facility Update

A Strategic Vision for Incoherent Scatter Radar
March 30 – April 1 2020

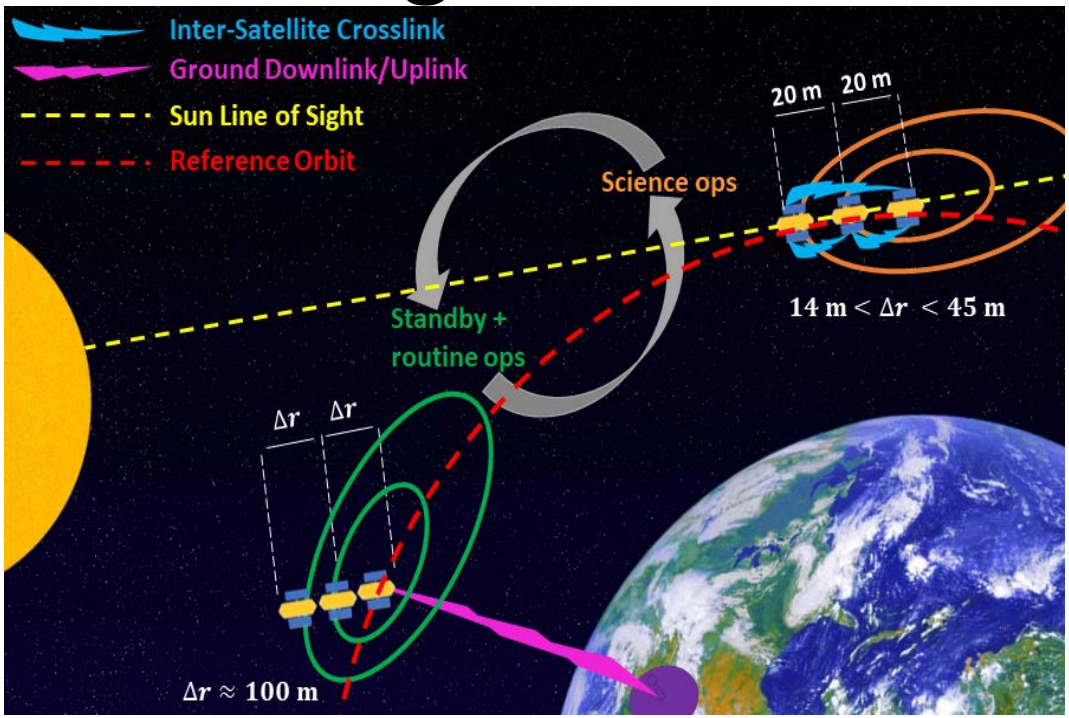
SWARM-EX: Space Weather Atmospheric Reconfigurable Multiscale Experiment



PI: Palo, University of Colorado at Boulder

- **SWARM-EX will answer outstanding questions about the ionosphere and thermosphere through in-situ measurements with a global constellation of CubeSat swarms**
- **Testbed for a larger swarm useful for many future science missions**
- **Technology advancement in formation flying, satellite communications and propulsion.**
- **Intercollegiate CubeSat Mentoring Program builds a community of students and faculty skilled in space systems – pairing the expertise from established programs with emerging programs**

VISORS: Virtual Super-resolution Optics with Reconfigurable Swarms



PI: Kamalabadi, University of Illinois at Urbana-Champaign

High Risk, High Reward Project: Pushes Technology Boundaries

- **VISORS will test fundamental theories of solar coronal heating to answer a decades old question – how the outer layer of the Sun is heated to millions of degrees?**
- **First very high resolution imaging of nanofilaments in the solar corona**
- **Revolutionary, potentially Transformative technology: 3 individual CubeSats acting as a single telescope (optics, Sun shade, detector)**

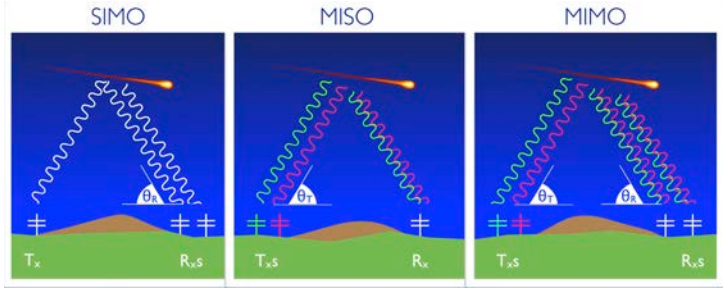
DASI Track 1: Development of a Distributed MIMO Meteor Radar Network for Space Weather Research - Ryan Volz (MIT)

Team Lead – Early Career Scientist, in collaboration with CU Boulder (Palo)

Meteor trails are used to characterize high altitude winds (120km-50km), which are important to understand, in part, for understanding the impacts of space weather events (externally or internally driven) on radio communications.

