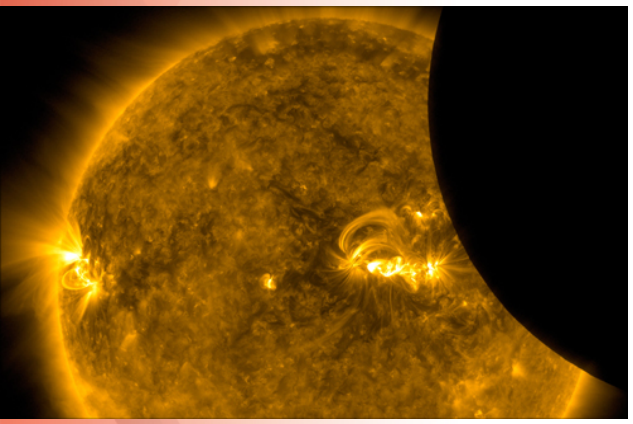
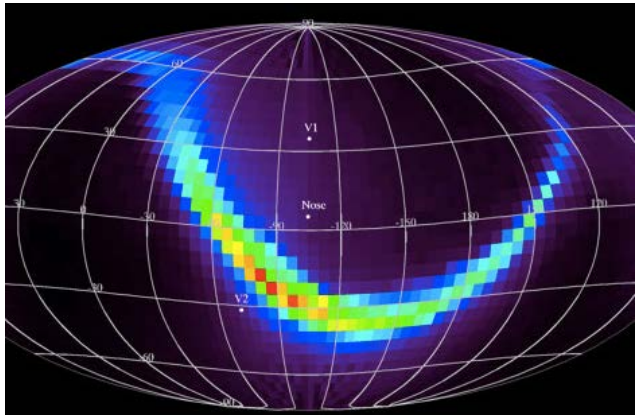
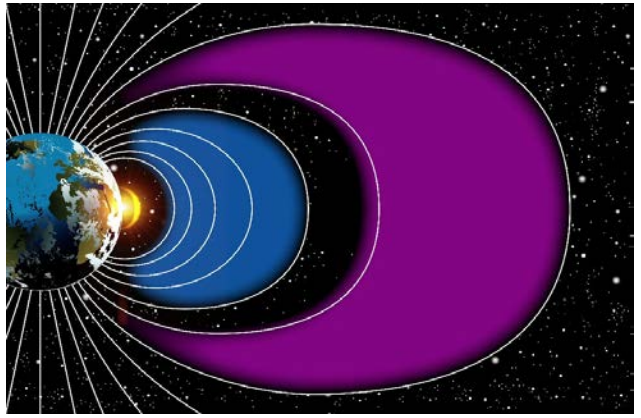
SCIENCE

National Aeronautics and Space Administration







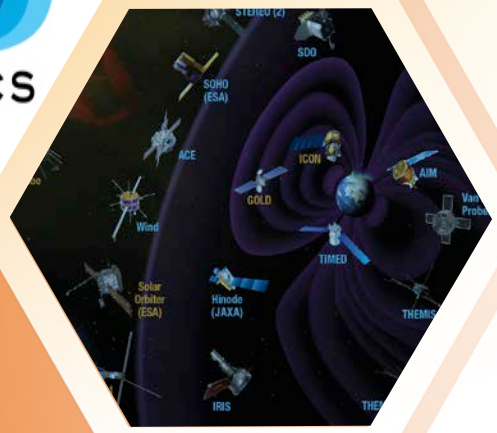
NASA Space Weather and Impacts to Human Space Flight

