



SCIENCE

# NASA Science Update **(Including Budget)**

Dr. David Sibeck (for Mona Kessel)

June 18, 2013



# Heliophysics Announcements

- **Heliophysics Subcommittee Meeting** April 15-16
- **NASA-NSF Space Weather Modeling Collaborations Kick-off**  
May 1
- **NSWP Council Mtg** May 13
- **Electric Infrastructure Security Summit** May 20
- **Heliophysics Explorer Kick-Off** meeting – May 29, 2013
- **Space Weather Enterprise Forum** – June 4, 2013
- **IRIS Launch media briefing**—June 4, 2013  
**Launch** -- June 26, 2013

## Other Announcements

Senior Review (Missions) out soon

2013 Roadmap available soon

# Heliophysics Program 2013-2018

## Solar Terrestrial Probes

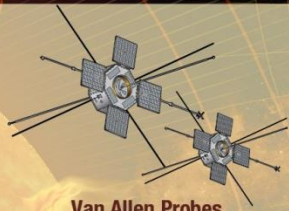


Magnetospheric Multiscale (MMS)  
March 2015

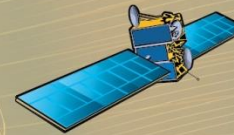


STP #5

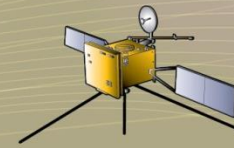
## Living With a Star



Van Allen Probes  
August 2012



Space Environment Testbeds (SET)  
Mid-2015



Solar Orbiter Collaboration (with ESA)  
January 2017



Solar Probe Plus  
July 2018

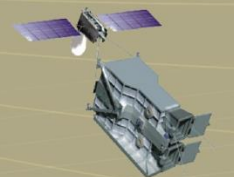
## Explorers



Interface Region Imaging Spectrograph (IRIS)  
June 2013



Ionospheric Connection Explorer (ICON)  
2017



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

## Research Program



HYPE - TBD  
FORTISS - May 2013  
CIBER - June 2013  
RockOn - June 2013

DayDynamo - June 2013  
VERIS - July 2013  
MOSES - August 2013  
RAISE - September 2013

VESPR - November 2013  
ACCESS - January 2014  
CHESS - April 2014  
DFS - May 2014

SUNRISE II - June 2013/Sweden  
GRIPS - September 2013/New Mexico

BARREL #2 - January 2014/Antarctica

Ongoing

Heliophysics Missions  
Astrophysics Missions  
Planetary Missions

2012

2013

2014

2015

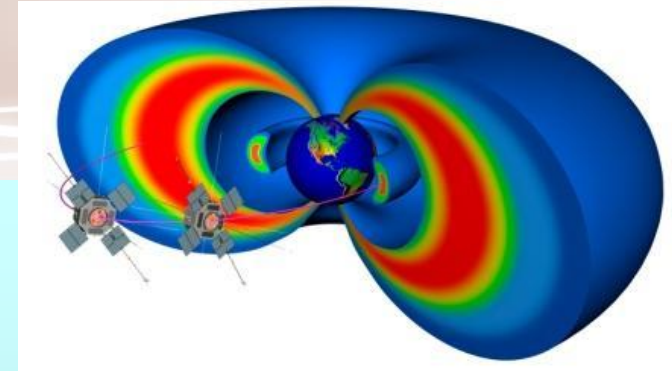
2016

2017

2018

# Van Allen Probes

(6 months after commissioning)



**Mission Book on line (Springer)**  
***Space Science Reviews***

## Press Conferences

- August 2012 – Launch!
- November 2012 - Renamed after discoverer of Radiation Belts: James Van Allen
- December 2012 – (AGU) new insights into structure and behavior of radiation belts
- February 2013 – First Science Result (published in *Science*) New radiation/storage belt

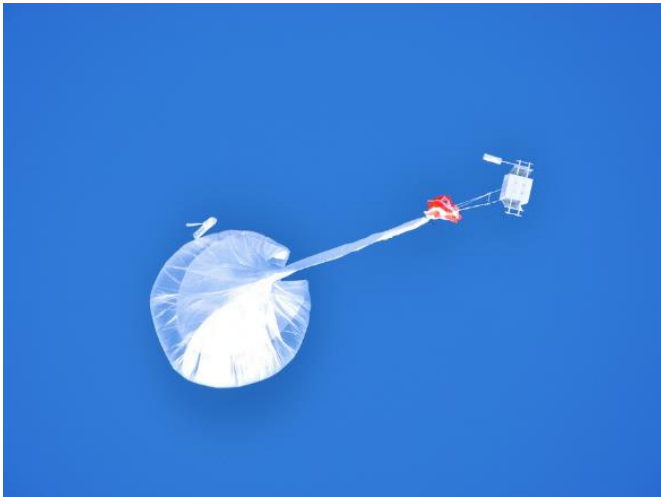
**Feature Story and publication online in June 2013** local acceleration

