Update on Roadmap Committee Activities

Edward DeLuca, Chair
HP Roadmap Committee
7-March-2013, CSSP Meeting

2012 Roadmap Committee

HELIOPHYSICS

Name	Institution	Name	Institution
Edward DeLuca, Chair	SAO	John Leibacher	NSO
Larry Kepko, Co-Chair	GSFC	Ruth Leiberman	GATS
Mihir Desai*	SwRI	Xinlin Li	U. Colorado
George Fisher	U. California, Berkeley	Jeff Newmark, Ex-Officio	NASA
		Larry Paxton	APL
Maura Hagan*	NCAR	Steve Petrinec	LMSAL
Russ Howard	NRL	Daniel Winterhalter	JPL
Greg Howes	U. Iowa		
Janet Kozyra	U. Michigan		

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HPS 2012 Roadmap

Charter:

- **Align Decadal Survey science strategy and the NASA Heliophysics Program**
- **Craft a sustainable science program that is achievable within HPD resources and constraints**
- **Contribute to a useful strategic plan with a notional scheme to guide the implementation of critical science in the HPD program**
- **Develop a streamlined document: Focus on describing the current program, the science we need to explore, and the key technology developments.**
- **Describe high-level (not prescriptive) mission studies (i.e., what needs to be learned): Science targets are the important key and can be achieved through a Design Reference Mission.**

Roadmap Committee Decisions

- **Follow the science priorities of the Decadal Survey report**
  - The R&A program and DRIVE initiative should be the highest priorities for new funding
- **Follow the Science Targets of the Decadal Survey report**
  - Support for the Explorer Program, highest priority mission class
  - Follow the STP and LWS Science Targets
- **Solicit community input via Quad Charts**
  - We will retain the Quad Charts from the 2009 Roadmap
  - New or updated Quad Charts will be accepted
  - See SPA and SPD newsletters for details – still accepting quad charts.
- **Keep chapter structure from the 2009 Roadmap**
- **Update the Research Focus Areas (RFAs) from the 2009 Roadmap**
  - Requires mapping DS science goals and challenges to RFAs
  - New science drives the expansion of RFAs
- **Keep, with modification, the 2009 definitions of the STP and LWS mission lines**

Understand the Sun and its interactions with the earth and the solar system

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Top Level Objectives

2009

- F: Open the frontier to space environmental prediction
  - Understand the fundamental physical processes of the space environment from the sun to Earth, to other planets, and beyond to the interstellar medium.
- H: Understand the nature of our home in space
  - Understand how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.
- J: Safeguard the journey of exploration
  - Maximize the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space.

2013

- F: Solve fundamental mysteries of Heliophysics
  - Understand the physical processes of the space environment - from the sun to Earth, to other planets, and beyond to the interstellar medium.
- H: Understand the nature of our home in space
  - Understand the coupled system consisting of the sun and solar wind, Earth, planetary environments, and the local interstellar medium.
- W: Build the knowledge to forecast space weather throughout the heliosphere
  - Develop the knowledge and capability to detect and predict the extreme and dynamic conditions in space to safeguard human society on Earth, and that of human and robotic explorers beyond Earth.

Mission Line Definitions

2009

Explorer

The Explorer Program provides frequent flight opportunities for world-class scientific investigations from space to address heliophysics and astrophysics space science goals.

STP

The STP program explores fundamental solar and space physics processes occurring within the solar system and how they affect the nature of our home in space.

LWS

The LWS program targets specific aspects of the coupled sun-Earth-planetary system that affect life and society and that enable robotic and human exploration of the solar system.

2013

Explorer

The Explorer program provides frequent flight opportunities for focused missions that address exploratory or highest priority new scientific questions, and thereby fill critical gaps in our understanding of Heliophysics.

