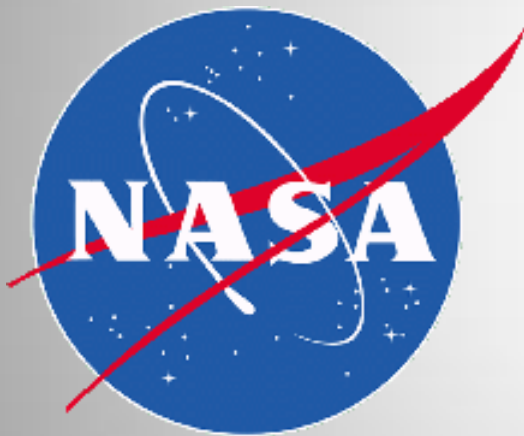


# Status and News from NASA's Heliophysics Division of SMD

June 23, 2014



# *Heliophysics Program Highlights*

## Significant Accomplishments

- **MMS**
  - Stacked vibration testing successfully completed ahead of schedule.
  - Stacked separation and shock testing successfully completed.
- **SPP** – Phase C Kickoff Meeting May 1
- **ICON** – Completed all four instrument PDRs and the Structure/Thermal PDR at ATK

## Upcoming Key Events

- **MMS**
  - DPMC: June 27
  - APMC: August 6
- **ICON**
  - Mission PDR: July 8-10 at Orbital
  - DPMC: August 26
- **GOLD**
  - Mission PDR Sep 30-Oct 1
  - DPMC November 2014