## > 20 papers either in press, submitted, or in preparation

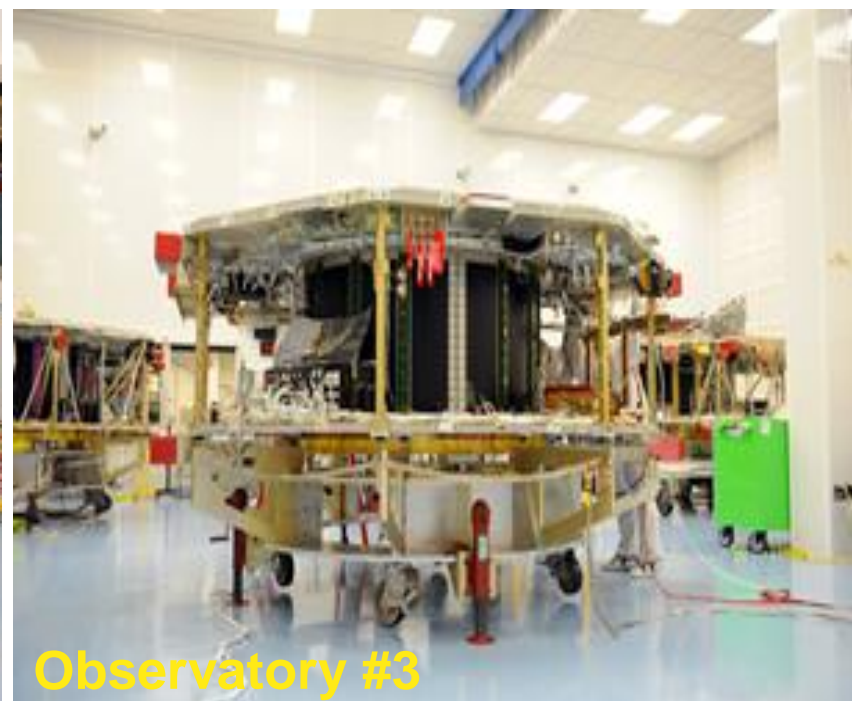
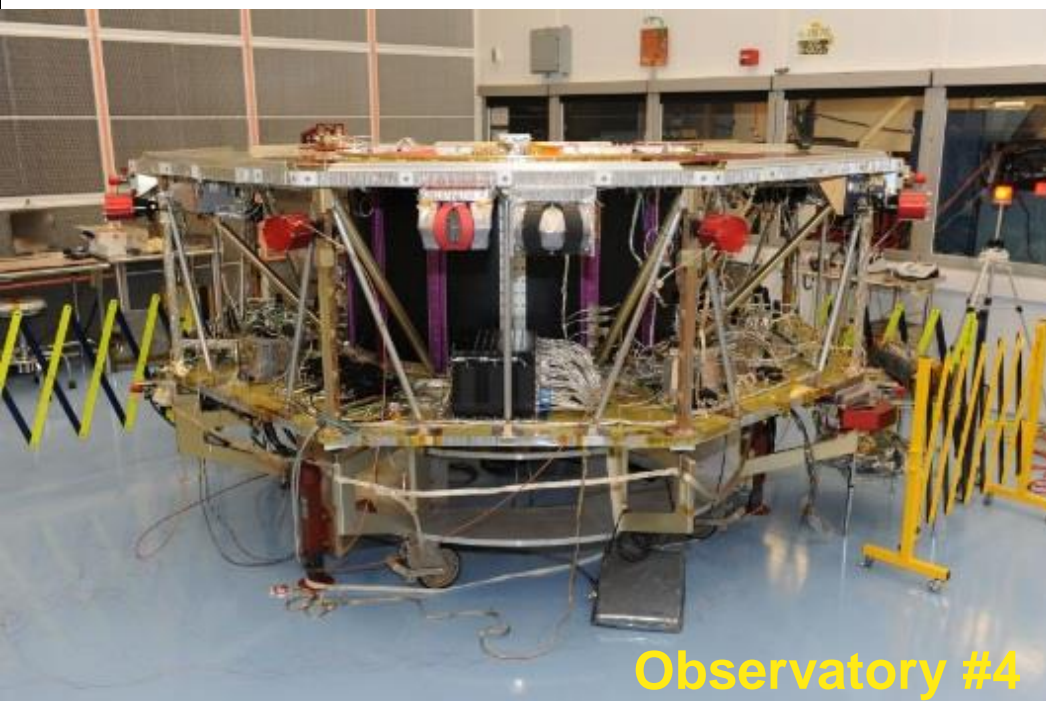
- Examines the spatial extent and influence of ULF waves on particle transport
- First observation of multiple charge state species injections in the inner magnetosphere
- Chorus and precipitation seen with Van Allen/EMFISIS and BARREL
- **Can Quasi-linear whistler-electron interactions explain sudden electron acceleration?**