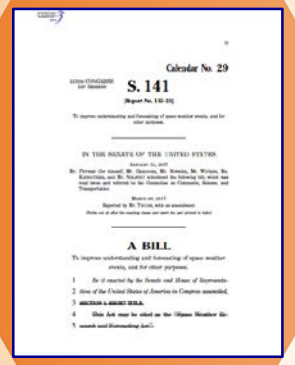
James Spann

Acting Chief Scientist
Heliophysics Division

25 July 2018

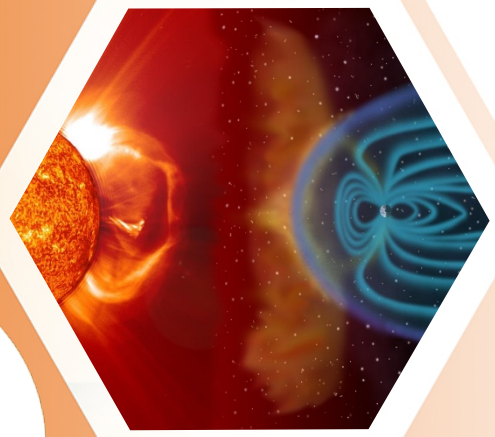
HELIOPHYSICS




Calendar No. 29

S. 141

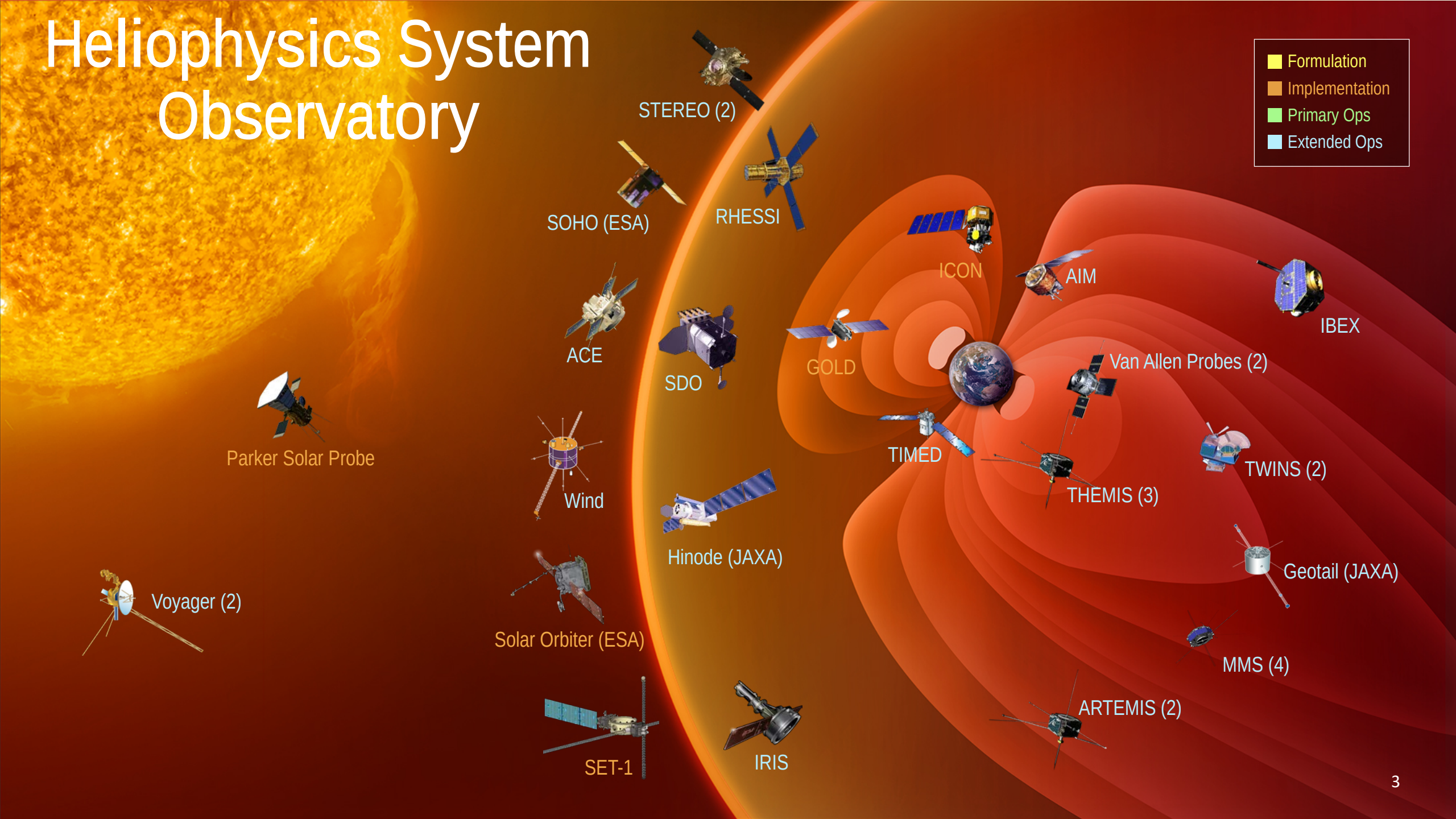
A BILL



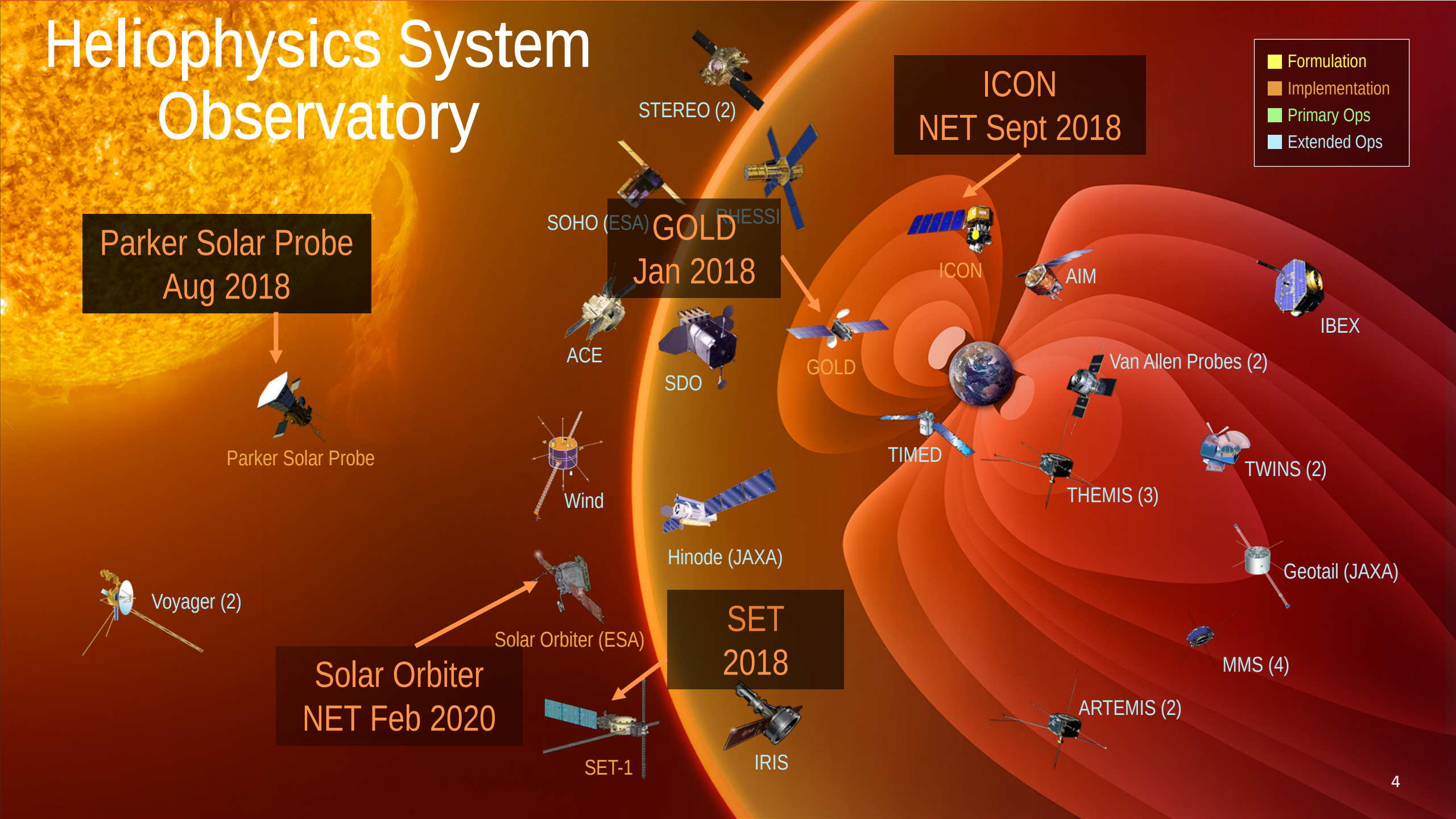
Overview

- Heliophysics System Observatory
- Space Weather Strategy
- SWx Science Applications Project – SnAP
- International and Interagency Partnerships
- Space Weather and Human Exploration

Heliophysics System Observatory

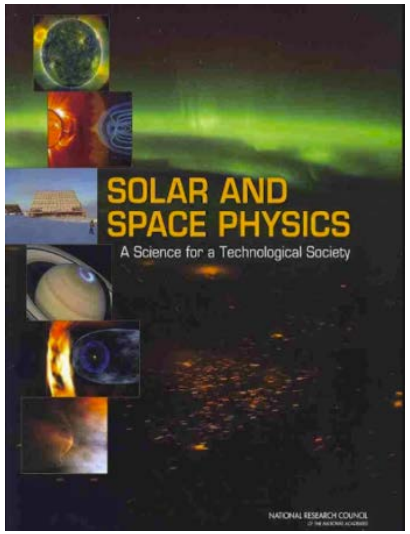


