Overview Topics

- Science Highlights
- Senior Review Results
- Missions in Development
- Sounding Rockets
- Research & Analysis
- National Space Weather Strategy
- International Collaboration Update
- Division Strategy

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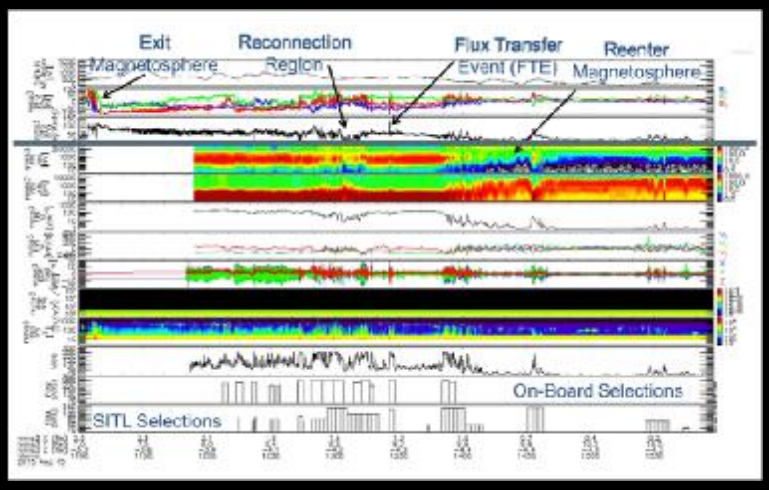
Science Highlights

Heliophysics Science Highlights

August 2015

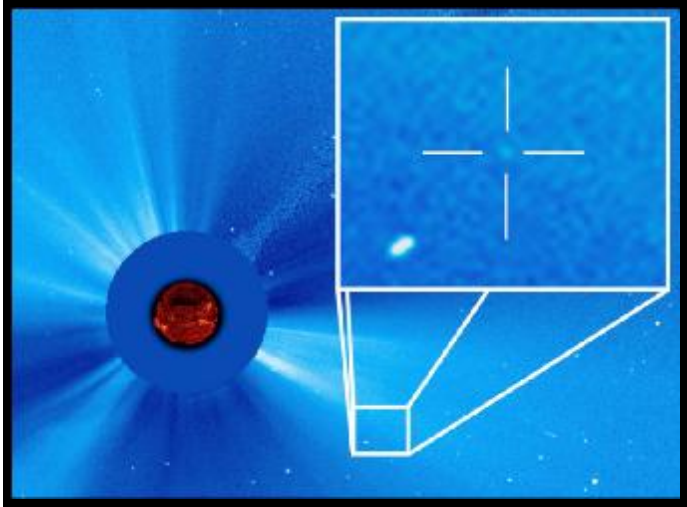


MMS First Passage Through the Magnetopause:

In mid-August 2015, the four MMS spacecraft recorded their first passage through Earth's magnetopause. This first passage observed a number of interesting measurements, including a dynamic reconnection region and a flux transfer event. This provides a hint of the groundbreaking science data to come. This sequence also provides validation of the Scientist in the Loop (SITL) data selection methodology that supplements the on-board selections.

Heliophysics Science Highlights
September 2015

SOHO Discovers Its 3,000th Comet!



- On Sept. 13, 2015, citizen scientist Worachate Boonplod, of Samut Songkhram, Thailand used data from the Solar and Heliospheric Observatory (SOHO) to discover its 3,000th comet.

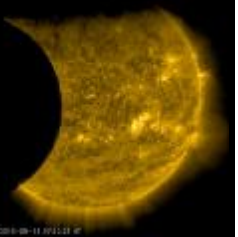
- Prior to the 1995 launch of SOHO, only a dozen or so comets had ever even been discovered from space, while some 900 had been discovered from the ground.

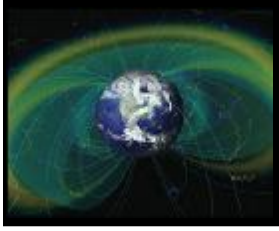
- SOHO's great success as a comet finder is dependent on the people who sift through its data – a task open to the world as the data is publicly available online in near-real time. The result: 95 percent of SOHO comets have been found by these citizen scientists.

