National Aeronautics and Space Administration

NASA LWS Program and Research to Operations

Janet Kozyra (LWS Science Lead)
Jeff Morrill (LWS Program Scientist)
Elsayed Talaat (Chief Scientist)
Heliophysics Division, NASA HQ

SEESAW Workshop

5-8 September 2017

Some Heliophysics Division News

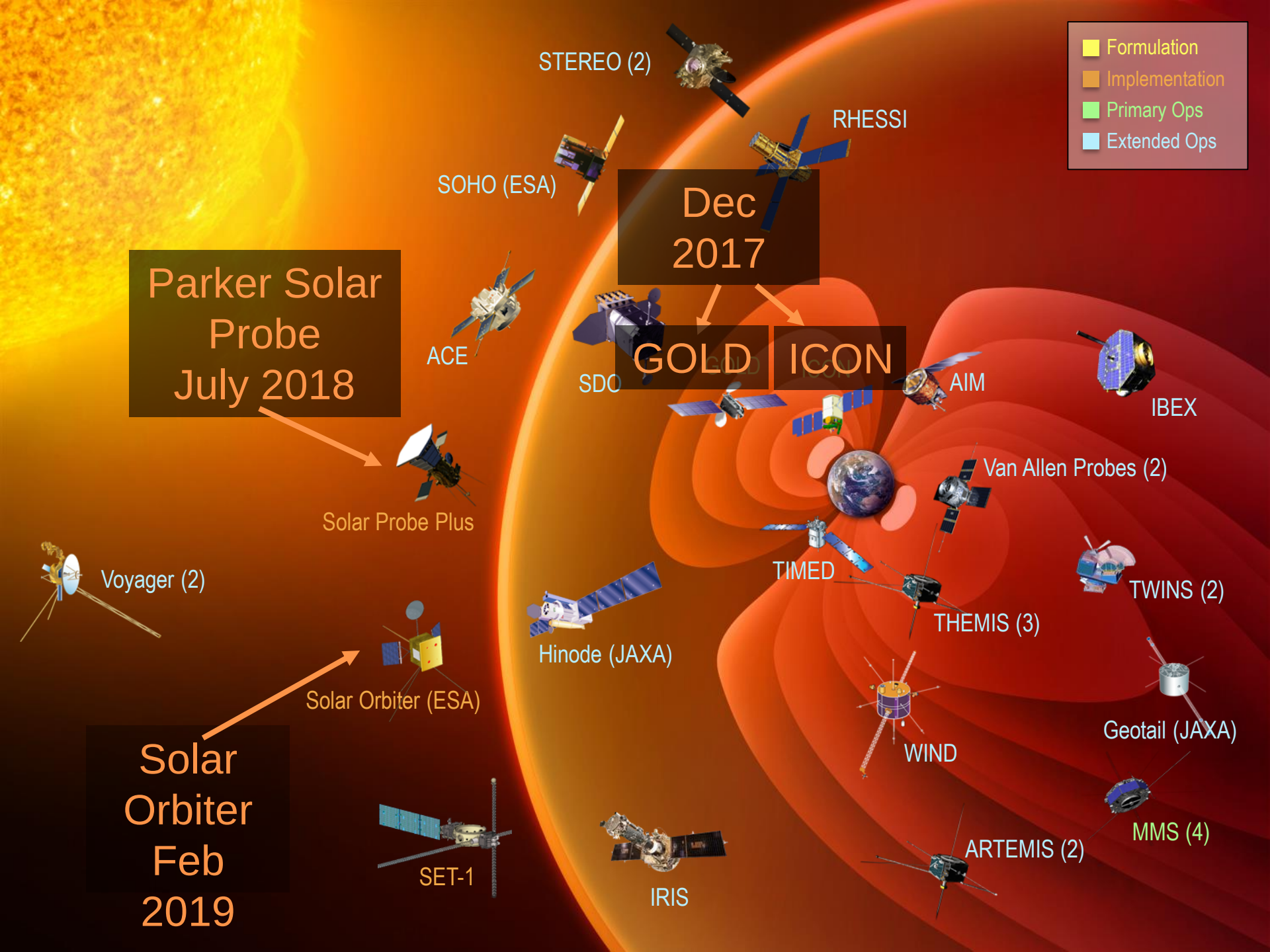
Steve Clarke on detail to OSTP as of end of July