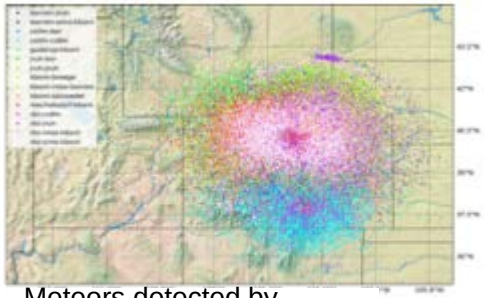
MIMO will capture vertical wind component and spatial variability of wind field that classical meteor radar systems (SISO) cannot capture

This award is to develop and test the instrumentation and open source software. Testing and deployment will take place in CO with long term plans to deploy at two transmit array sites, one receive array site, and 10 single receiver sites over ~90,000 km^2.

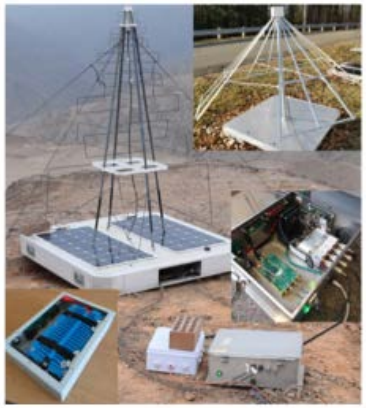


MIMO schematic

Chau et al 2018 "Novel specular meteor radar systems using coherent MIMO techniques..."



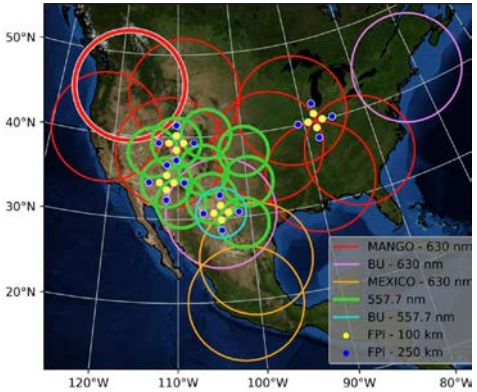
Meteors detected by radars in Germany over the proposed deployment region.



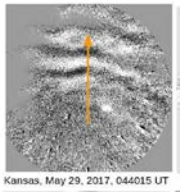
Hardware to be improved and deployed.

DASI Track 2: An optical network to study the vertical propagation resulting in spatio-temporal variability in the thermosphere - Elizabeth Kendall (SRI)

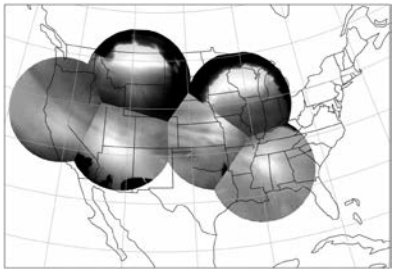
- **Investigate thermosphere – ionosphere – neutral atmosphere coupling.**
- **Improve understanding of the space weather events in the atmosphere and inform improvements to global whole atmosphere models.**
- **Synergistic with the NSF funded Mid-latitude All-sky-imaging Network for Geophysical Observations (MANGO) network. MANGO is located at 7 locations from Montana to Mississippi, including high schools, and managed by the same team.**
- **This current award is to deploy one additional MANGO site and 10 all sky imagers and Fabry Perot Interferometers at sites in the southwestern US.**



Fields of view for proposed and existing imagers.



MANGO image of Traveling Ionospheric Disturbance



Overlap of all sky images showing continental scale of TIDs during a geomagnetic storm.