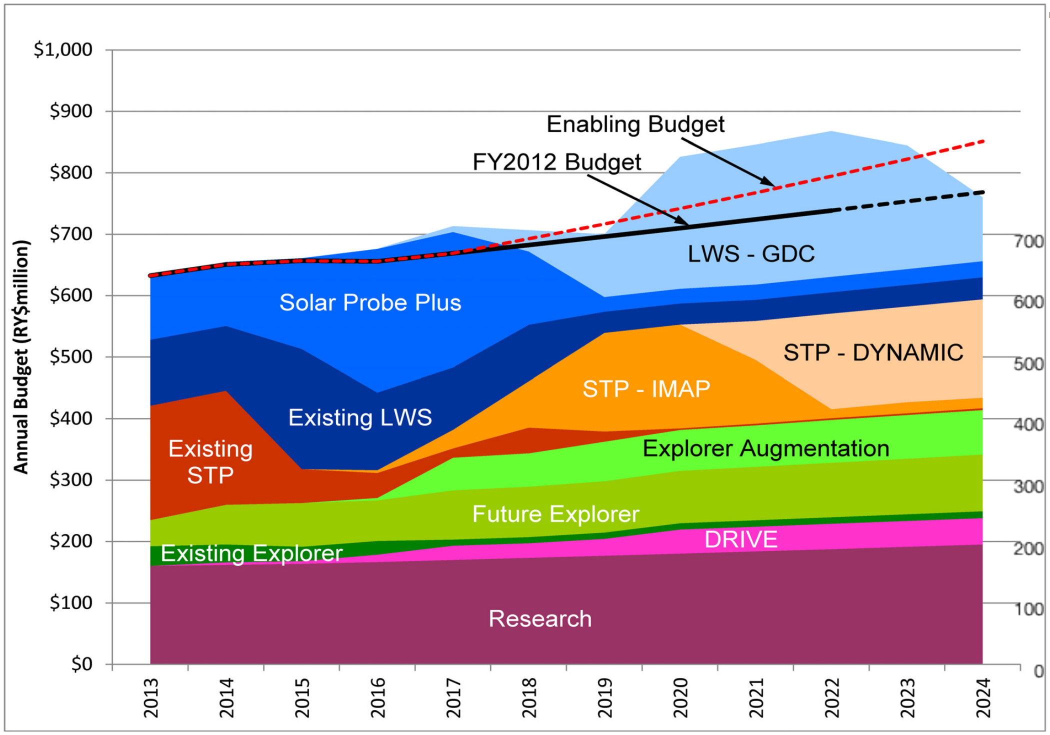
STP

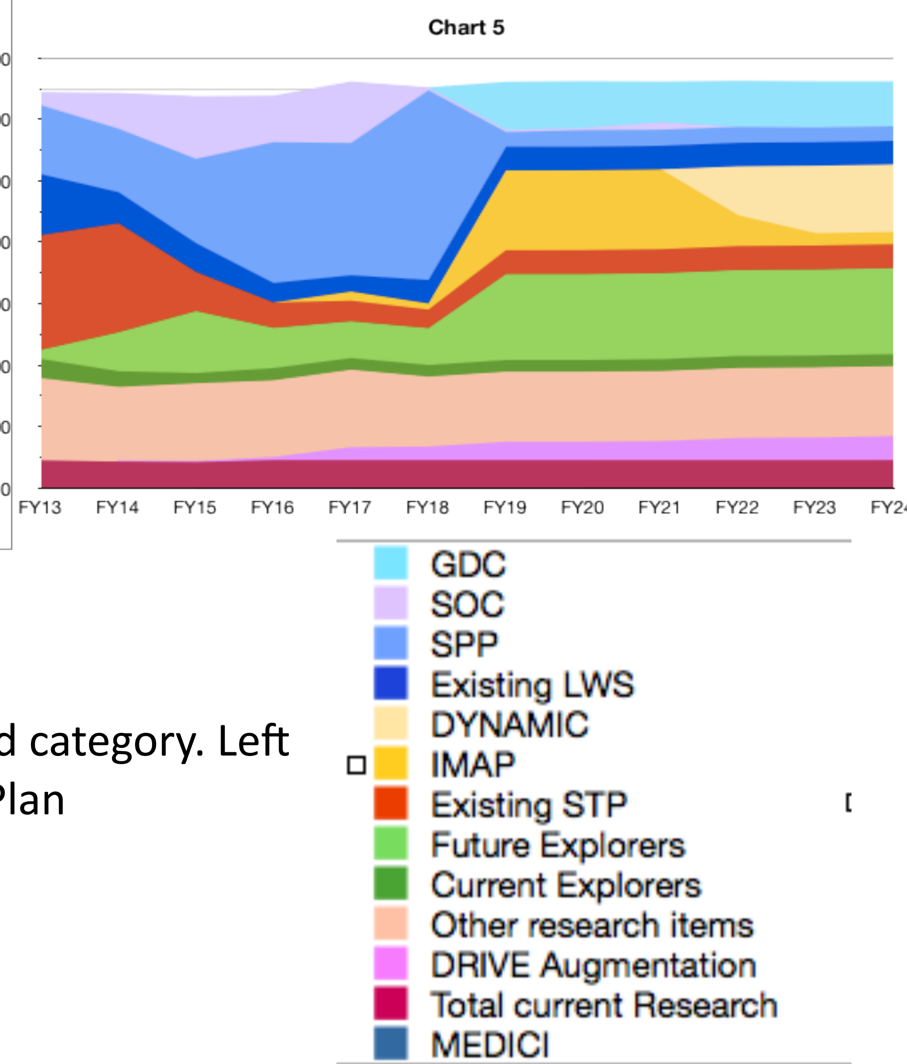
The STP missions target unsolved scientific questions that are critical for understanding the fundamental universal processes that determine the mass, momentum, and energy flow within the interconnected sun-heliosphere-Earth system.