Heliophysics System Observatory



Recent National Space Weather Strategy

- 2012 Decadal Survey “Solar and Space Physics: A Science for a Technological Society”
  - Action 4.3
- National Space Weather Strategy and Space Weather Action Plan, released October 2015
  - Details the activities, outcomes and timelines that will be undertaken by U.S. federal departments and agencies for the Nation to make progress toward the strategic goals
- Space Weather Research and Forecasting Act (S.141), 2017
  - House of representatives developing a companion bill: held hearing on this topic on April 26 and marked up a version of this bill on July 24
  - National Defense Authorization Act, 2017
  - Strategy to prepare for natural and adversarial electromagnetic pulse

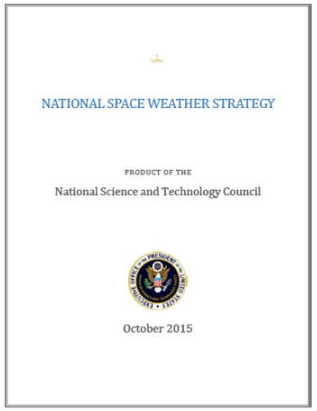



NATIONAL SPACE WEATHER ACTION PLAN

PRODUCT OF THE

National Science and Technology Council

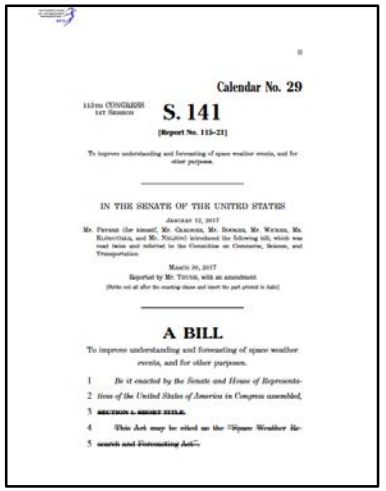
October 2015


NATIONAL SPACE WEATHER STRATEGY

PRODUCT OF THE

National Science and Technology Council

October 2015


Calendar No. 29

115TH CONGRESS 1ST SESSION

S. 141

[Report No. 115–21]