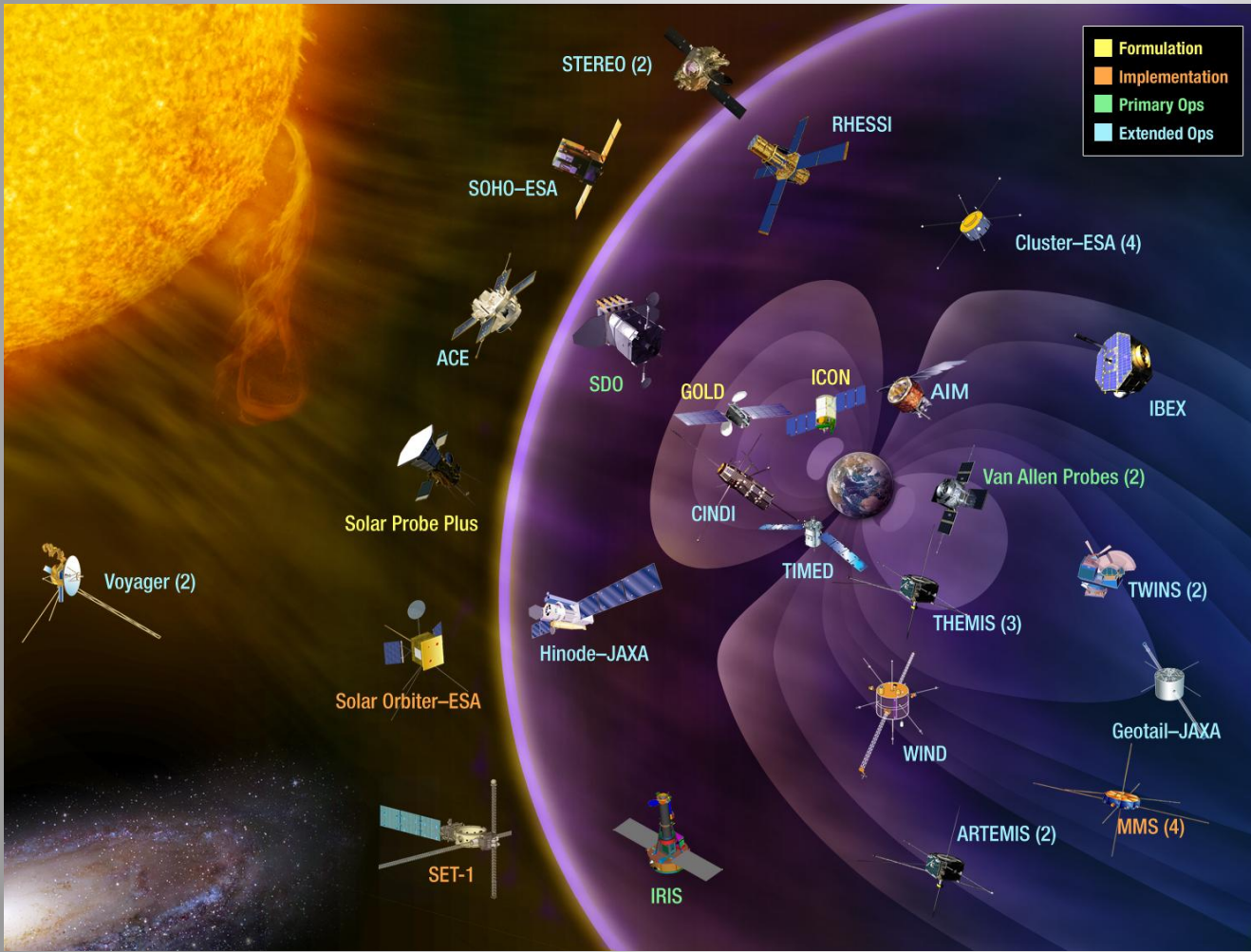
## Explorer AO

- **NET FY 16 – SMEX + MoO**



# Heliophysics System Observatory

A coordinated and complementary fleet of spacecraft to understand the Sun and its interactions with Earth and the solar system



- Heliophysics has 18 operating missions (on 29 spacecraft):

Voyager, Geotail, Wind, **SOHO**, **ACE**, Cluster, TIMED, RHESSI, TWINS, Hinode, **STEREO**, THEMIS/ARTEMIS, AIM, CINDI, IBEX, **SDO**, **Van Allen Probes**, IRIS

(Missions in red contribute to operational Space Weather.)

- 6 missions are in development:

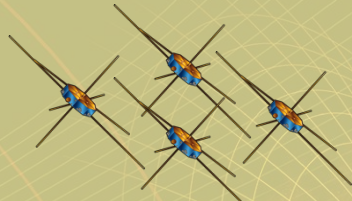
SET, MMS, SOC, SPP, ICON, and GOLD

\$5.5B total investment in Heliophysics space assets (excluding launch costs)

\$68M annual operating budget

# Heliophysics Program 2014 - 2020

Solar Terrestrial Probes

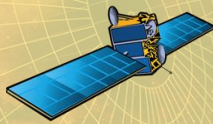


Magnetospheric Multiscale (MMS)  
March 2015

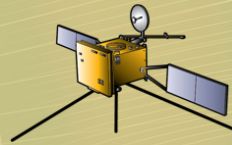


STP#5

Living With a Star



Space Environment Testbeds (SET)  
March 2016

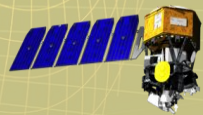


Solar Orbiter Collaboration (with ESA)  
July 2017

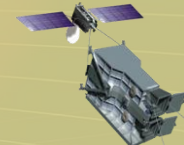


Solar Probe Plus  
July 2018

Explorers



Ionospheric Connection Explorer (ICON)  
February 2017



Global-scale Observations of the Limb and Disk (GOLD)  
September 2017

Research Program



HYPERION  
GEMINI  
FALCON  
SOLARWIND

RISE  
VALERIE  
RIGOR  
MCS

HYPERION

DISCOVER  
COSMIC  
PENELOPE  
CANDOR

GREENWICH  
FOCUS  
MIRAGE  
RUBIN

RESEARCH  
ASPECTS  
ACROSS  
GEMINI

MISSIONS  
RESEARCH  
OSIRIS

HYPERION  
ASPECTS  
RESEARCH

Opportunity

2014

2015

2016

2017

2018

2019

2020

# Heliophysics Research Grant Programs (FY2014)

*Typical Annual Award Size \$125k-\$150k (Approx \$400k for LCAS)*

| <b>Program</b>   | <b>Funding Level</b> | <b>Number of Awards</b>  |
|--|----------------------|--|
| LWS Science: Targeted Research and Technology  | \$16.8M Total        | 115 - Including focus teams, workshops, post doc program, summer school, and sun-climate |
| Supporting Research and Technology: Solar, Heliospheric, and Geospace                              | \$23M Total          | 200 - Including supporting research, ongoing instrument development and LCAS             |
| Instrument and Technology Development for Science  | \$5M Total           | 15 – New instrument development, Laboratory and Atomic physics, and LCAS                 |
| Guest Investigator Program - (intended to maximize the scientific output of Heliophysics missions) | \$8.2 M Total        | 72 – Guest investigator awards   |
| CubeSat Initiative   | \$5M* Total          | 6 (5 Heliophysics)   |