**Special *Geophysical Research Letters* issue (November 2013)**

# BARREL mission launches 20 balloons during January 2013 campaign in Antarctica



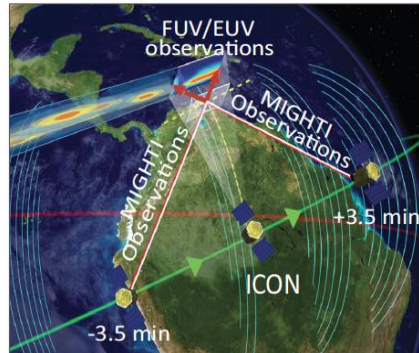
# MMS



# Explorer Program Selections

## ICON

### ***Ionospheric Connection Explorer***



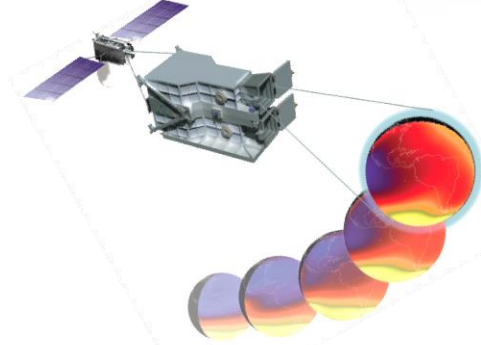
- How neutral atmosphere affects the ionosphere
- How solar wind and magnetosphere affect the ionosphere

ICON is a single s/c traveling eastward and continuously imaging the thermosphere and ionosphere.

Orbit: 550 km at 24° inclination  
PI: **Thomas Immel** / UC Berkeley

## GOLD

### ***Global Scale Observations of the Limb and Disk***



- ... how the ionosphere and thermosphere respond to geomagnetic storms, solar radiation, and upward propagating atmospheric tides


Two identical scanning imaging spectrographs on a geosynchronous commercial communication satellite.


PI: **Richard Eastes** / U. Central Florida


These two Explorer missions would be able to accomplish the majority of the science objectives for the Decadal's high priority reference mission, Dynamical Neutral Atmosphere-Ionosphere Coupling (DYNAMIC), at half the cost and launch approximately 8 years earlier.

# Heliophysics Operating Missions

| Mission         | Launch      | Phase    | Extension to (*) | M-3 | M-2 | M-1 | Cur. M. | Remarks  |
|-----------------|-------------|----------|------------------|-----|-----|-----|---------|--|
| Geotail         | 7/24/92     | Extended | 9/30/2014        |     |     |     |         |  |
| Artemis (Helio) | 7/15/10     | Extended | 9/30/2014 (+)    |     |     |     |         |  |
| STEREO          | 10/25/06    | Extended | 9/30/2014        |     |     |     |         | Assessment of DSN contention in backup.                |
| THEMIS          | 2/17/07     | Extended | 9/30/2014        |     |     |     |         | D - experienced an SEU on 5/4: 3.4 hr of science lost. |
| AIM             | 4/25/07     | Extended | 9/30/2014        |     |     |     |         |  |
| Hinode          | 9/23/06     | Extended | 9/30/2014        |     |     |     |         |  |
| Cluster         | 7/16/00     | Extended | 9/30/2014 (+)    |     |     |     |         |  |
| ACE             | 8/27/97     | Extended | 9/30/2014        |     |     |     |         |  |
| RHESSI          | 2/05/02     | Extended | 9/30/2014        |     |     |     |         |  |
| SOHO            | 12/02/95    | Extended | 9/30/2014        |     |     |     |         |  |
| TIMED           | 12/07/01    | Extended | 9/30/2014        |     |     |     |         | SEU occurred on 5/17 while in SAA: ~10 hr data lost.   |
| Voyager 1 + 2   | 8/20/77     | Extended | 9/30/2014        |     |     |     |         |  |
| TWINS A + B     | 6/06 & 3/08 | Extended | 9/30/2014        |     |     |     |         |  |
| CINDI:C/NOFS    | 4/16/08     | Extended | 9/30/2014        |     |     |     |         |  |
| IBEX            | 10/19/08    | Extended | 9/30/2014        |     |     |     |         |  |
| Wind            | 11/01/94    | Extended | 9/30/2014        |     |     |     |         |  |
| SDO             | 2/11/10     | Prime    | 2/11/15          |     |     |     |         |  |
| Van Allen       | 8/30/12     | Prime    | 11/30/14         |     |     |     |         | RBSPICE-A Tiger Team report issued 5/1/2013            |

 Mission proceeding to meet science requirements

 Area of concern - possible reduction in capability

 Significant problem - possible or probable loss of mission



# Van Allen Probes E/PO

Pre-service Teacher Workshop in Partnership with Historically Black Colleges and Universities, April 16, 2013 at the Johns Hopkins University Applied Physics Lab. The theme of the workshop was “Science Across Curriculums.”