Heliophysics Science Highlights
September 2015

NASA's BARREL Team Return from Sweden: After seven balloon launches in the bright Arctic sun, the BARREL team has returned home from a 4-week campaign in Kiruna, Sweden, north of the Arctic Circle. Each research balloon observed emissions high in our atmosphere that correlated to events in the complex space environment above. This third mini-balloon campaign follows two 20-balloon campaigns that launched from Antarctica in 2013 and 2014. The team also achieved science conjunction with six other missions during this campaign, collecting data in coordination with NASA's Van Allen Probes, MMS, THEMIS, the joint ESA/NASA Cluster and two CubeSat missions.

SDO Observes an Earth Eclipse and a Lunar Transit in the Same Day!:
On Sept. 13, 2015, as NASA's Solar Dynamics Observatory, or SDO, kept up its constant watch on the sun, its view was photo-bombed not once, but twice. Just as the moon came into SDO's field of view on a path to cross the sun, Earth entered the picture, blocking SDO's view completely. When SDO's view of the sun emerged from Earth's shadow, the moon was just completing its journey across the sun's face.





Van Allen Probes Celebrate Third Anniversary of Launch: On Aug. 30, three years after NASA's Van Allen Probes were launched, the twin spacecraft continue to push the boundaries of what is known about the space above our world. These discoveries have led to the formulation of new objectives for the extended mission including optimized data compression and a new maneuver to double the double the number of times the spacecraft lap each other, allowing scientists to gather more detailed information on the processes that accelerate radiation belt particles.

Voyager in the News

HELIOPHYSICS

Voyager on the cover of American Scientist

An article written by Drs. Stamatios Krimigis and Robert Decker entitled "The Voyager's Odyssey" is the feature story in the July-August 2015 issue of American Scientist (volume 103, number 4). The article describes the challenges and discoveries Voyager has experienced on its journey to interstellar space.

http://www.americanscientist.org/issues/id.115/past.aspx

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HELIOPHYSICS

Senior Review Results

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Operating Mission Suite

Mission	Launch	Phase	Extension to (*)	M-3	M-2	M-1	Cur. M.	Remarks
Geotail	7/24/1992	Extended	12/31/2015					
STEREO	10/25/2006	Extended	9/30/2018					STEREO-B ping moved to 3/2016
THEMIS+Artemis	2/17/2007	Extended	9/30/2018					
AIM	4/25/2007	Extended	9/30/2018					
Hinode	9/23/2006	Extended	9/30/2018					
Cluster	7/16/2000	Extended	9/30/2015 (+)					NASA supports ends 10/1/2015
ACE	8/27/1997	Extended	9/30/2018					
RHESSI	2/5/2002	Extended	9/30/2018					
SOHO	12/2/1995	Extended	9/30/2018					
TIMED	12/7/2001	Extended	9/30/2018					
Voyager 1 + 2	8/20/1977	Extended	9/30/2018					
TWINS A + B	6/2006 & 3/2008	Extended	9/30/2018					
CINDI/C/NOFS	4/16/2008	Extended	12/31/2015					Reentry of C/NOFS: Nov 2015
IBEX	10/19/2008	Extended	9/30/2018					
Wind	11/1/1994	Extended	9/30/2018					
SDO	2/11/2010	Extended	9/30/2018					
Van Allen	8/30/2012	Extended	9/30/2018					
IRIS	6/27/2013	Extended	9/30/2018					
MMS	3/12/2015	Prime	9/1/2017					Successful PLAR 8/2015 - in Phase E.

(*) Extended mission end dates subject to upcoming Senior Reviews. (+) Terminates at date.