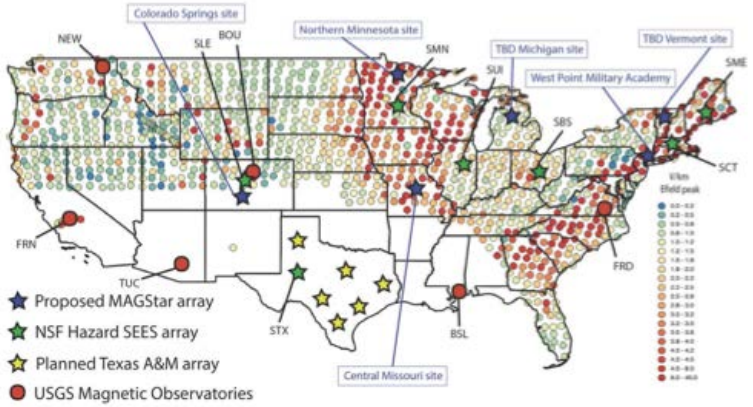
DASI Track 2: MagStar- Improving the spatial coverage of US magnetometers for space weather research and operations
- Jennifer Gannon (Computational Physics, Inc)

Magstar will make observations of the Earth's Magnetosphere for the purposes of monitoring geomagnetically induced currents (GICs).

GICs during geomagnetic storms can impact power grids, particularly those with aging transformers.

The 2019 and 2015 National Space Weather Strategy and Action Plan both call for further study of induced geoelectric fields.

Adds six sites to sparse coverage of the continental US and provide reliable streams for the operations and science community.



Magnetic observatories with IRIS magnetotelluric survey locations.

NSF Hazard SEES magnetometer at Leyden, SO

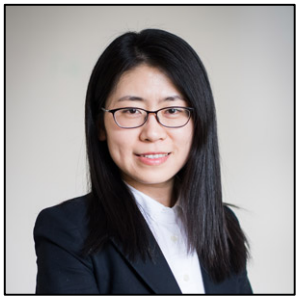
GS CAREER Awards

Matsuo, Tomoko
UC Boulder

Predictability of the whole atmosphere from ground to geospace

Deshpande, Kshitija
ERAU

Characterization of sources of ionospheric scintillation and space weather prediction through analytics and machine learning



Li, Wen
Boston U

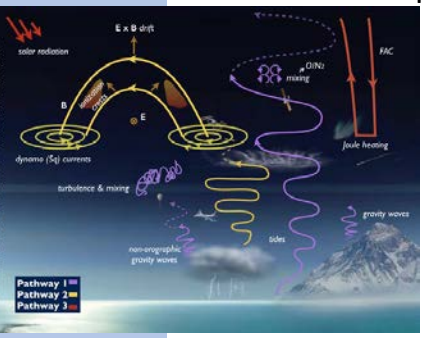
Exploring mysterious whistler mode waves in earth's plasmaspheric plumes

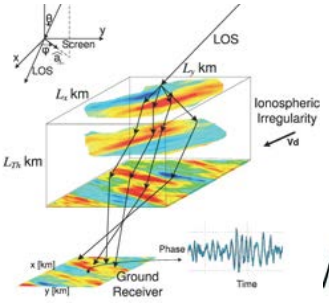
Walsh, Brian
Boston U

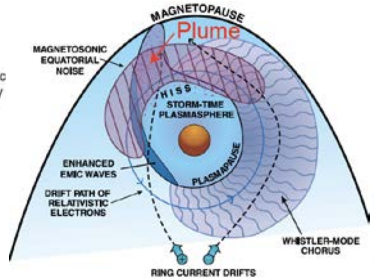
What controls out of plane spreading of magnetic reconnection?

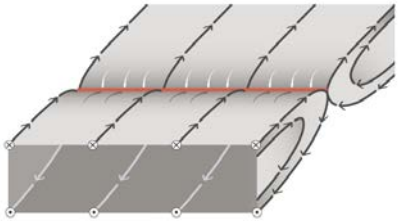
Sun, Xudong
U Hawaii

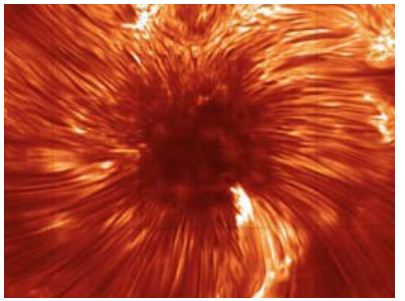
Probing stressed magnetic fields in solar active regions











Faculty Development in Space Sciences

Leveraging Other Programs at NSF

OIA, Convergence Accelerator, 1937152, $892,316, Ryan McGranaghan, Convergence Accelerator Phase I (RAISE): Convergence Hub for the Exploration of Space Science (CHESS)

OAC, HDR-Harnessing the Data Revolution, 1940208, $170,000, Ryan McGranaghan, Collaborative Research: Predictive Risk Investigation SysteM (PRISM) for Multi-layer Dynamic Interconnection Analysis

GEO/ICER, EarthCube, 1928403, $627,763, Tomoko Matsuo, EarthCube Data Capabilities: Collaborative Proposal: Assimilative Mapping of Geospace Observations