Thirty three pre-service teachers and three education faculty from Howard University and University of Maryland/Eastern Shore participated in the workshop. The classroom disciplines represented ranged from STEM, to music and art, as well as Special Education.

The emphasis of the workshop was to show these future teachers how to integrate NASA Mission science into their curriculums, using Van Allen Probes education materials as examples, as well as activities found on NASA Wavelength.



*“Science was always a foreign language to me. I could never grasp the information enough to completely understand it and love it. Now, I am so interested in it. I want to engage my little explorers into science related activities so that an interest for the science field will be sparked.”*

*-future English teacher*



# Budgets

1. These numbers are not final, they could change.
2. The president's budget only goes to FY19.
3. After FY19, the budgets represent educated guesses.
4. The Roadmap committee was directed to assume a flat budget.
5. If you have questions beyond those that I can/am permitted to answer, you may contact Mona Kessel at NASA HQ.

# Budget Numbers

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|---|-----------------------|----------------|----------------|----------------|----------------|----------------|
| <b>Heliophysics FY13 President's Budget</b>   | <b>\$647.0</b>        | <b>\$643.0</b> | <b>\$636.7</b> | <b>\$638.3</b> | <b>\$661.6</b> | <b>\$661.6</b> |
| Strengthen NASA Institutional Capabilities  |                       | (7.4)          | (7.3)          | (7.3)          | (7.4)          | (7.4)          |
| GEMS FY12 Offset to Astrophysics  |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor  |                       | 2.4            | 1.9            | 3.7            | 8.1            | 8.4            |
| SMD Administrative  | 3.6                   | 0.6            | 0.6            | 0.6            | 0.6            | 0.6            |
| <b>Heliophysics FY14 OMB Submit</b>   | <b>\$650.6</b>        | <b>\$614.3</b> | <b>\$631.9</b> | <b>\$635.3</b> | <b>\$662.9</b> | <b>\$663.2</b> |
| CubeSats  |                       | 5.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions  |                       | 1.7            |                |                |                |                |
| STEM Reductions   |                       | (3.1)          | (3.3)          | (3.0)          | (3.0)          | (3.0)          |
| Directed R&T  |                       | 35.9           |                |                |                |                |
| Sequester Reduction   | (30.6)                |                |                |                |                |                |
| SMD Administrative  |                       |                | (0.5)          | (0.4)          | (0.6)          | (0.6)          |
| <b>Heliophysics FY14 President's Budget</b>   | <b>\$620.1</b>        | <b>\$653.7</b> | <b>\$633.1</b> | <b>\$636.8</b> | <b>\$664.3</b> | <b>\$664.6</b> |
| FY13 Initial Operating Plan Reductions  | (13.0)                |                |                |                |                |                |
| Reduce RBSP/Van Allen Probes (605745)   | (2.5)                 |                |                |                |                |                |
| Reduce SSMO (385616)  | (3.2)                 |                |                |                |                |                |
| Reduce SDO (939252)   | (3.1)                 |                |                |                |                |                |
| Reduce SOC (996805)   | (4.1)                 |                |                |                |                |                |
| <b>Heliophysics FY13 Budget</b>   | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*  | (16.6)                | (44.1)         | (9.9)          | (13.5)         | (18.1)         | (20.1)         |
| <b>Net Heliophysics</b>   | <b>590.6</b>          | <b>609.6</b>   | <b>623.2</b>   | <b>623.3</b>   | <b>646.2</b>   | <b>644.5</b>   |

\*These budgets support SMD shared activities and not specific Heliophysics programs or projects.

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Sequester cut

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| Reduce SDO (939252)   | (3.1)                 |                |                |                |                |                |
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**Sequester**