LWS

The LWS missions adopt a systems approach toward understanding how major components of the coupled sun-heliosphere-Earth-planetary environment interact to influence life, society, and solar system exploration, with an ultimate goal of enabling a predictive capability.

Decadal Survey & Draft Roadmap Budget Plan and Priorities





Heliophysics budget and program plan by year and category. Left Decadal Survey Plan; Right Roadmap Plan

Decadal Survey Report
Budget Goal - Rebalancing

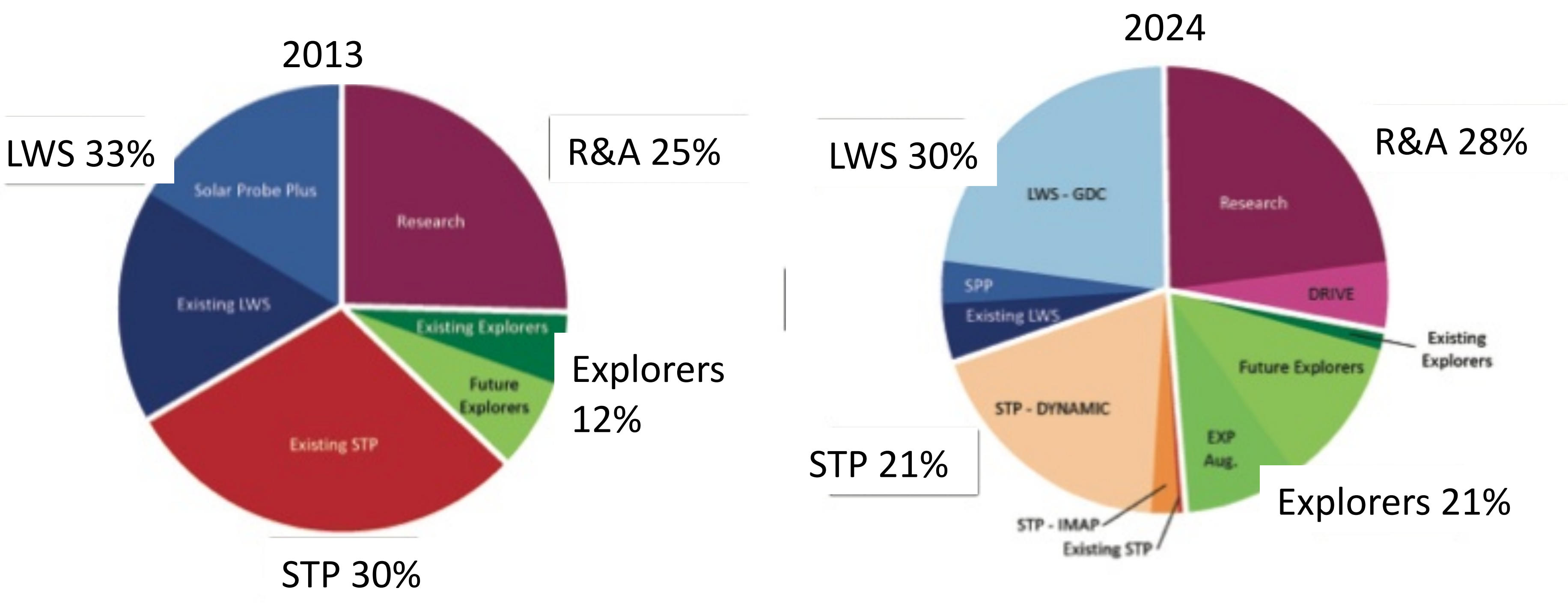
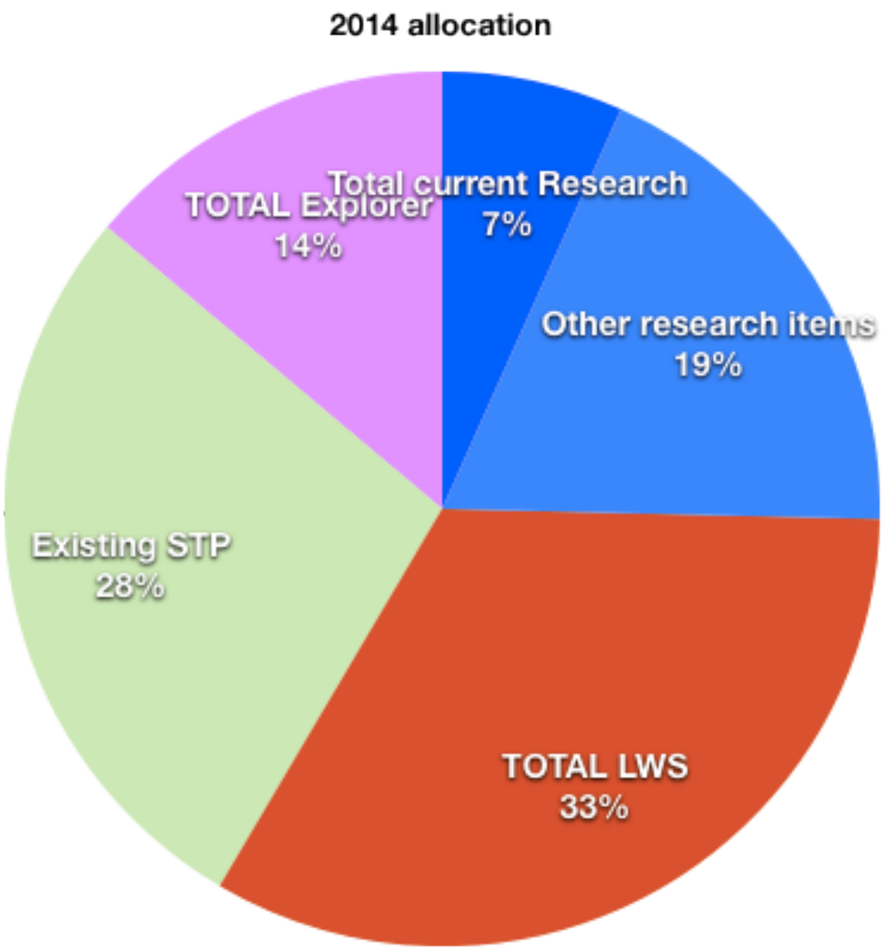
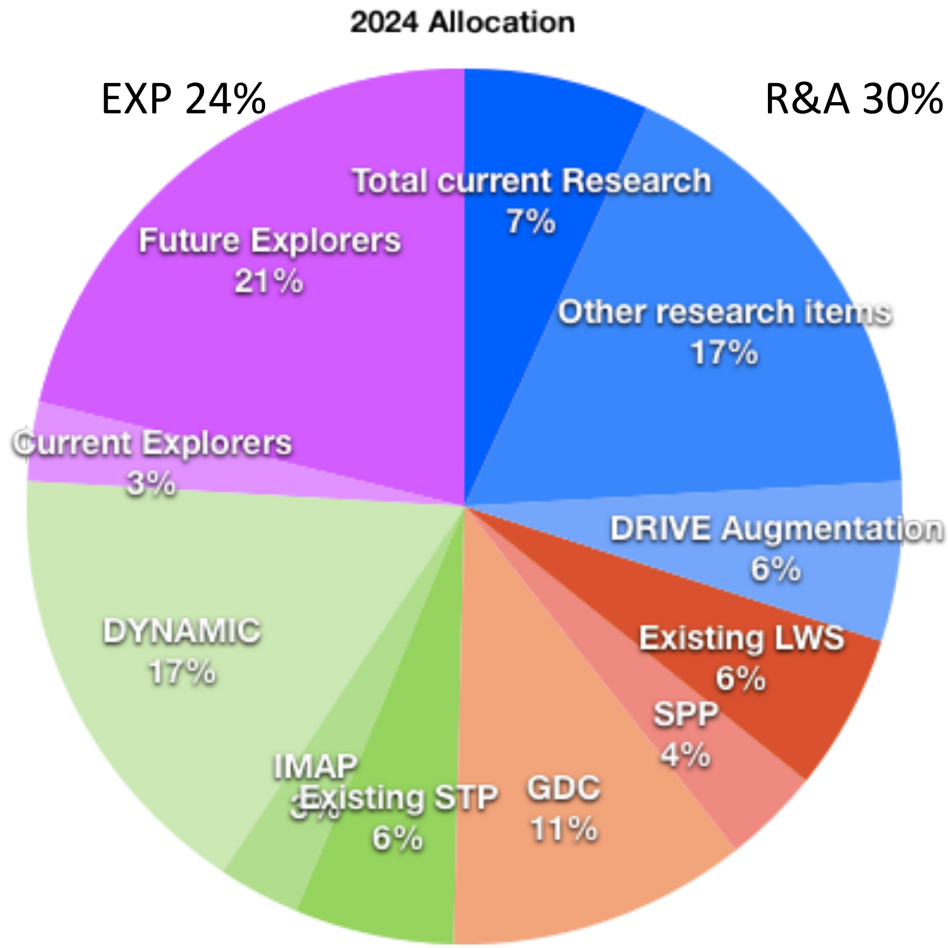