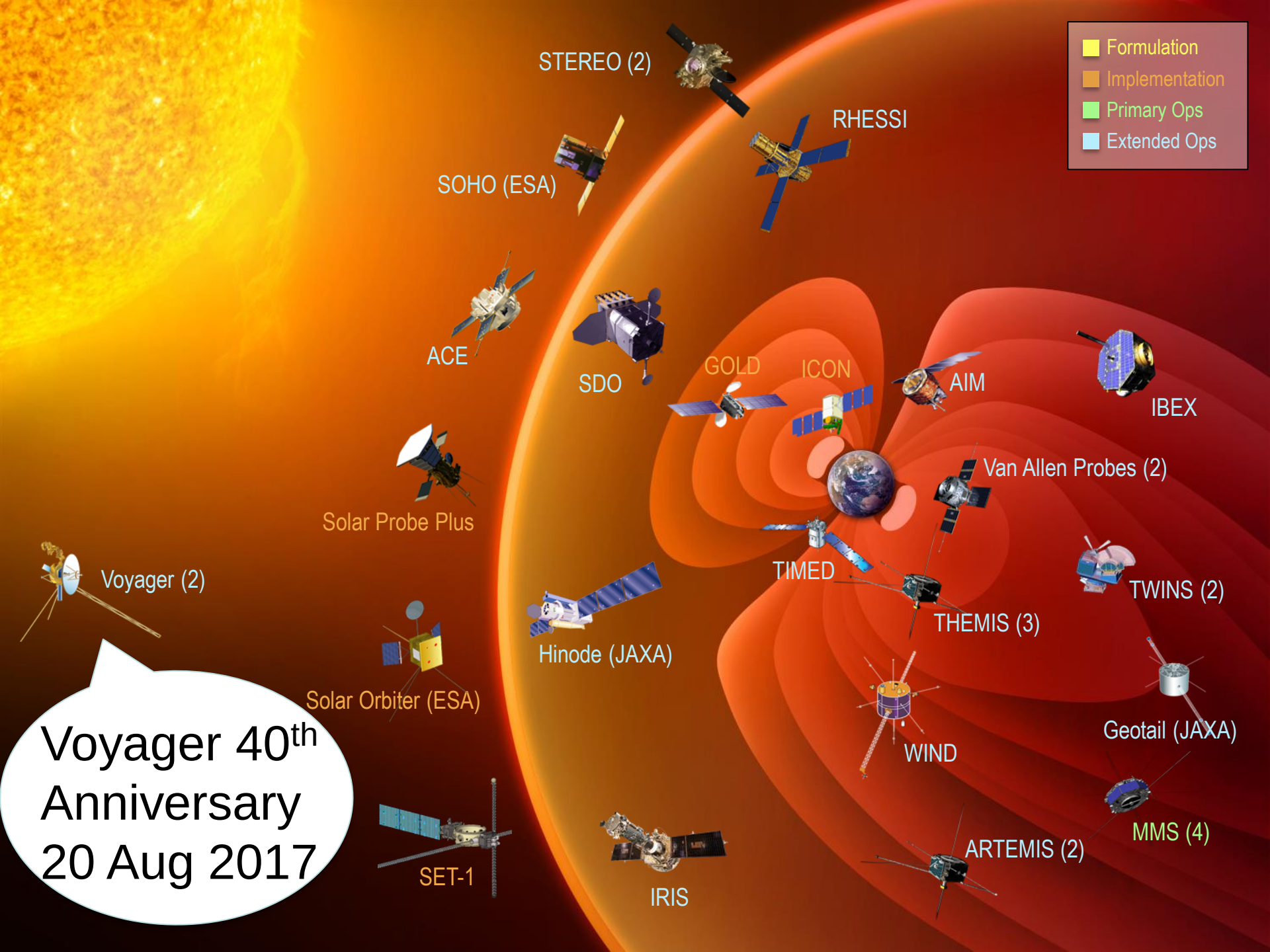
New faces: Janet Kozyra (recently joined NASA from NSF)
Jared Leisner (joined from NASA Planetary Science Div)

Seeking a Heliophysics Division Director – IPA Position

- NASA is looking for an experienced science leader to serve as Heliophysics Division Director under an Intergovernmental Personnel Act (IPA) appointment. You can find more information on this open position here: https://science.nasa.gov/about-us/job-opportunities.