**If sequestration continues,  
there will be similar cuts in future**

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Sequestration

Cut all  
Operating Missions  
This year

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| Strengthen NASA Institutional Capabilities  | Help NASA                                  |                       | (7.4)          | (7.3)          | (7.3)          | (7.4)          | (7.4)          |
| GEMS FY12 Offset to Astrophysics  | Institutions, indefinitely into the future |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor  |  | 2.4                   | 1.9            | 3.7            | 8.1            | 8.4            |                |
| SMD Administrative  |  | 0.5                   | 0.6            | 0.6            | 0.6            | 0.6            |                |
| <b>Heliophysics FY14 OMB Submit</b>   |  | <b>\$650.6</b>        | <b>\$614.3</b> | <b>\$631.9</b> | <b>\$635.3</b> | <b>\$662.9</b> | <b>\$663.2</b> |
| CubeSats  |  |                       | 5.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions  |  |                       | 1.7            |                |                |                |                |
| STEM Reductions   | Sequestration                              |                       | (3.1)          | (3.3)          | (3.0)          | (3.0)          | (3.0)          |
| Directed R&T  |  |                       | 35.9           |                |                |                |                |
| Sequester Reduction   |  | (30.6)                |                |                |                |                |                |
| SMD Administrative  |  |                       |                | (0.5)          | (0.4)          | (0.6)          | (0.6)          |
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| FY13 Initial Operating Plan Reductions  | Cut all Operating Missions This year       | (13.0)                |                |                |                |                |                |
| Reduce RBSP/Van Allen Probes (605745)   |  | (2.5)                 |                |                |                |                |                |
| Reduce SSMO (385616)  |  | (3.2)                 |                |                |                |                |                |
| Reduce SDO (939252)   |  | (3.1)                 |                |                |                |                |                |
| Reduce SOC (996805)   |  | (4.1)                 |                |                |                |                |                |
| <b>Heliophysics FY13 Budget</b>   |  | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*  |  | (16.6)                | (44.1)         | (9.9)          | (13.5)         | (18.1)         | (20.1)         |
| <b>Net Heliophysics</b>   |  | <b>590.6</b>          | <b>609.6</b>   | <b>623.2</b>   | <b>623.3</b>   | <b>646.2</b>   | <b>644.5</b>   |

\*These budgets support SMD shared activities and not specific Heliophysics programs or projects.

# Budget Numbers

| Totals and subtotals may not sum precisely due to rounding.<br>Totals displayed are Budget Authority Dollars. | CY (2013)<br>Estimate | BY (2014)      | BY + 1 (2015)  | BY + 2 (2016)  | BY + 3 (2017)  | BY + 4 (2018)  |
|---|-----------------------|----------------|----------------|----------------|----------------|----------------|
| <b>Heliophysics FY13 President's Budget</b>   | <b>\$647.0</b>        | <b>\$643.0</b> | <b>\$636.7</b> | <b>\$638.3</b> | <b>\$661.6</b> | <b>\$661.6</b> |
| Strengthen NASA Institutional Capabilities  |                       | (7.4)          | (7.3)          | (7.3)          | (7.4)          | (7.4)          |
| GEMS FY12 Offset to Astrophysics  |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor  |                       | 2.4            | 1.9            | 3.7            | 8.1            | 8.4            |
| SMD Administrative  | 3.6                   | 0.6            | 0.6            | 0.6            | 0.6            | 0.6            |
| <b>Heliophysics FY14 OMB Submit</b>   | <b>\$650.6</b>        | <b>\$614.3</b> | <b>\$631.9</b> | <b>\$635.3</b> | <b>\$662.9</b> | <b>\$663.2</b> |
| CubeSats  |                       | 5.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions  |                       | 1.7            |                |                |                |                |
| STEM Reductions   |                       | (3.1)          | (3.3)          | (3.0)          | (3.0)          | (3.0)          |
| Directed R&T  |                       | 35.9           |                |                |                |                |
| Sequester Reduction   | (30.6)                |                |                |                |                |                |
| SMD Administrative  |                       |                | (0.5)          | (0.4)          | (0.6)          | (0.6)          |
| <b>Heliophysics FY14 President's Budget</b>   | <b>\$620.1</b>        | <b>\$653.7</b> | <b>\$633.1</b> | <b>\$636.8</b> | <b>\$664.3</b> | <b>\$664.6</b> |
| FY13 Initial Operating Plan Reductions  | (13.0)                |                |                |                |                |                |
| Reduce RBSP/Van Allen Probes (605745)   | (2.5)                 |                |                |                |                |                |
| Reduce SSMO (385616)  | (3.2)                 |                |                |                |                |                |
| Reduce SDO (939252)   | (3.1)                 |                |                |                |                |                |
| Reduce SOC (996805)   | (4.1)                 |                |                |                |                |                |
| <b>Heliophysics FY13 Budget</b>   | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*  | (16.6)                | (44.1)         | (9.9)          | (13.5)         | (18.1)         | (20.1)         |
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Help NASA Institutions  
Help Astrophysics