FIGURE 6.3 Effects of strategic rebalancing.Pg6-5

Roadmap Draft
Budget Rebalancing





EXP 24%

R&A 30%

STP 26%

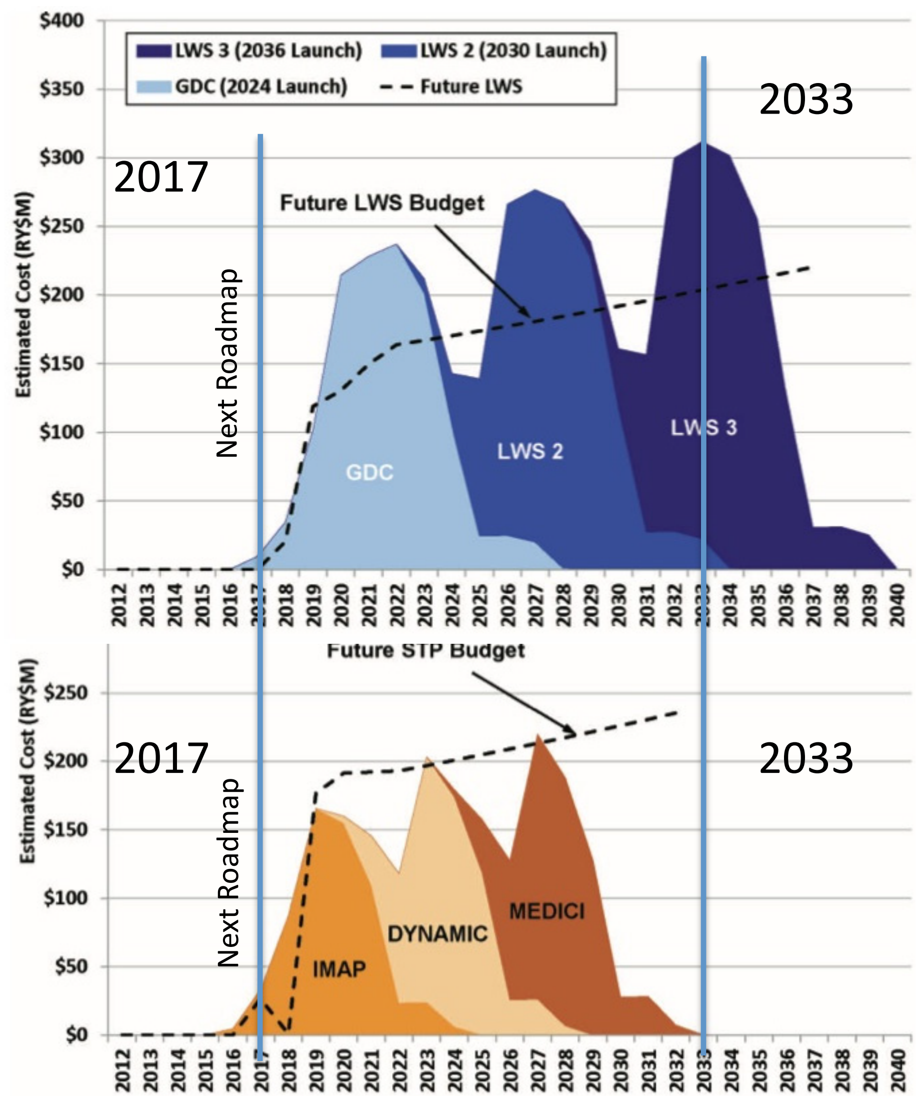
LWS 22%

Cost Control Measures

- **Stay Flexible**
  - The strategic science targets outline measurements that MAY address the key science questions. Teams may propose different instrumentation to address the science questions.
  - The current Explorer, STP and LWS missions lines are roughly \$250M, \$500M and \$1B, respectively. As the budget environment evolves the definition of small, mid-sized and large may change.
- **Identify Cost Growth Early**
  - NASA has implemented new cost tracking and reporting requirements to identify cost growth early.
  - NASA requires a 70% Joint Confidence Level at KDP-C (before the beginning of Phase C).
  - Cost growth after confirmation will result in mandatory termination reviews
- **Protect the Research Program**
  - The Decadal Survey report decision rules are designed to protect the R&A part of the HP budget in the event of unexpected budgetary impacts (Pg 6-8 to 6-12)
    - STP & LWS missions should be reduced in scope or delayed first.
    - Reduce the cadence of the Explorer program
    - Delay the implementation of the DRIVE program

Flight Program – Out Years

- **Flight Program Beyond Decadal Survey Report**
  - Roadmap covers the period from 2013 to 2033
  - LWS two additional science targets
  - STP one additional science targets
  - We will take the design reference missions from the Decadal sub-panel reports. We will just list the missions without rank and without separation into LWS or STP mission lines
  - Recognize that there will be another roadmap in four years (2017) that will have the time and resources to address the future needs.