IN THE SENATE OF THE UNITED STATES

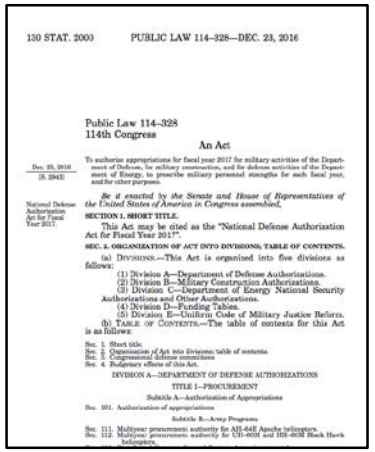
A BILL

To improve understanding and forecasting of space weather events, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the “Space Weather Research and Forecasting Act”.


130 STAT. 2000 PUBLIC LAW 114–328—DEC. 23, 2016

Public Law 114–328
114th Congress

An Act

To authorize appropriations for fiscal year 2017 for military activities of the Department of Defense, for military construction, and for defense activities of the Department of Energy, to prescribe military personnel strengths for such fiscal year, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the “National Defense Authorization Act for Fiscal Year 2017”.

SEC. 2. ORGANIZATION OF ACT INTO DIVISIONS; TABLE OF CONTENTS.

(a) DIVISIONS.—This Act is organized into five divisions as follows:

(1) Division A—Department of Defense Authorizations.
(2) Division B—Military Construction Authorizations.
(3) Division C—Department of Energy National Security Authorizations and Other Authorizations.
(4) Division D—Funding Tables.
(5) Division E—Uniform Code of Military Justice Reform.

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

DIVISION A—DEPARTMENT OF DEFENSE AUTHORIZATIONS

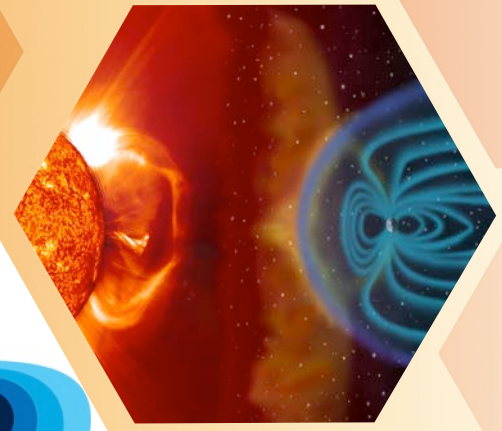
TITLE I—PROCUREMENT

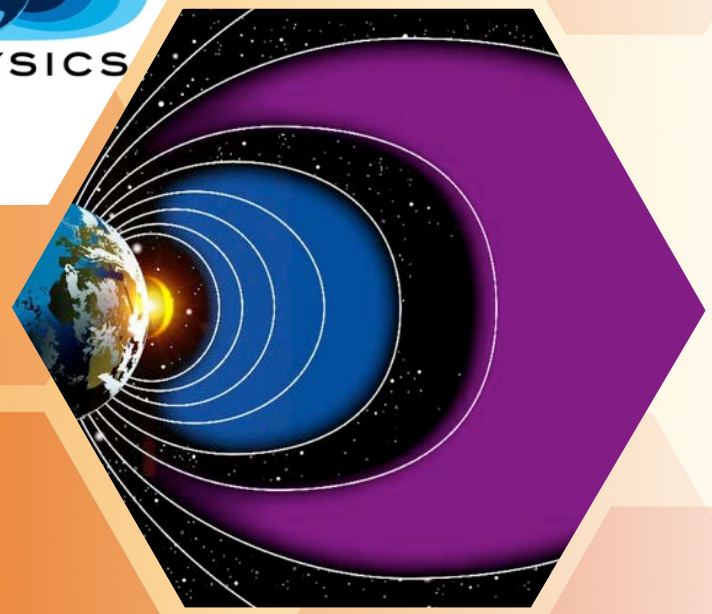
Subtitle A—Authorization of Appropriations