Mission proceeding to meet science requirements

Area of concern - possible reduction in capability

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Mission Rankings

Science Ranking Contribution Ranking

	Median	Std Dev
IBEX	9	1.6
IRIS	9	1.3
Van Allen	9	1.5
AIM	8	1.2
Hinode	8	1.2
RHESSI	8	1.0
STEREO (2)	8	1.2
TIMED	8	1.2
Voyager	8	1.6
ACE	7	1.5
SDO	7	1.5
STEREO (1)	7	1.4
THEMIS	7	1.8
TWINS	7	1.3
Wind	7	1.2
CINDI	7	1.2

HSO

	Median	Std Dev
ACE	9	1.9
SDO	9	1.5
Hinode	9	1.8
IBEX	8	1.2
IRIS	8	1.2
STEREO (2)	8	1.1
THEMIS	8	1.3
Wind	8	1.3
RHESSI	8	1.6
STEREO (1)	8	1.5
Voyager	7	1.6
AIM	7	1.3
TIMED	7	1.9
TWINS	7	1.3
Van Allen	7	1.4
CINDI	6	1.2

All of the missions reviewed by the Senior Review Panel have been recommended for continued operations.

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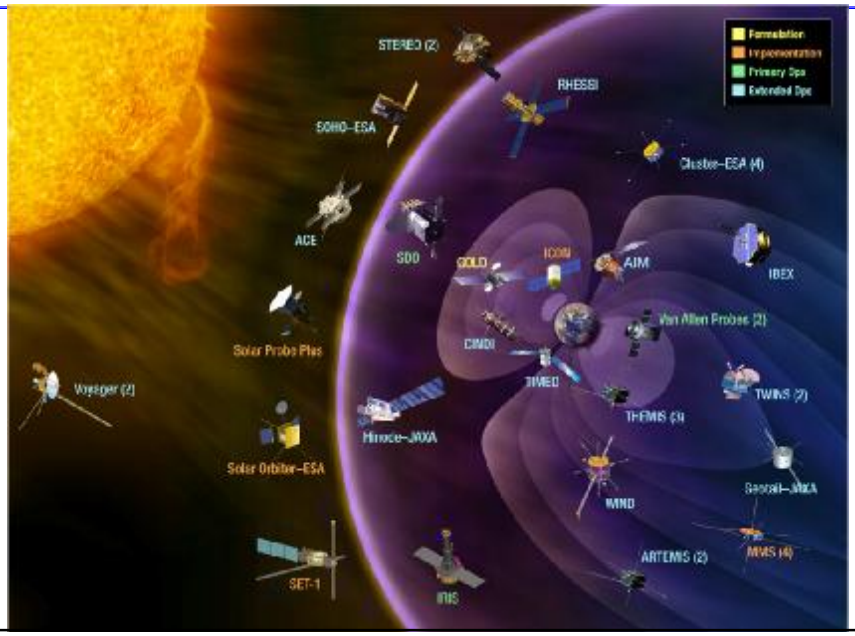
Heliophysics System Observatory



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Missions in Development

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Magnetospheric Multiscale (MMS) Mission

Description: MMS is a Solar Terrestrial Probes mission with four identically instrumented spacecraft that use Earth's magnetosphere as a laboratory to study the microphysics of magnetic reconnection.

Launched 3/12/2015, the MMS constellation's orbit, spin rates and attitudes are nominal, and initial science results are excellent.

Recent Accomplishments:

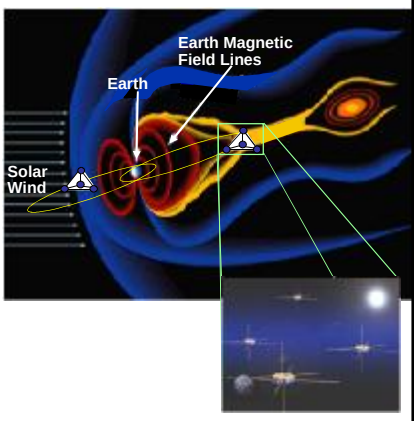
- Mission entered Phase E on 9/1/2015
- Currently in Phase 1 (Magnetopause/day side). Orbit size is 1.2 x 12 Earth Radii (Re). Performed formation resizing maneuvers to successfully decrease the probe separation from 160 km to 60 km on 9/16-17.