Decadal Survey Report Figures 6.6 (top) and 6.5(bottom)

More Information

- Contact a committee member
- Our Web Page
  - http://sec.gsfc.nasa.gov/Roadmap2013.htm

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Extra Slides

Research Focus Areas Solve Fundamental Mysteries of Heliophysics

2009

- F1: Understand magnetic reconnection as revealed in solar flares, coronal mass ejections, the solar wind, and in magnetospheres
- F2: Understand the plasma processes that accelerate and transport particles
- F3: Understand the ion-neutral interactions that couple planetary ionospheres to their upper atmospheres and solar and stellar winds to the ambient neutrals
- F4: Understand the creation and variability of magnetic dynamos and how they drive the dynamics of solar, planetary, and stellar environments

2013

- F1: Understand magnetic reconnection
- F2: Understand the plasma processes that accelerate and transport particles
- F3: Understand ion-neutral interactions.
- F4: Understand the creation and variability of solar and stellar magnetic dynamos.
- F5: Understand the role of turbulence and waves in the transport of mass, momentum, and energy

Research Focus Areas
Understand the Nature of Our Home in Space

2009

- H1: Understand the causes and subsequent evolution of solar activity that affects Earth's space climate and environment.
- H2: Understand changes in the Earth's magnetosphere, ionosphere, and upper atmosphere to enable specification, prediction, and mitigation of their effects
- H3: Understand the role of the sun and its variability in driving change in the Earth's atmosphere
- H4: Apply our knowledge of space plasma physics to understand other regions of the solar system, stars and the galaxy

2013

- H1: Understand the origin and dynamic evolution of solar plasmas and magnetic fields throughout the heliosphere
- H2: Understand the role of the sun and its variability in driving changes in the Earth's atmosphere, the space environment, and planetary objects
- H3: Understand the coupling of the Earth's magnetosphere-ionosphere-atmosphere system and its response to internal and external forcing
- H4: Understand the nature of the heliospheric boundary region, and the interactions between the solar wind and the local interstellar medium.

Research Focus Areas
Build the Knowledge to Forecast Space Weather Throughout the Heliosphere

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2009

- J1: Characterize the variability, extremes, and boundary conditions of the space environments that will be encountered by human and robotic explorers
- J2: Develop the capability to predict the origin, onset, and level of solar activity in order to identify potentially hazardous space weather events and safe intervals
- J3: Develop the capability to predict the propagation and evolution of solar disturbances to enable safe travel for human and robotic explorers
- J4: Understand and characterize the space weather effects on and within planetary environments to minimize risk in exploration activities

2013

- W1: Characterize the variability, extremes, and boundary conditions of the space environments that will be encountered by human and robotic explorers
- W2: Develop the capability to predict the origin, onset, and level of solar activity in order to identify potentially hazardous space weather events and all-clear intervals
- W3: Develop the capability to predict the propagation and evolution of solar disturbances to enable safe travel for human and robotic explorers
- W4: Understand and characterize space weather and space climate on and within terrestrial and planetary environments