\* SMD Wide Resource

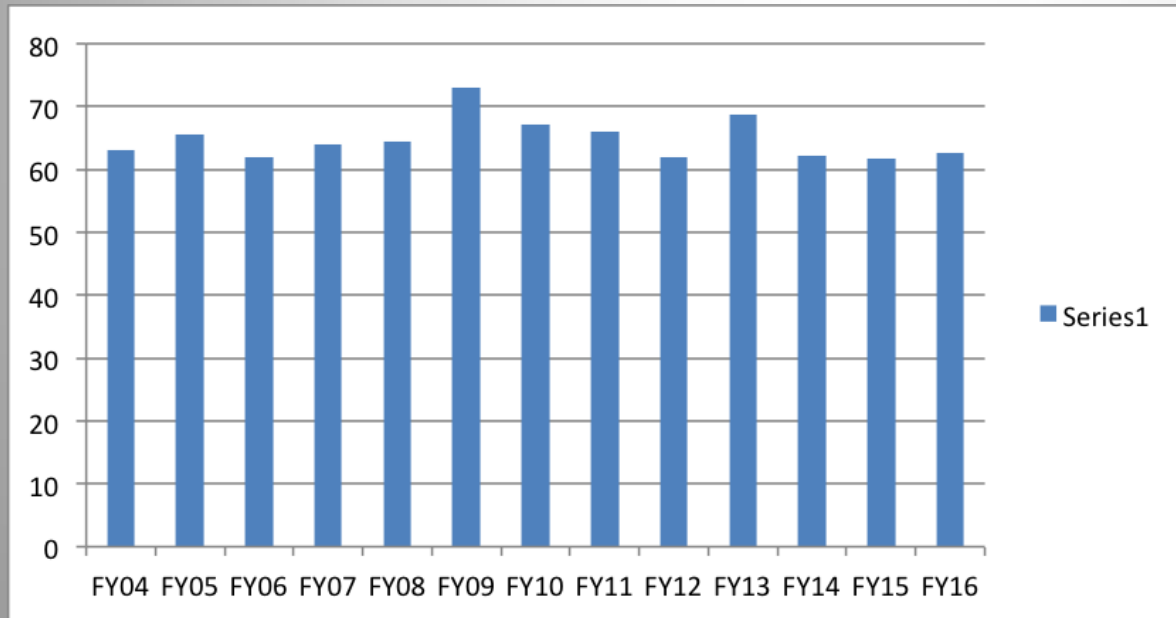
# Heliophysics Research Grant Programs (FY2014)

*Support for Larger, Critical Mass Efforts*

| <b>Program</b>  | <b>Funding Level</b> | <b>Details</b>                     |
|---|----------------------|------------------------------------|
| Theory Program (problems requiring critical mass of expertise)                  | \$4.0 M Total        | 11 new awards                      |
| Living With a Star Strategic Capability – Development of first-principle models | \$4M Total           | 9 (subset of TR&T), joint with NSF |
| STP Interdisciplinary Science Teams (IDS)                                       | \$350K Each per year | 3 10-year grants                   |

# Competed PI Research

| Competed PI Research Elements Summary            | FY 2013      | FY 2014   | FY 2015   | FY 2016      | FY 2017     | FY 2018     | FY 2019     |
|--|--------------|-----------|-----------|--------------|-------------|-------------|-------------|
| Guest Investigator Program                       | 10.6         | 8.217     | 7.2       | 8            | 8           | 8           | 8           |
| LWS Science                                      | 20           | 16.788    | 17.5      | 17.5         | 17.5        | 17.5        | 17.5        |
| Heliophysics Research and Analysis (SR&T+Theory) | 35.1         | 33.467    | 33.9      | 34           | 33.9        | 33.9        | 33.9        |
| Data & Modeling Services                         | 3.5          | 3.2       | 3.2       | 3            | 3           | 3           | 3           |
| Cubesats*  | 0            | 1.25      | 1.25      | 1.25         | 1.25        | 1.25        | 1.25        |
| <b>Total Competed PI Research Budget</b>         | <b>69.23</b> | <b>63</b> | <b>63</b> | <b>63.75</b> | <b>63.6</b> | <b>63.6</b> | <b>63.6</b> |



This is the Sum(SR&T+Theory+GI+TR&T+Data/Modeling). These are all roughly constant, the GI having the largest swings over this time period.