Planning Items:

- Resizing maneuvers planned throughout Phase 1 to decrease probe spacing to 40km, 30km, 25 km and 10 km.
- Orbit will be raised for Phase 2 (Magnetotail) from 12 Re to 25 Re.

Watch Items/Concerns:

- Anomaly Review Board is investigating a data downlink anomaly with one spacecraft.



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LWS Space Environment Testbeds (SET)-1

Launch Information:

- Spacecraft: AFRL Deployable Structures Experiment (DSX)
- Launch Vehicle: SpaceX Falcon Heavy
- Date: October 2016
- Site: Cape Canaveral
- Orbit: 6000 x 12,000 km, 45 degree inclination MEO

Description:
Space Environment Testbeds (SET) improves the engineering approach to accommodate and/or mitigate the effects of solar variability on spacecraft design and operations by: 1) collecting data in space to develop a physics-based understanding of response of spacecraft materials, components, & sensors/detectors to space environments; 2) collecting data in space to validate new & existing ground test protocols for the effects of solar variability on emerging technologies; and 3) developing & validating engineering environment models, tools, & databases for spacecraft design & operations

Upcoming Milestones:

- Complete Vibration and TVAC testing Dec 2015
- Launch October 2016

Accomplishments:

- All flight hardware has been delivered, including the separation system for the DSX secondary payload.
- Activities scheduled for FY16 include work with the separation system, mission readiness review (MRR), and 4 mission rehearsals.

Watch Items/Concerns:

- None

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Ionospheric Connection Explorer (ICON)

Description: ICON will explore the boundary between Earth and space to understand the physical connection between our world and our space environment. ICON will launch on a Pegasus XL launching from Kwaj in October 2017. The spacecraft will be placed in a LEO Orbit at 575 km with a 24 ° inclination. The payload consists of four instruments, MIGHTI (NRL) – neutral wind measurements; IVM (UT Dallas) – in situ ion velocities; and FUV & EUV imaging UV spectrographs (UC Berkeley) – O/N2, O+ ion density

Flight Structure

Upcoming Milestones:

- System Integration Review – June 2016
- Pre-Environmental Review – August 2016
- LRD – Oct 2017

Recent Accomplishments:

- Mission CDR completed April 9, 2015
- Spacecraft structure fabrication completed and structural load testing completed
- MIGHTI EM completed and vibration testing completed
- FUV instrument shipped to CSL (Belgium)
  - Turret EM vibration completed and flight turret assembled; structural resonance issue resolved.
  - Optics integrated to chassis, final alignment verified
- EUV: Instrument integrated, and in optical/functional testing
- Decision reached not to change launch site.

Watch Items/Concerns:

- Instrument Control Panel now critical path due to delay of flight digital board layout & build

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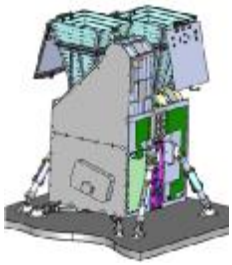
GOLD
- Global Observations of the Limb And Disk -

Description: GOLD is an Explorer Program Mission of Opportunity that will provide the first simultaneous measurements of temperatures and composition in Earth's thermosphere and ionosphere on a global scale. GOLD will fly a UV imaging spectrograph as a hosted payload on a commercial communications spacecraft in geostationary orbit.

Upcoming Milestones:

- Critical Design Review – 26-30 October 2015
- Pre-Environmental Review - March 2016
- Pre-Ship Review - October 2016
- Launch Readiness Date - April 2018



Recent Accomplishments:

- Engineering Model struts have been assembled.
- Flight detectors processing continues.

Watch Items/Concerns:

- Lightshade on critical path; mitigating coating issues using Germanium Black Kapton Tape.
- Interface Requirements Doc't indicates a potential for high (45V/m) radiative emissions. TIM determined that housing design was sufficient, but additional mitigations are also being considered.