Sequestration

Cut all  
Operating Missions  
This year

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| Strengthen NASA Institutional Capabilities  |                       | (7.4)          | (7.3)          | (7.3)          | (7.4)          | (7.4)          |
| GEMS FY12 Offset to Astrophysics  |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor  |                       | 2.4            | 1.9            | 3.7            | 8.1            | 8.4            |
| SMD Administrative  | 3.6                   | 0.6            | 0.6            | 0.6            | 0.6            | 0.6            |
| <b>Heliophysics FY14 OMB Submit</b>   | <b>\$650.6</b>        | <b>\$614.3</b> | <b>\$631.9</b> | <b>\$635.3</b> | <b>\$662.9</b> | <b>\$663.2</b> |
| CubeSats  |                       | 5.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions  |                       | 1.7            |                |                |                |                |
| STEM Reductions   |                       | (3.1)          | (3.3)          | (3.0)          | (3.0)          | (3.0)          |
| Directed R&T  |                       | 35.9           |                |                |                |                |
| Sequester Reduction   | (30.6)                |                |                |                |                |                |
| SMD Administrative  |                       |                | (0.5)          | (0.4)          | (0.6)          | (0.6)          |
| <b>Heliophysics FY14 President's Budget</b>   | <b>\$620.1</b>        | <b>\$653.7</b> | <b>\$633.1</b> | <b>\$636.8</b> | <b>\$664.3</b> | <b>\$664.6</b> |
| FY13 Initial Operating Plan Reductions  | (13.0)                |                |                |                |                |                |
| Reduce RBSP/Van Allen Probes (605745)   | (2.5)                 |                |                |                |                |                |
| Reduce SSMO (385616)  | (3.2)                 |                |                |                |                |                |
| Reduce SDO (939252)   | (3.1)                 |                |                |                |                |                |
| Reduce SOC (996805)   | (4.1)                 |                |                |                |                |                |
| <b>Heliophysics FY13 Budget</b>   | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*  | (16.6)                | (44.1)         | (9.9)          | (13.5)         | (18.1)         | (20.1)         |
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Help NASA Institutions  
Help Astrophysics

Sequestration

Cut all E/PO activities

Cut all  
Operating Missions  
This year

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| Strengthen NASA Institutional Capabilities  |                       | (7.4)          | (7.3)          | (7.3)          | (7.4)          | (7.4)          |
| GEMS FY12 Offset to Astrophysics  |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor  |                       | 2.4            | 1.9            | 3.7            | 8.1            | 8.4            |
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| CubeSats  |                       | 5.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions  |                       | 1.7            |                |                |                |                |
| STEM Reductions   |                       | (3.1)          | (3.3)          | (3.0)          | (3.0)          | (3.0)          |
| Directed R&T  |                       | 35.9           |                |                |                |                |
| Sequester Reduction   | (30.6)                |                |                |                |                |                |
| SMD Administrative  |                       |                | (0.5)          | (0.4)          | (0.6)          | (0.6)          |
| <b>Heliophysics FY14 President's Budget</b>   | <b>\$620.1</b>        | <b>\$653.7</b> | <b>\$633.1</b> | <b>\$636.8</b> | <b>\$664.3</b> | <b>\$664.6</b> |
| FY13 Initial Operating Plan Reductions  | (13.0)                |                |                |                |                |                |
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| Reduce SDO (939252)   | (3.1)                 |                |                |                |                |                |
| Reduce SOC (996805)   | (4.1)                 |                |                |                |                |                |
| <b>Heliophysics FY13 Budget</b>   | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*  | (16.6)                | (44.1)         | (9.9)          | (13.5)         | (18.1)         | (20.1)         |
| <b>Net Heliophysics</b>   | <b>590.6</b>          | <b>609.6</b>   | <b>623.2</b>   | <b>623.3</b>   | <b>646.2</b>   | <b>644.5</b>   |