- Response on or before October 13, 2017


Formulation
Implementation
Primary Ops
Extended Ops
STEREO (2)
RHESSI
SOHO (ESA)
Dec 2017
GOLD
ICON
Parker Solar Probe July 2018
ACE
SDO
AIM
IBEX
Van Allen Probes (2)
Solar Probe Plus
Voyager (2)
TIMED
TWINS (2)
THEMIS (3)
Hinode (JAXA)
Solar Orbiter (ESA)
Geotail (JAXA)
WIND
Solar Orbiter Feb 2019
MMS (4)
ARTEMIS (2)
SET-1
IRIS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Voyager 40th Anniversary 20 Aug 2017

40th Anniversary of Voyager

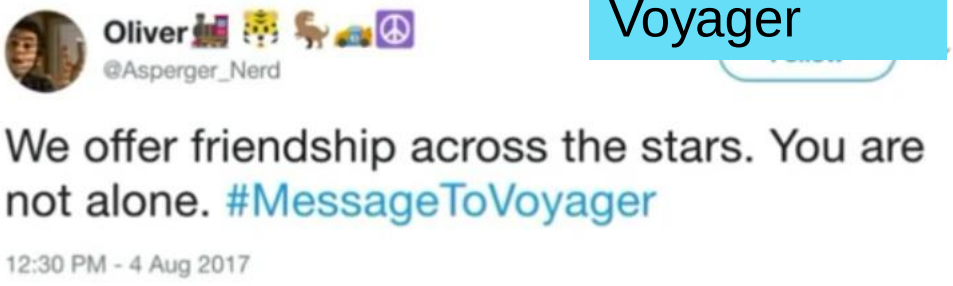
Smithsonian Air & Space Museum, Sept 5

What design strategies enabled Voyager to survive? Three elements:

1) Learned from Pioneer about the severity of the space environment -> Added shielding & redesigned somecomponents
2) Simpler design, 63kB memory, 1/240,000th of the computing power in your smartphone
3) Redundancy and automation:
   - "Two-string" redundancy for its critical systems
   - Voyager could sense the state that it was in, and turn something off if there was a problem.
   - Also one of 1st probes to have "back up" mission installed. Carried on even without ground commands.

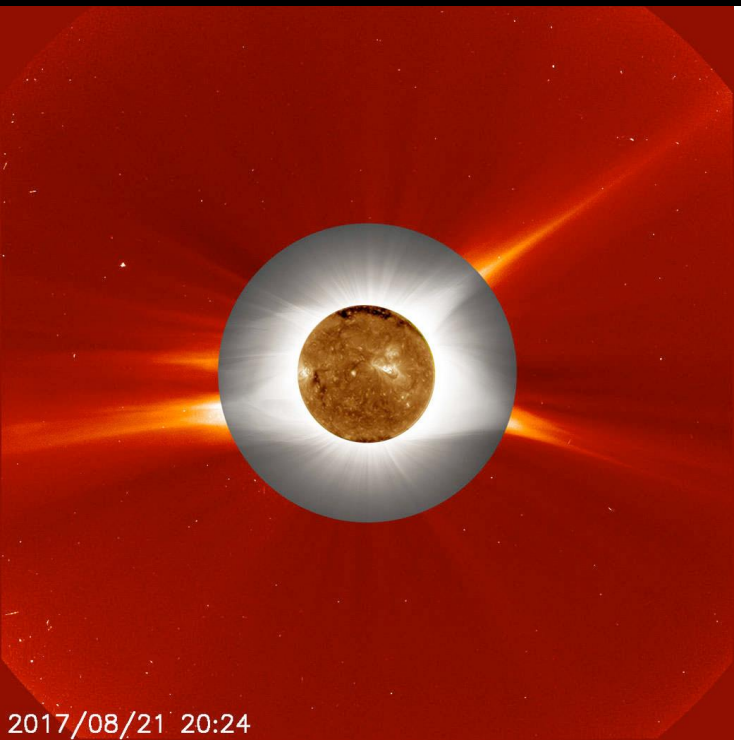
--Suzanne Dodd, project manager, Voyager