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Solar Probe Plus (SPP)

Description

Spacecraft in a highly eccentric elliptical orbit with a minimum perihelion of 9.9 Solar Radii (~4.3 million miles). Employs a combination of in-situ measurements and imaging to achieve the mission's primary scientific goal: to understand how the Sun's corona is heated and how the solar wind is accelerated.

Upcoming Milestones

- Mission Operations Review – Nov 2015
- System Integration Review – June 2016
- LRD – July 2018

Recent Accomplishments

- TPS: Completed edge closeout testing at C-CAT (Carbon-Carbon Advanced Technologies, Inc.)
- Cooling System: Successfully completed thermal cycle acceptance testing of 24 of 48 radiator fins
- Solar Array: Completed initial impedance tests and began bakeout of qualification S/A wing
- G&C: Successfully completed the test readiness review for flight Sun sensor system
- FIELDS: Completed antenna testing with maximum Truss Structure Assembly spacer
- SWEAP: Completed Solar Probe Cup Moog Engineering Dev't Unit test

Watch Items/Concerns

- Coupled loads analysis indicated significant loads on FIELDS whip antenna.
- DSN costs are increasing – initiated discussions between the project and SCAN.

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Solar Orbiter Collaboration (SOC)

Description: Will use a unique combination of measurements: *In situ* measurements will be used alongside remote sensing, close to the Sun (~.3 AU), to relate these measurements back to their source regions and structures on the Sun's surface. Operates both in and out of the ecliptic plane. Measures solar wind plasma, fields, waves and energetic particles close enough to the Sun to ensure that they are still relatively pristine.

Upcoming Milestones:

- Required Instrument Deliveries to ESA/Airbus: October 2016 (TBC)
- LRD October 2018

Recent Accomplishments:

- KDP-C March 2013– For NASA-contributed instruments (HIS, SoloHI)
- Heavy Ion Sensor (HIS):
  - Integration and Test Phase 1 Underway
  - Detector Section-Time Of Flight (DS-TOF) Integrated with Flight Model boards
  - First-Light Test conducted showing triple coincidence
  - Electrical Model Delivered and successfully communicated with SWA DPU
- Solar Orbiter Heliospheric Imager (SoloHI):
  - Integration and Test Underway
  - Electrical Model Delivered and Integrated on ESA Solar Orbiter Electrical Test Bed (ETB)
  - First SO Instrument to Successfully Send Data Through the ETB

Watch Items/Concerns:

- Mission schedule uncertainties; ESA/Airbus working to recover schedule reserve.

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Sounding Rockets

Recent Sounding Rocket Launches

- Kankelborg Mission – Successful launch from White Sands Missile Range, NM on 27 August
  - An investigation of the transition region of the Sun (the layer of material where the photosphere, the layer of the Sun we see, becomes the corona) to better understand why the Sun's atmosphere is approximately 1,000 times hotter than its surface
- Winebarger Mission – Successful launch from White Sands Missile Range, NM on 3 September
  - An investigation to achieve the first measurement of the Sun's magnetic field in the upper chromosphere and transition region of the Sun through the detection and measurement of Hanle effect polarization of the Lyman alpha line
  - Black Brant Motor performed nominally, showing no combustion instability
- Bernhart Mission – Successful launch from Andøya, Norway on 16 September
  - A Naval Research Laboratory experiment to examine the effect of artificially created charged-particulate layers on the scatter of UHF, L-Band, and S-Band radars.
- Black Brandt Mk-IV – Successful launch from WFF on 07 October