Help NASA Institutions  
Help Astrophysics

Sequestration

Cut all E/PO activities

Cut HQ management funds

Cut all  
Operating Missions  
This year

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# Budget Numbers

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| <b>Heliophysics FY13 President's Budget</b> | <b>\$647.0</b>        | <b>\$643.0</b> | <b>\$636.7</b> | <b>\$638.3</b> | <b>\$661.6</b> | <b>\$661.6</b> |
| Strengthen NASA Institutional Capabilities  |                       | (5.1)          | (7.1)          | (6.8)          | (5.7)          | (7.7)          |
| GEMS FY12 Offset to Astrophysics            |                       | (24.3)         |                |                |                |                |
| Added CS FTE/Labor                          |                       | 1.4            | 1.9            | 3.7            | 3.1            | 3.4            |
| SMD Administrative                          | 3.6                   | 1.6            | 0.6            | 0.6            | 0.6            | 0.6            |
| <b>Heliophysics FY14 OMB Submit</b>         | <b>\$610.6</b>        | <b>\$614.3</b> | <b>\$611.9</b> | <b>\$631.3</b> | <b>\$661.9</b> | <b>\$661.2</b> |
| CubeSats                                    |                       | 1.0            | 5.0            | 5.0            | 5.0            | 5.0            |
| Explorer Future Missions                    |                       | 1.7            |                |                |                |                |
| STEM Reductions                             |                       | (3.1)          | (3.3)          | (1.0)          | (1.0)          | (1.0)          |
| Directed R&T                                |                       | 3.9            |                |                |                |                |
| Sequester Reduction                         | (0.6)                 |                |                |                |                |                |
| SMD Administrative                          |                       |                | (0.5)          | (1.4)          | (1.6)          | (1.6)          |
| <b>Heliophysics FY14 President's Budget</b> | <b>\$610.1</b>        | <b>\$653.7</b> | <b>\$613.1</b> | <b>\$631.8</b> | <b>\$661.3</b> | <b>\$661.6</b> |
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| <b>Heliophysics FY13 Budget</b>             | <b>\$607.13</b>       |                |                |                |                |                |
| Less Admin & Directed R&T*                  | (6.6)                 | (44.1)         | (9.9)          | (13.5)         | (16.1)         | (21.1)         |
| <b>Net Heliophysics</b>                     | <b>590.6</b>          | <b>609.6</b>   | <b>623.2</b>   | <b>623.3</b>   | <b>646.2</b>   | <b>644.5</b>   |

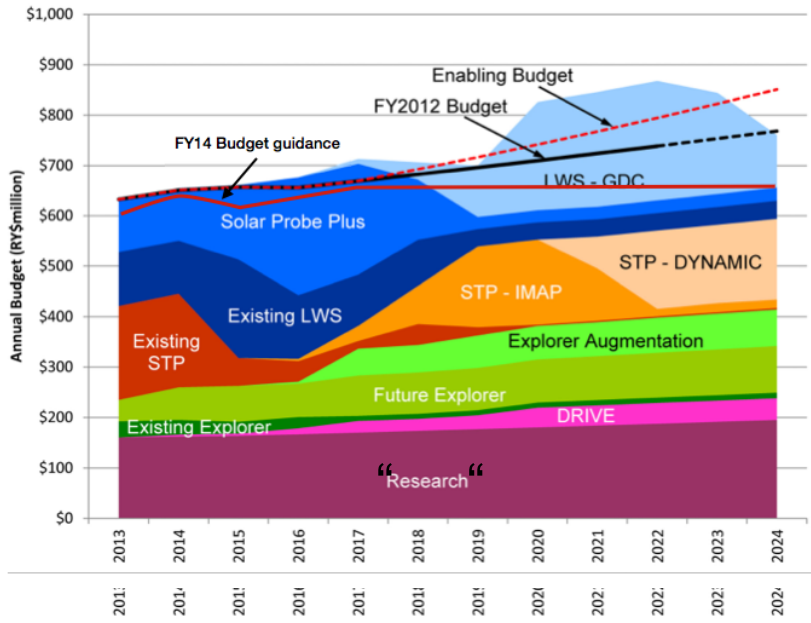
**Bottom Line**

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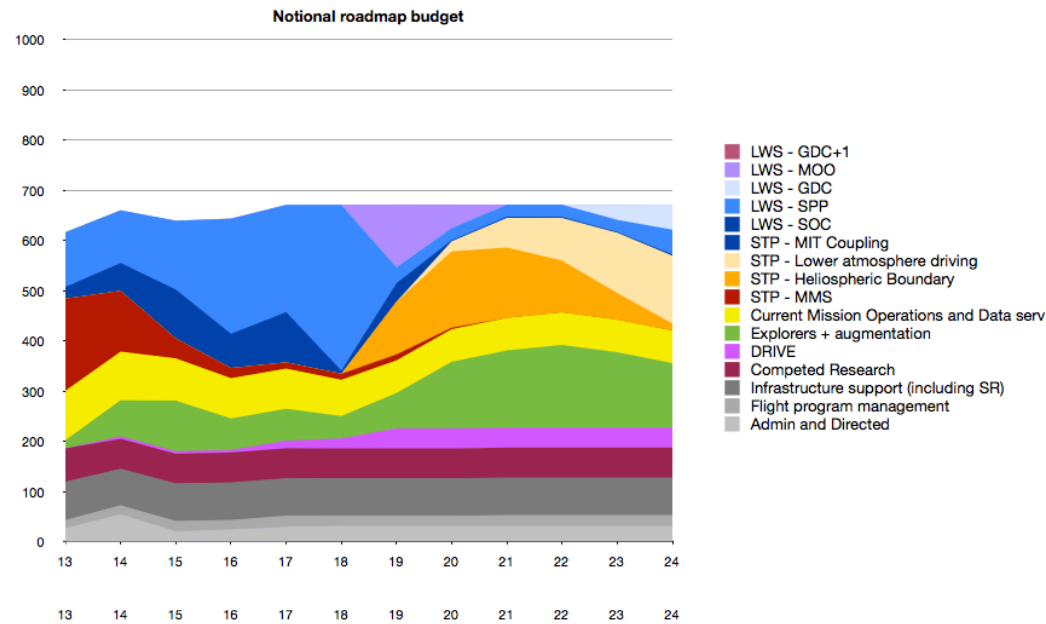
# Budgets: Then....and Now