\*Cubesat program is \$5M for all SMD, above table assumes 25% to Heliophysics. In reality it has been phased differently.

# *NASA's New CubeSat Initiative*

- Heliophysics is administering SMD's new CubeSat budget, \$5M/yr in FY14
- Management approach approved at SMD level on 20 February
  - HQ-based administration, “thin” program office supported part-time
  - Modest contribution to support KSC CubeSat Launch Initiative for accommodations
  - CubeSat proposals will be solicited via ROSES and selected by each SMD Division
  - Science CubeSat Integration Panel established
- Science CubeSat Integration Panel responsibilities:
  - Establish policy, incorporate lessons learned, and conduct outreach
  - Integrate management and implementation as needed
  - Recommend awards following review by Divisions
- CubeSat proposals received and selected for 2014 awards

NASA CubeSat proposals will be solicited and selected on the basis of science merit and technology value.



# NASA's Appropriation for FY2014

| PRELIMINARY--1/13/2014                              |                   |                     |                    |                          |                        |                          |                        |                                  |               |
|---|-------------------|---------------------|--------------------|--------------------------|------------------------|--------------------------|------------------------|----------------------------------|---------------|
| FY 2014 OMNIBUS APPROPRIATIONS CONFERENCE AGREEMENT |                   |                     |                    |                          |                        |                          |                        |                                  |               |
|   | FY 2012<br>Actual | FY 2013<br>Enacted* | FY 2014<br>Request | FY 2014 HAC<br>Comm Mark | Change from<br>Request | FY 2014 SAC<br>Comm Mark | Change from<br>Request | FY 2014<br>Omnibus<br>Conference |               |
| <b>NASA FY 2014</b>                                 | <b>\$17,770.0</b> | <b>\$17,491.7</b>   | <b>\$17,715.4</b>  | <b>\$16,598.0</b>        | <b>(1,117.4)</b>       | <b>\$18,010.3</b>        | <b>294.9</b>           | <b>17,646.5</b>                  | <b>(68.9)</b> |
| <b>Science</b>                                      | <b>\$5,073.7</b>  | <b>\$5,037.4</b>    | <b>\$5,017.8</b>   | <b>\$4,781.0</b>         | <b>(236.8)</b>         | <b>\$5,154.2</b>         | <b>136.4</b>           | <b>5,151.2</b>                   | <b>133.4</b>  |
| Earth Science                                       | \$1,765.7         | \$1,748.0           | \$1,846.1          | \$1,659.2                | (187.1)                | \$1,846.2                | 0.1                    | 1,826.0                          | (20.1)        |
| Planetary Science                                   | \$1,501.4         | \$1,385.7           | \$1,217.5          | \$1,315.3                | 97.8                   | \$1,317.6                | 100.1                  | 1,345.0                          | 127.5         |
| Astrophysics  | \$648.4           | \$655.1             | \$642.3            | \$621.9                  | (20.3)                 | \$678.4                  | 36.1                   | 668.0                            | 25.7          |
| James Webb Space Telescope                          | \$518.6           | \$615.0             | \$658.2            | \$583.8                  | (74.2)                 | \$658.2                  | 0.0                    | 658.2                            | 0.0           |
| Heliophysics  | \$644.9           | \$633.6             | \$653.7            | \$601.4                  | (52.7)                 | \$653.8                  | 0.1                    | 654.0                            | 0.3           |

- NASA's FY2014 budget is \$17,646.5M, \$68.6M or 0.4% less than the request
- NASA/SMD's budget is \$5,151.2M, \$133.4M or 2.6% more than the request
- The Heliophysics budget is \$654.0M, \$0.3M or 0.05% more than the request
  - This Heliophysics budget includes \$44.1M in administrative items
  - Net of administrative items, Helio budget is greater in FY14 than in FY13