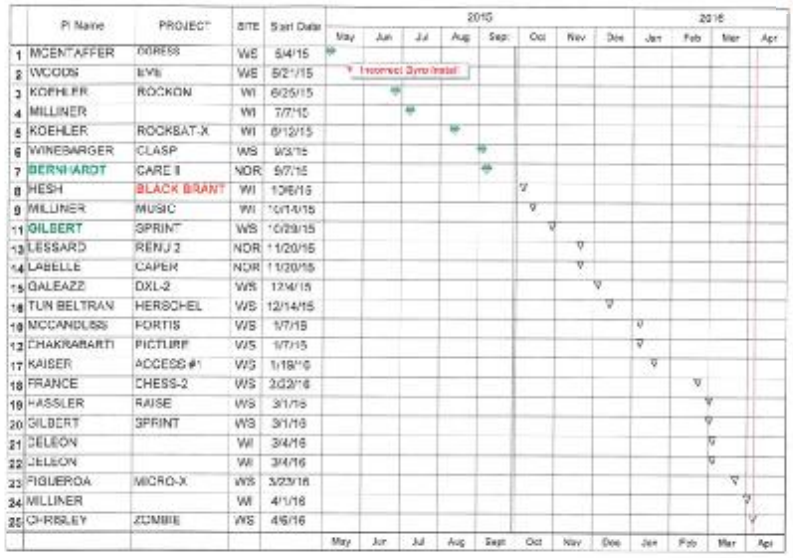

Kankelborg


Winebarger


Andøya Rocket Range, Norway

Schedule of Sounding Rocket Launches

	PI Name	PROJECT	SITE	Start Date
1	MCENTAFFER	ORESS	WS	5/4/15
2	WOODS	EVE	WS	5/21/15
3	KOEHLER	ROCKON	WI	6/25/15
4	MILLNER		WI	7/7/15
5	KOEHLER	ROCKSAT-X	WI	8/12/15
6	WINEBARGER	CLASP	WS	9/3/15
7	BERNHARDT	CARE II	NOR	9/7/15
8	HESH	BLACK BRANT	WI	10/5/15
9	MILLNER	MUSIC	WI	10/14/15
11	GILBERT	SPRINT	WS	10/29/15
13	LESSARD	RENU 2	NOR	11/20/15
14	LABELLE	CAPER	NOR	11/20/15
15	GALEAZZ	DXL-2	WS	12/4/15
16	TUN BELTRAN	HERSCHEL	WS	12/14/15
10	MCCANDLESS	FORTIS	WS	1/7/16
12	CHAKRABARTI	PICTURE	WS	1/7/16
17	KAISER	ACCESS #1	WS	1/18/16
18	FRANCE	CHESS-2	WS	2/22/16
19	HASSLER	RAISE	WS	3/1/16
20	GILBERT	SPRINT	WS	3/1/16
21	DELEON		WI	3/4/16
22	DELEON		WI	3/4/16
23	FIGUEROA	MICRO-X	WS	3/23/16
24	MILLNER		WI	4/1/16
25	CHRISLEY	ZOMBIE	WS	4/5/16



Reimbursables shown in GREEN

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Research & Analysis

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HPD 2015 ROSES Award Status

ELEMENT	STEP 1 PROPOSALS	STEP 2 PROPOSALS	AWARDS (ESTIMATED)	YEAR 1 ($M) (ESTIMATED)
B.2 H-SR	343	251	(25 – 33)	4.5
B.3 H-TIDeS	135	106	(15)	5.5
B.4 H-GI	204	149	(20 – 25)	3.1
B.6 H-LWS	103	92	20	3.5
B.7 H-IDEE	15	14	(10 – 12)	0.5
TOTALS	799	612	(90 – 105)	17.1

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National Space Weather Strategy

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National Space Weather Strategy

- The Office of Science Technology Policy (OSTP), Executive Office of the President, is leading the multi-agency effort to develop a National Space Weather Strategy (NSWS).
- The NSWS will articulate strategic goals for improving forecasting, impact evaluation, and enhancing National Preparedness (protection, mitigation, response and recovery) to a severe space weather event.
- A Space Weather Action Plan (SWAP) is being developed to establish cross-Agency actions, timelines and milestones for the implementation of the NSWS.
- The Action Plan will:
  - Ø Enhance the transition of research to operations for space weather observations, modeling tools, advance warning capabilities and mitigation approaches
  - Ø Incorporate severe space weather events in Federal emergency preparedness, planning, scenarios, training, and exercises
  - Ø Establish Federal and non-Federal stakeholder collaborations to enhance observing systems and networks and data management activities