Recent National Space Weather Strategy

- Presidential Priorities
  - Promote leadership, technology, and innovation
  - Promote American resilience to threat of natural and induced space weather disasters
  - Enhance space weather forecasts, alerts and services
  - Strengthen space weather capabilities to enhance national security
  - Advance American influence and leadership in space
- NASA Strategic Plan, 2018
  - Strategic Objective 1.1: Understand The Sun, Earth, Solar System, And Universe,
    - Third core context of NASA's first strategic objective: Safeguarding and Improving Life on Earth
- Space Weather Operations, Research, and Mitigation (SWORM) Task Force
  - Established by OSTP National Science and Technology Council, 2014

SWx Science Applications Project – SnAP: Focus and Objectives





- SnAP Goal:
  - Effectively transition heliophysics science investigation output to products that enhance the user communities' ability to address impacts caused by the dynamic space environment.
- SnAP Description:
  - SnAP is a Heliophysics Division managed project that enables transition of heliophysics science results to application products.
  - The drivers for SnAP are the expressed needs of user communities such as space exploration, engineering, industry, service providers, and operational agencies, that are impacted by the dynamic space environment.
  - SnAP competes ideas and products, leverages existing Agency capabilities, collaborates with other agencies, and partners with the user communities.

SnAP General Construct and Content

SMD Heliophysics Division managed

- Light touch independent project management at a field center
- Draws on expertise across the agency
- Multiagency Collaborations – NSF, NOAA, DoD

1. Competed elements
   a. Applied Research focused on transitioning science to applications
   b. Technology development for observations and informatics required to improve space weather prediction
   c. Small Business Innovation Research (SBIR)
   d. Mission of Opportunity or Small Explorer – focused on observations to improve space weather prediction
2. Enhanced capabilities
   a. CCMC enhancement for model assessment and transition
   b. High-End Computing capability to enable large scale predictive modeling development
3. Generates responses to National Space Weather actions (e.g., SWORM/SWAP)

Space Weather Science Application Implementation

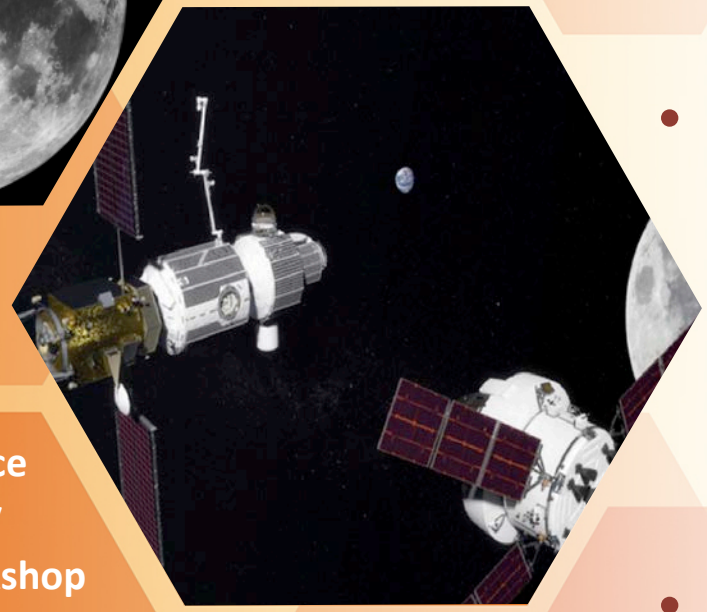
- $3M in President's FY2019 budget request – NASA: "...enhancing the ability to forecast and characterize space weather events in collaboration with NASA's inter-agency partners."
- Senate Committee recommended $15M; final amount decided later in Appropriations process