# Heliophysics Budget and Projections

| <b>Budget Authority Dollars</b>         | BY(2013)       | BY (2014)      | BY (2015)      | BY+ 1<br>(2016) | BY+ 2<br>(2017) | BY+ 3<br>(2018) | BY+ 4<br>(2019) |
|---|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| <b>President's Budget Request</b>       | <b>\$647.0</b> | <b>\$643.0</b> | <b>\$668.9</b> | <b>\$647.6</b>  | <b>\$676.6</b>  | <b>\$673.3</b>  | <b>\$675.5</b>  |
| FY13 Sequester Reduction                | (\$30.6)       |                |                |                 |                 |                 |                 |
| FY13 Operating Plan Reductions          | (\$13.9)       |                |                |                 |                 |                 |                 |
| Other adjustments                       | (\$0.7)        | \$10.7         |                |                 |                 |                 |                 |
| <b>Total Heliophysics Budget</b>        | <b>\$603.2</b> | <b>\$653.7</b> | <b>\$668.9</b> | <b>\$647.6</b>  | <b>\$676.6</b>  | <b>\$673.3</b>  | <b>\$675.5</b>  |
| <b>Heliophysics Budget Appropriated</b> | <b>\$603.2</b> | <b>\$654.0</b> |                |                 |                 |                 |                 |
| Less Admin & Directed R&T*              | (\$16.6)       | (\$44.1)       | (\$55.0)       | (\$12.2)        | (\$16.7)        | (\$18.7)        | (\$19.0)        |
| <b>Net Heliophysics Budget</b>          | <b>\$589.7</b> | <b>\$609.9</b> | <b>\$613.9</b> | <b>\$635.4</b>  | <b>\$659.9</b>  | <b>\$654.6</b>  | <b>\$656.5</b>  |
| <b>Heliophysics Expenditures for FY</b> | <b>\$589.7</b> |                |                |                 |                 |                 |                 |

\*These budgets support SMD activities not specific to Heliophysics.

Greyed entries represent notional estimates.

## FY15 President's Budget Request of 10 March 2014

### Budget Authority (in \$ millions)

|   | Actual<br>FY 2013 | IOP<br>FY 2014 | Request<br>FY 2015 | Notional<br>FY 2016 | Notional<br>FY 2017 | Notional<br>FY 2018 | Notional<br>FY 2019 |
|---|-------------------|----------------|--------------------|---------------------|---------------------|---------------------|---------------------|
| Heliophysics Research                         | 165.3             | 187.401        | 217.4              | 158.3               | 167.6               | 169.7               | 169.9               |
| Living with a Star                            | 174.9             | 212.473        | 266.4              | 355.8               | 378.2               | 398.9               | 282.7               |
| Solar Terrestrial Probes                      | 203.9             | 143.275        | 61.4               | 41.5                | 42.1                | 30.5                | 129.4               |
| Heliophysics Explorer Program                 | 59.1              | 100.199        | 123.6              | 91.9                | 88.7                | 74.3                | 93.4                |
| <b>Total Budget</b>                           | <b>603.2</b>      | <b>643.348</b> | <b>668.9</b>       | <b>647.6</b>        | <b>676.6</b>        | <b>673.3</b>        | <b>675.5</b>        |
| <b>Total budget net of Admin and DR&amp;T</b> | <b>586.6</b>      | <b>609.843</b> | <b>613.9</b>       | <b>635.4</b>        | <b>659.9</b>        | <b>654.6</b>        | <b>656.5</b>        |

# *Key Budget Consequences for Heliophysics*

- The Heliophysics budget for FY15 is increased over FY14
  - Net of administrative items: \$609.8 in FY14, to \$613.9 in FY15
- The budget sustains long-standing HPD programs
  - Research & Analysis, operating mission support is essentially constant
- The budget covers the Agency Baseline Commitment cost for SPP
  - Baseline commitment for launch in 2018. No impact to research budget.
- It maintains the July 2017 launch date for Solar Orbiter
- It supports MMS through final integration and test, but not to launch
- It funds both ICON and GOLD for launches in 2017
- We will continue to implement the DRIVE initiative, subject to finding
  - Small satellites: Addressed with CubeSat budget line item (success)
  - Neither MO&DA augmentation nor increase in Explorer cadence funded

# *Where is the Heliophysics Division Going?*

- **NASA's SMD Heliophysics Division Mission Statement (draft):**

Empower the community to advance our understanding of Heliophysics and reap the benefits through science missions and enabling technology and research.