## 10 Year Outlook

### Decadal Assumptions

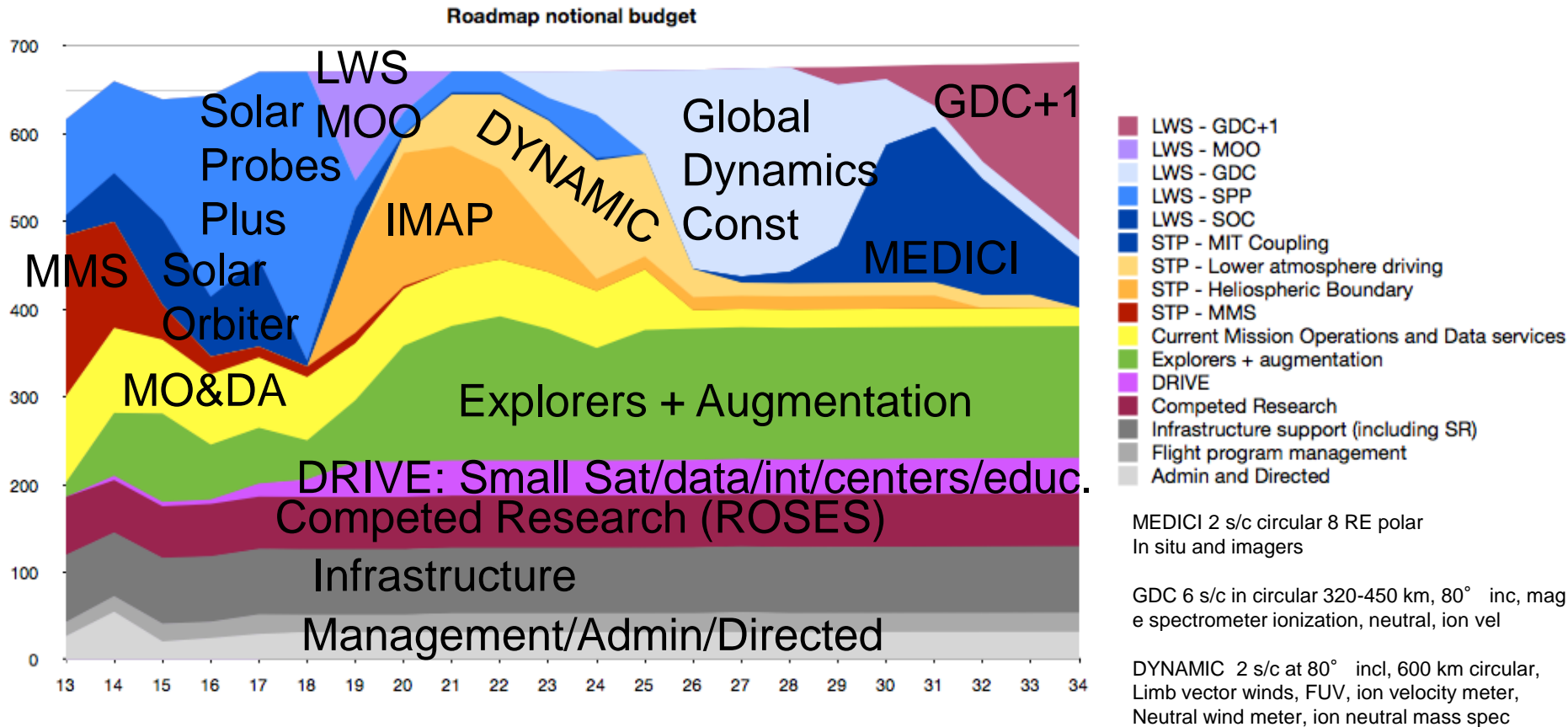


### Current Assumptions



Postpone implementation of DRIVE and enhanced Explorer by 2-3 years  
 Over 10 years, competed research grows from 9 to 13% of total budget  
 Flat total budget, indicating a reduction by the inflation rate each year  
 GDC cannot occur in this time frame, replaced with an LWS MOO

# Roadmap Budget Chart: 20 Year Outlook



Flat funding overall, and in particular for competed research



# Budgets

1. These numbers are not final, they could change.
2. The president's budget only goes to FY19.
3. After FY19, the budgets represent educated guesses.
4. The Roadmap committee was directed to assume a flat budget.
5. If you have questions beyond those that I can/am permitted to, answer, you may contact Mona Kessel at NASA HQ.