- January 2018 – Pilot funding opportunity for Operations-to-Research
  - NASA/NOAA joint opportunity; NSF released separate announcement
  - Target: Improved geomagnetic activity forecasting

- March 2018 – Second applied research opportunity released
  - NASA/NOAA coordinated research announcement
  - Target: Satellite radiation environment

- Tri-Agency NASA, NOAA, NSF Memorandum of Understanding
  - Under agency General Counsel review
  - Enables ongoing multi-agency coordination of research topics

Lunar Orbital Platform-Gateway Science/Research Workshop



NASA SMD and HEOMD sponsored a three-day workshop in February that engaged the scientific/research communities in Lunar Gateway formulation and determine the best ways the it can be used in its early phases to facilitate science and research

- Purpose
  - Engage the science community with respect to the scientific potential of a lunar gateway
  - Discuss potential scientific investigations leveraging the gateway including the scope of possible instruments using the gateway infrastructure
  - Discuss what resources the gateway would have to provide to facilitate different types of scientific investigations
- Based on the successful Tempe Lunar Science Workshop held in 2007

Deep Space Gateway

Science Workshop

February 27-March 1, 2018

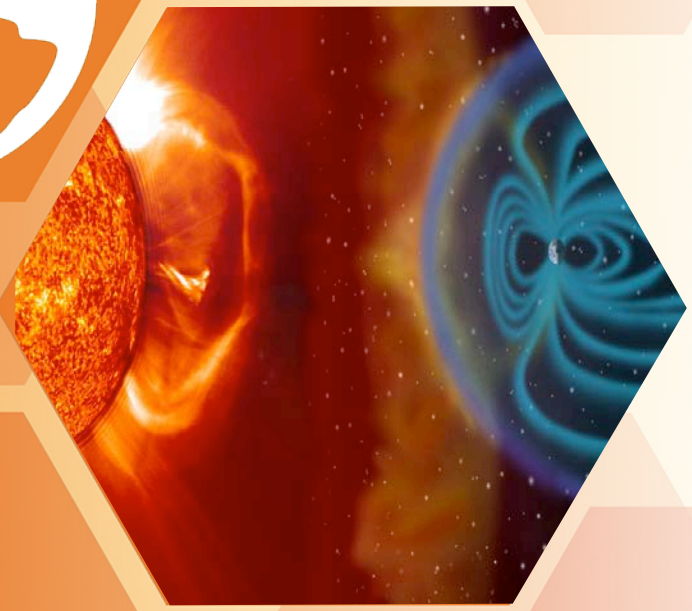
Denver, Colorado

Top Science Takeaways

- Gateway, in a near rectilinear halo orbit (NHRO), offers unique opportunities for some Earth, Heliophysics, Astrophysics and fundamental physics investigations
- With the addition of additional transportation infrastructure (low lunar orbit (LLO) tug/pallet, surface access, sample return capability) gateway can enable additional important lunar science
  - Concepts for free flying platform now under review at NASA
- Externally mounted sample collection with controlled pointing can collect samples and provide important science about cometary material, solar composition, interstellar particles, and near Earth objects
- Radiation environment of the Gateway can provide important tests of the effects of radiation on biological organisms.
- Science utilization extremely constrained until the presence of an external robotic arm
  - Arm is the de facto external experiment installer
  - Some small-scale initial science might be possible with instruments on power propulsion element (PPE)
- *Need to coordinate with international partners on sharing/allocation of science resource*