GEO/ICER, PREEVENTS, 1854790, $1,994,773, Jon Linker, Quantifying the Risk of Extreme Solar Eruptions (QUEST)

OAC, Software Institutes, EarthCube, 1835573, $599,750, Asti Bhatt, Elements: Software: The Integrated Geoscience Observatory (InGeO)

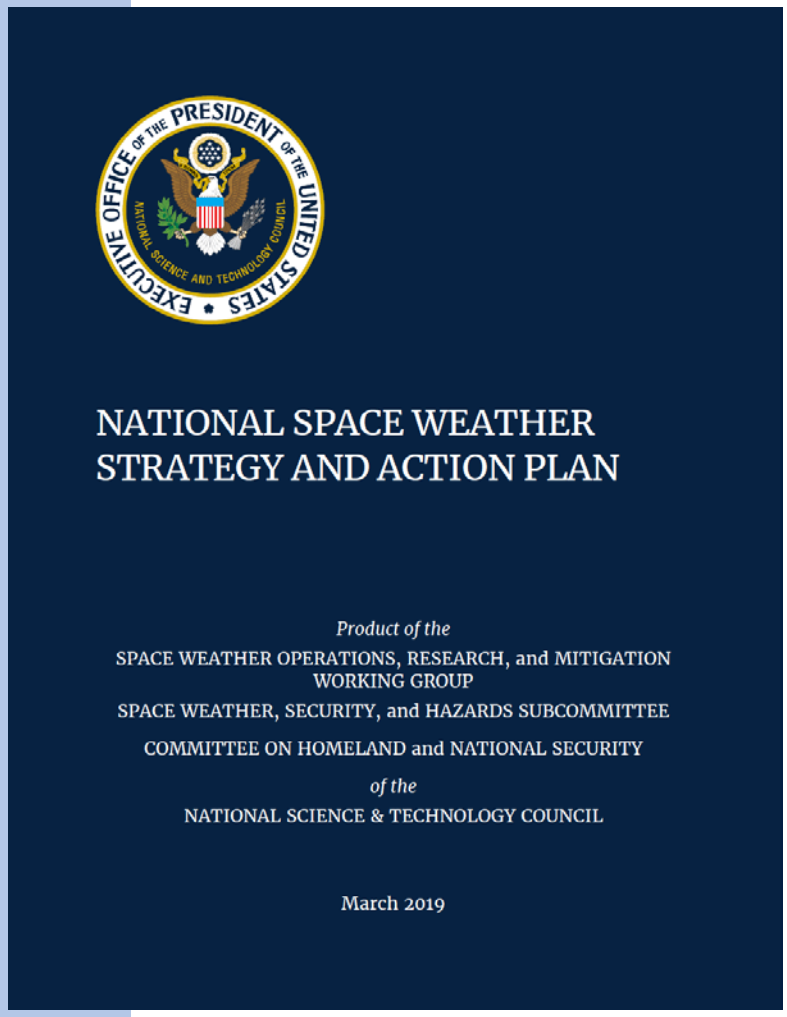
MPS/PHY, Plasma Physics, 1903416, $404,531, Meers Oppenheim, Solar Chromospheric Plasma Turbulence and Heating Driven by Neutral-Plasma Coupling

AGS Postdoctoral Research Fellowships

- After a hiatus the AGS-PRF program has returned to support highly qualified early career investigators independent research efforts

- Solicitation Information
  - Provides two years of support
    - 94K in year 1 and 96K in year 2
  - Award made directly to PI, but need to identify a host institution
  - Graduate student or less than 2 years since PhD to apply
  - No deadlines
  - Google NSF AGS PRF for more information

National Space Weather Strategy and Action Plan



- NSF AGS was actively involved in the development of this new plan
- Objective II – Develop and Disseminate Accurate and Timely Space Weather Characterization and Forecasts
  - 2.3 – Support and coordinate opportunities for fundamental research in heliophysics and geopace sciences
  - 2.4 – Identify, develop, and test innovative approaches to enable, enhanced, more informative, robust, and cost-effective measurements
- Supported the Next Step Benchmark activity required by Objective 1.1

We need you!

- The heart and soul of the NSF proposal review process is the participation of experts such as yourself
  - Please, please, please agree to contribute ad hoc reviews and join panels
- New solicitations and cross directorate activities are increasing the demand for reviewers
- Thanks to all who have already stepped up!

Thank you – Questions?

- Happy to provide answers ☺