- **Approach to implementing Decadal Survey recommendations**

- Heliophysics Roadmap defines our detailed implementation plan for the Decadal Survey, including technology development requirements
- Perform on our commitments to complete the current program on time and on budget
  - President's FY15 budget supports Solar Probe Plus launch in 2018
- Strengthen our Research and Analysis, MO&DA, and Technology Programs
  - Work towards rebalancing research program (DRIVE) as recommended by the Decadal Survey
- Plan for more frequent, lower cost missions: Expand Explorers and Missions of Opportunity
  - CubeSat line started in FY14, next Heliophysics Explorer A/O likely in 2016
- Commence development of the highest priority Strategic Program (STP, LWS) science targets, consistent with the budget and with Research and Explorer priorities

- **Continue to build our understanding of heliophysics (the sun and its interaction with the Earth and the solar system) and the science of space weather**

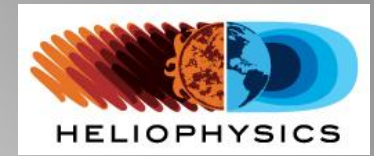
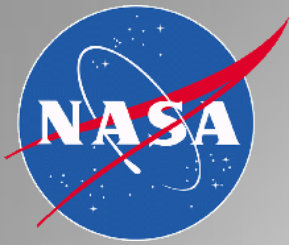
# Decadal Survey Implementation

| Priority | sub | Recommendation   | Objective       | Status                                       |
|----------|-----|--|-----------------|--|
| 0        |     | Complete the current program                             |                 |  |
|          | 0.1 | Van Allen Probes   | on orbit        | Mission Success achieved                     |
|          | 0.2 | BARREL   | completed       | Data analysis underway for publications      |
|          | 0.3 | IRIS   | on orbit        | Mission Success achieved                     |
|          | 0.4 | MMS  | LRD March 2015  | In System I&T                                |
|          | 0.5 | Solar Orbiter  | LRD July 2017   | In Implementation                            |
|          | 0.6 | Solar Probe Plus   | LRD August 2018 | In Implementation                            |
| 1        |     | Implement the DRIVE initiative                           |                 |  |
|          | 1.1 | NASA tiny-satellite grants program (and overall LCAS)    | \$9M/yr more    | New \$1M/yr HPD share for CubeSats           |
|          | 1.2 | Permanently augment MO&DA support                        | \$10M/yr more   | HPD #1 strategic objective                   |
|          | 1.3 | Directed guest investigator program as %-age of mission  | 2% of mission   | (\$20M by MMS, \$9M by SOC, \$30M by SPP)    |
|          | 1.4 | Laboratory plasma astrophysics and spectroscopy          | \$2M/yr more    | Coordinate with Astrophysics                 |
|          | 1.5 | Coordinate programs across agencies                      | continue        | Coordinate with NSF, NOAA, DoD, others       |
|          | 1.6 | Heliophysics science centers                             |                 | Ramp up to \$8M/yr                           |
|          | 1.7 | Consolidate technology funding, including constellations | up to \$4M/yr   |  |
|          | 1.8 | Educate  | continue        | Summer schools, Fellowships, E&PO            |
| 2        |     | Accelerate and expand the Heliophysics Explorer program  | \$70M/yr more   | Next AO no earlier than FY16, 5-year cadance |
| 3        |     | Restructure STP as a moderate-scale, PI-led line         |                 |  |
|          | 3.1 | IMAP-like  |                 |  |
|          | 3.2 | DYNAMIC-like   |                 |  |
|          | 3.3 | MEDICI-like  |                 |  |
| 4        |     | LWS Geospace Dynamics Constellation - like               |                 |  |

# *NASA SMD Heliophysics Division*

## *What's Changed?*

- Heliophysics Interim Director: Jeffrey Newmark
- Congratulations to Dana Brewer, retiring after 36.5 years service to NASA
  - Including 10 years as a contractor at NASA Langley
- Voleak Roeum is temporarily replacing Willis Jenkins as the Program Executive for ICON (Jenkins on 6 month detail)
- ITM Program Scientist Hired: Elsayed Talaat, from JHUAPL



# Heliophysics: CEDAR Workshop 2014

Jeffrey Newmark: Interim Heliophysics Director

Sandra Smalley: Acting Deputy Director

**Draft** Vision: Committed to creating a world in which our technological society benefits from understanding the sun, the space environment, and our place in the galaxy

**Draft** Mission Statement: Empower the community to advance our understanding of Heliophysics and reap the benefits through science missions and enabling technology and research

NASA Strategic Objective: Understand the Sun and its interactions with Earth and the solar system, including space weather