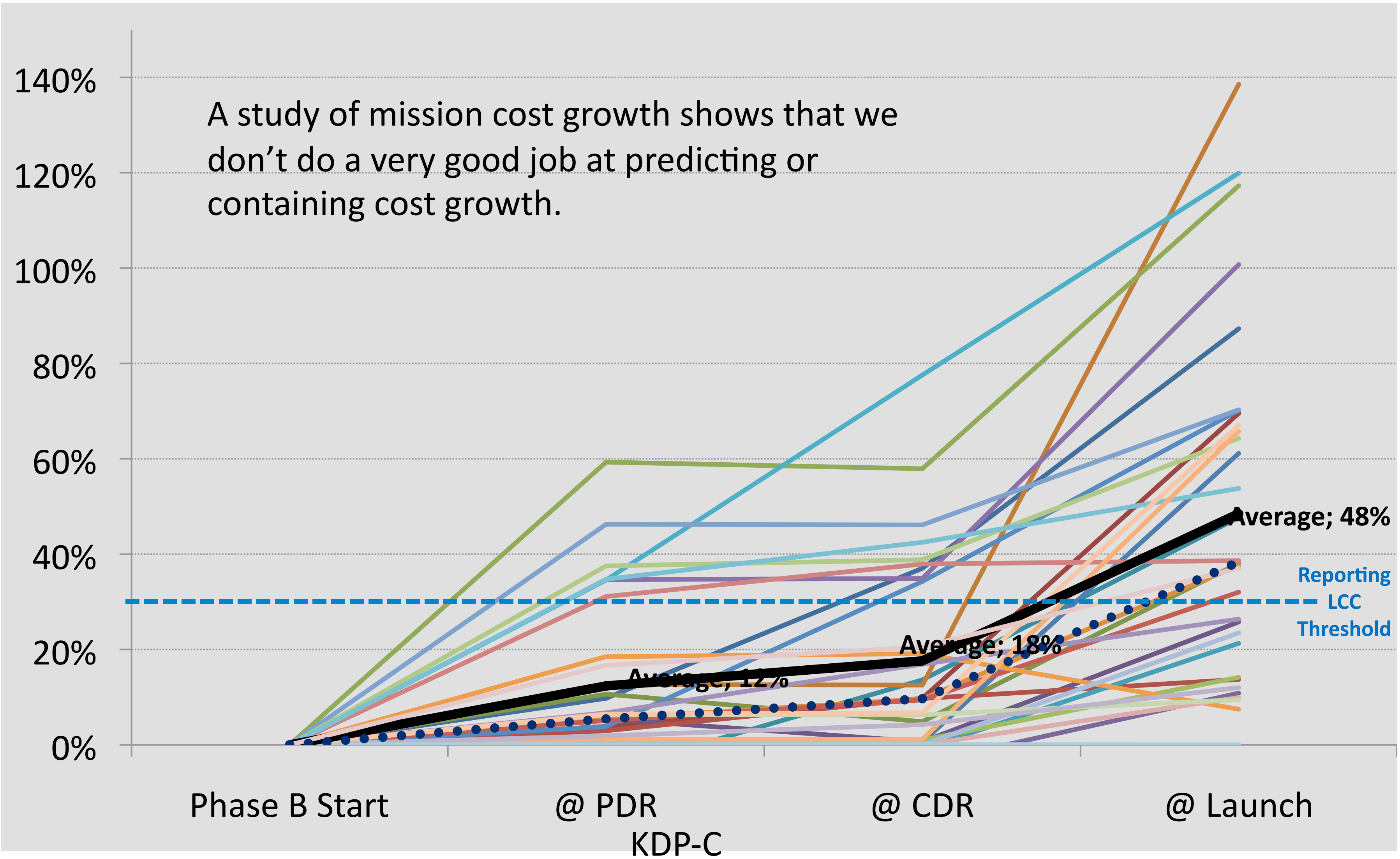
Mapping of Decadal Goal and Challenges to RFAs

- F1 Understand magnetic reconnection
  - Goal 1 Determine the Origins of the sun's Activity and predict the variations in the space environment
  - Goal 2 Determine the dynamics and coupling of the Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs
  - Goal 4 Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe
  - Challenge SH-3 Determine how magnetic energy is stored and explosively released and how the resultant disturbances propagate throughout the heliosphere
  - Challenge SWMI-1 Establish how magnetic reconnection is triggered and how it evolves to drive mass, momentum, and energy transport

Mapping of Decadal Goal and Challenges to RFAs

- H2: Understand the role of the sun and its variability in driving changes in the Earth's atmosphere, the space environment, and planetary objects
  - Goal 2 Determine the dynamics and coupling of the Earth's magnetosphere, ionosphere, and their response to solar and terrestrial inputs
  - Goal 3 Determine the interaction of the sun with the solar system and the interstellar medium
  - Challenge SH-3 Determine how magnetic energy is stored and explosively released and how the resultant disturbances propagate throughout the heliosphere
  - Challenge SWMI-3 Determine how the coupling and feedback between the magnetosphere, ionosphere and thermosphere govern the dynamics of the coupled system in its response to the variable solar wind
  - Challenge SWMI-4 Critically advance the physical understanding of magnetospheres and their coupling to ionospheres and thermospheres by comparing models against observations from different magnetospheric systems
  - Challenge AIMI-4 Determine and identify causes for long-term (multi-decadal) changes in the AIM system

SMD Flight Mission Cost Growth



Recent Project/Mgt Cost Performance