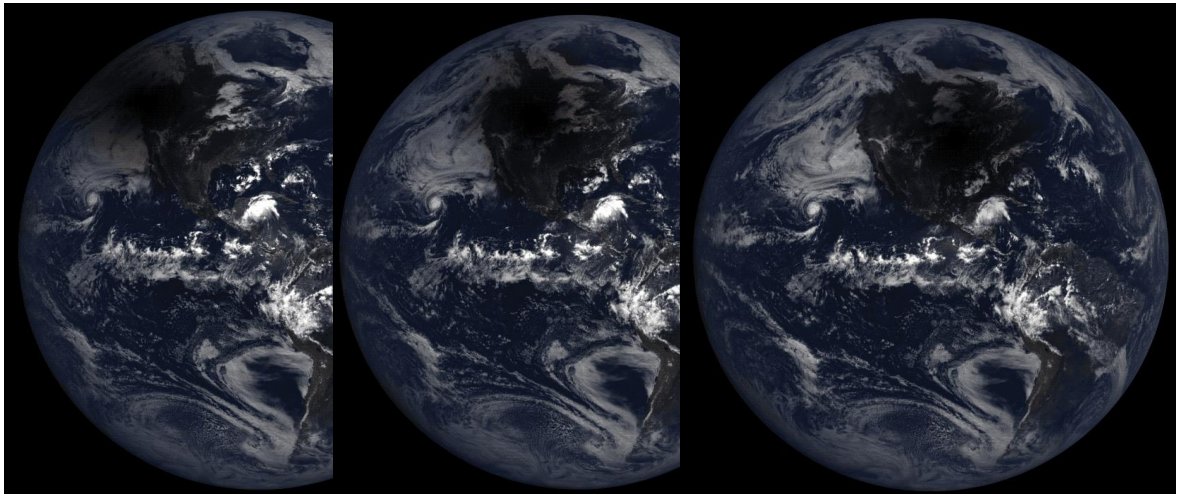
William Shatner sent message to Voyager



Solar Eclipse 21 August 2017

Photo Credit: (NASA/Aubrey Gemignani)





Moon's shadow moving across North America as seen by EPIC on DISCOVR.

Credit: NASA EPIC Team

Credits Innermost image: NASA/SDO. Ground-based eclipse image: Jay Pasachoff, Ron Dantowitz, Christian Lockwood and the Williams College Eclipse Expedition/NSF/National Geographic Outer image:

HPD ROSES16 Status

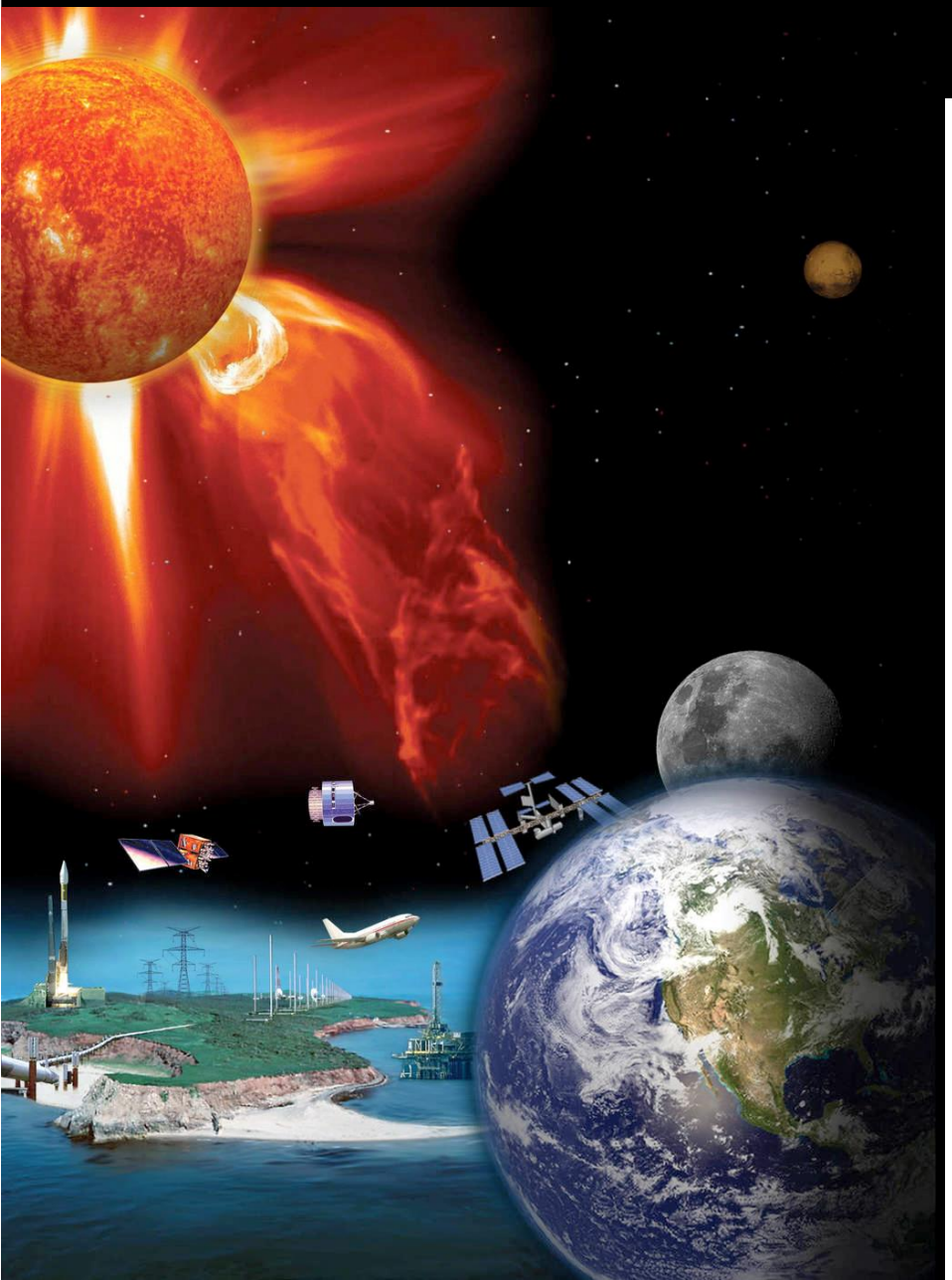
ELEMENT	STEP 1 PROPOSALS (Due Date)	STEP 2 PROPOSALS (Due Date)	AWARDS (Expected)	YEAR 1 ($M)	~ % Success Rate
B.2 H-SR	235	212	31	$6.3M	15
B.3 H-TIDeS	87	71	13	$5.3M	18
B.4 H-GI Open	197	181	33	$3.0M	18
B.5 H-GCR TMS	44	40	10	$4.4M	25
B.6 H-LWS	74	63	20	($3.75M)	32
B.7 H-DEE	28	24	7	0.5M	29
B.8 H-GI MMS	57	40	(8-10)	(1.3M)	(20-25)
B.9 H-GCR SC	*PPD ROSES17*	*PPD ROSES17*	-	-	
B.10 H-USPI	7	5	(2)	($0.4M)	(40)
E.5 ISE	41	39	11	$0.95M	28

Success rate = # proposals funded / # STEP 2 proposals received

DRIVE implemented in FY18 President's Budget

$M		FY16	FY17	FY18	FY19	FY20	FY21	FY22	Delta FY18	FY20-FY18
Sounding Rocket Program Office	FY15 PBR	**48.3**	53.0	53.0	53.0				10.7	4.1
	FY18 PBR	49.8	53.3	59.0	61.1	63.1	63.1	63.1		
Guest Investigator	FY15 PBR	**8.0**	8.0	8.0	8.0				7.2	4.8
	FY18 PBR	10.5	11.6	15.2	20.0	20.0	20.0	20.0		
Research & Analysis (HSR, H-TIDeS, H-GCR)	FY15 PBR	34.0	**33.9**	33.9	33.9				16.0	8.7
	FY18 PBR	36.3	39.4	49.9	58.2	58.6	58.6	58.6		
LWS Science	FY15 PBR	17.5	17.5	17.5	17.5				7.1	6.3
	FY18 PBR	18.4	**21.9**	29.0	35.5	35.3	35.3	35.3		
									+$41M	+$24M

Living With A Star (LWS)