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International Collaboration Update

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International Collaboration Update

- European Space Agency (ESA)
  - Bilateral meetings between Science Mission Directorate leadership and ESA leadership September 22-23 at the European Space Research and Technology Centre (ESTEC), The Netherlands
  - Heliophysics-related topics included
    - Solar Orbiter Collaboration mission development progress
    - US participation in the Turbulent Heating ObserveR (THOR) mission as one of three down-selected proposals as part of the ESA M4 call; final selection will be in mid-2017.
    - US participation in the Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) ESA-Chinese Academy of Sciences (CAS) partnership; final decision on mission adoption by both ESA and CAS is expected in November 2015
- Indian Space Research Organisation (ISRO)
  - Meeting between the Heliophysics Division and ISRO counterparts on August 14 at NASA HQ
  - Overview of ISRO and NASA Heliophysics activities presented
  - Proposed areas of collaboration have been provided to ISRO, including, but not limited to:
    - Modeling of solar activity
    - Joint observations and data analysis
    - Ground-based observations
  - Establishment of an ISRO-NASA Heliophysics Working Group under assessment

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Division Strategy

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Heliophysics Division Strategy

Primary Focus

Ensure a more balanced Heliophysics portfolio and enable a continuing robust and long-term Heliophysics System Observatory and research programs.

- ü Assessing Division Resource Needs
- ü Re-Balancing Staff Work-Load
- ü Participating in OSTP-led Space Weather Operations, Research and Mitigation (SWORM) Task Force activities
- ü Develop Division Technology Investment Focus
- ü Enhance Inter-Agency and International Partnerships
- ü Engage the Heliophysics Community

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Heliophysics Division Strategy

- Develop and Implement Long-Term Strategy for a Balanced Portfolio
  - Ø Plan for more frequent, lower-cost missions by expanding Explorers and Missions of Opportunity
  - Ø Commence development of the highest priority Strategic Program (STP, LWS) science targets, consistent with the budget and with Research and Explorer priorities
  - Ø Work towards enhancing research programs (DRIVE) as recommended by the Decadal Survey

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Heliophysics Budget Strategy

- Use the scientific priorities of the 2013 Decadal Survey to guide strategy and inform decisions.
- Ensure funding for missions in development
- Ensure funding for currently operating missions per 2015 Senior Review
- Maintain and grow competed PI research award program at no less than current funding level (~$63M/year => ~$100M/year)
- Ensure funding for missions entering extended operations (SDO, VAP, IRIS)
- Maintain and grow mission wedge for future missions, after launch of SOC and SPP
- Ensure balanced portfolio to meet Heliophysics science objectives: Research, LWS, STP, Explorers
- Maintain viable sounding rocket/range program for the benefit of the Agency
- Infuse technology and innovation for the benefit of future Heliophysics missions

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Budget Alignment With 2013 Decadal Survey

The NASA FY15 Appropriation and the FY16 President's Budget Request, including the notional out-year budget estimates, support the following:	
0.0 Complete the current program	Extended operations of current operating missions as recommended by the 2015 Senior Review; 5 missions currently in development (SET, ICON, GOLD, SOC and SPP)
1.0 Implement DRIVE (Diversify, Realize, Integrate, Venture, Educate)	Implementing DRIVE initiative wedge in FY15; fully funded in FY18
2.0 Accelerate and expand Heliophysics Explorer program	Release of next Explorer mission AO planned for 2016 (~3.5-year average historical cadence) vs. Decadal recommendation of every 2-3 years; strategy to increase cadence under assessment; notional mission cadence increases to Decadal recommendation by the early-2020s.
3.0 Restructure STP as a moderate scale, PI-led flight program	Assessing trade space for STP-5; next STP mission AO planned for 2017 with a LRD ~2023
4.0 Implement a large LWS mission and launch by 2024	Release of next LWS mission AO NET 2018 as recommended by Decadal Survey

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