Summary

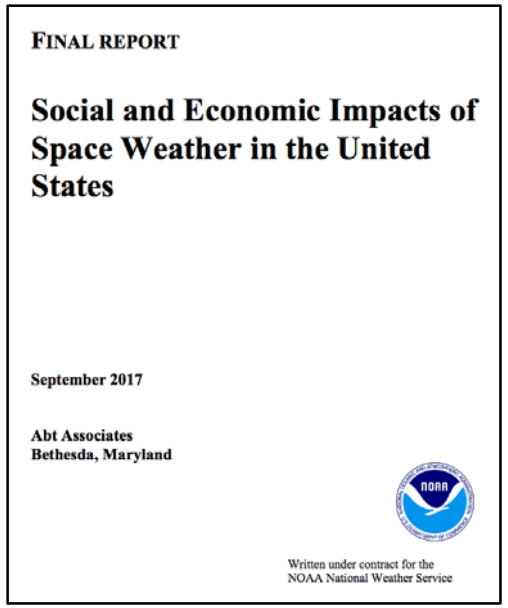
- Heliophysics Division continues execution of space weather objectives by
  - aligning with US National space weather policy and decadal recommendations
  - implementing SnAP program
  - incorporating interagency and international partnerships
- Prepared to support Human Exploration beyond low Earth orbit, lunar vicinity, and eventually to Mars with space weather prediction



Back Up

National Space Weather Action Plan

- Goal 1: Benchmarks
  - Provide a clear description of space weather events based on scientific and historical knowledge; Phase 1 document released
  - Next Step: Broader national and international input will be obtained through upcoming community meetings
- Goal 4: Impacts on critical infrastructure - Economic Impact Study
  - Final Report released in September 2017
- Goal 5: Improve services through advancing understanding
  - Coordinated interagency space weather research funding
  - Tri-agency MOU released between NASA, NOAA, and NSF
  - Joint NASA/NOAA Operations-to-Research solicitations


FINAL REPORT

Social and Economic Impacts of Space Weather in the United States

September 2017

Abt Associates
Bethesda, Maryland

Written under contract for the
NOAA National Weather Service

International Organizations engaged in Space Weather activities

UN Committee on the Peaceful Uses of Outer Space

World Meteorological Organization

International Civil Aviation Organization

Coordination Group for Meteorological Satellites

International Space Environment Service

Numerous other groups are active in space weather research (COSPAR, ISWI, ILWS, IAU, URSI, SCOSTEP, etc.)

International Partners

ESA:

- Solar Orbiter
- THOR-US was contingent on selection of ESA M4 mission

KASI:

- Development towards prototype coronagraph for balloon flight, BITSE, in 2019; agreement signed October 2017

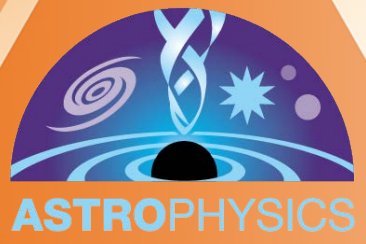
ISRO:

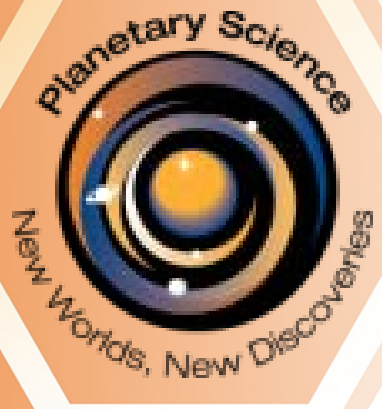
- Three sub-working groups established
  - 1) Aditya-1 mission collaboration
  - 2) space weather modeling
  - 3) long-term strategic collaboration focus areas

JAXA:

- Working with JAXA on approach for Next Generation Solar Physics Mission (NGSPM)

Intra- and Interagency Partners





Planetary:

- Co-selected LWS grants; joint ROSES Juno Participating Scientist Program

Astrophysics:

- Joint “Impact of Stellar Properties on the Habitability of Exoplanets” research opportunity

NASA-NSF:

- Coordinating ICON & GOLD opportunities (joint NASA mission GI and NSF CEDAR solicitations)
- Heliophysics Science Centers

Additional NSF/NOAA/NASA collaboration previously described with space weather