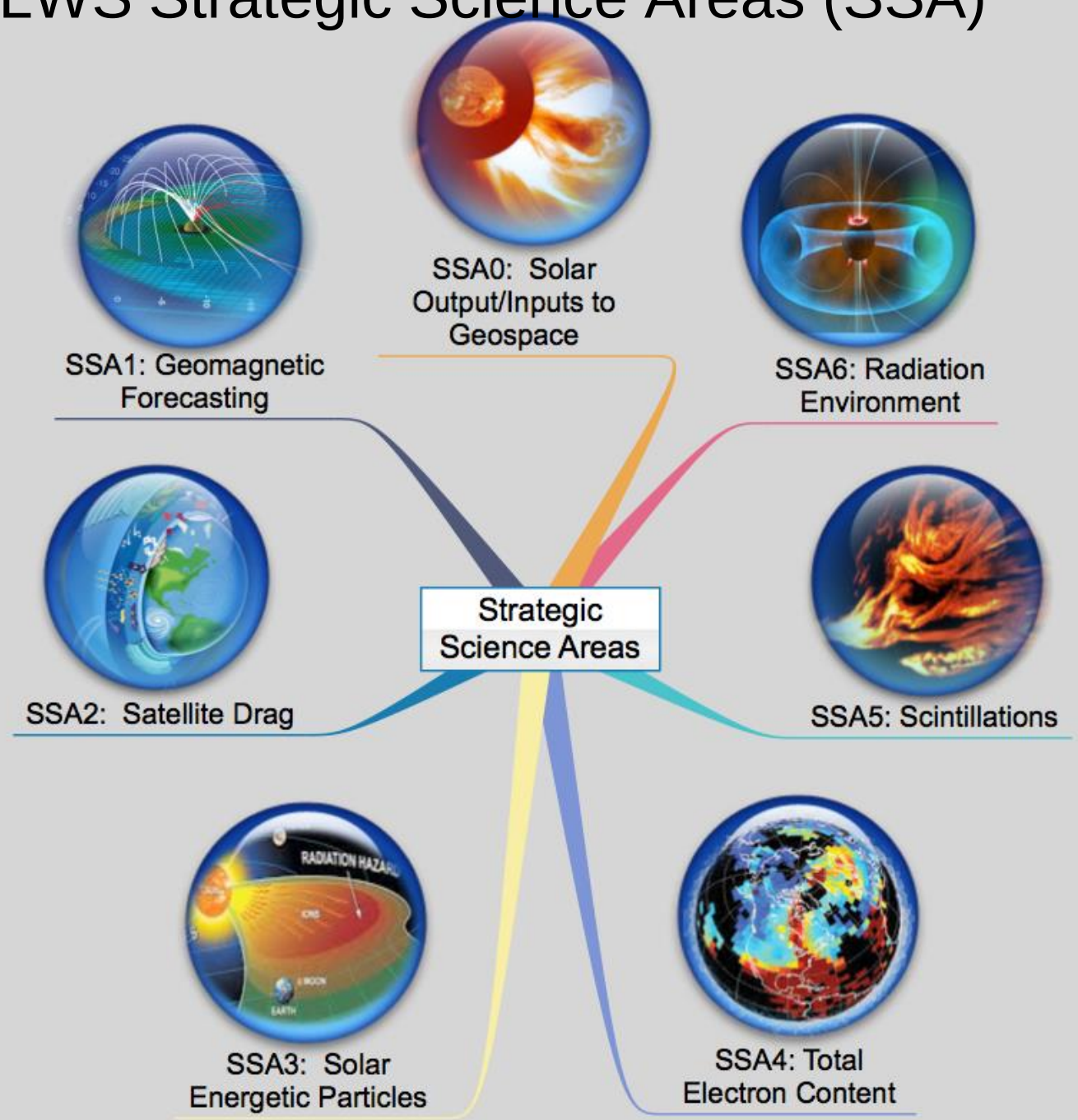
Objectives are to understand (and model):

- The variable sources of mass and energy from our Star
- The associated reactions of heliospheric and geospace regions and
- The implications for life and habitability at the Earth and beyond.

Elements:

- strategic missions
- targeted research
- technology development
- space environment testbed flight opportunity
- partnerships with other agencies/nations.

LWS Strategic Science Areas (SSA)



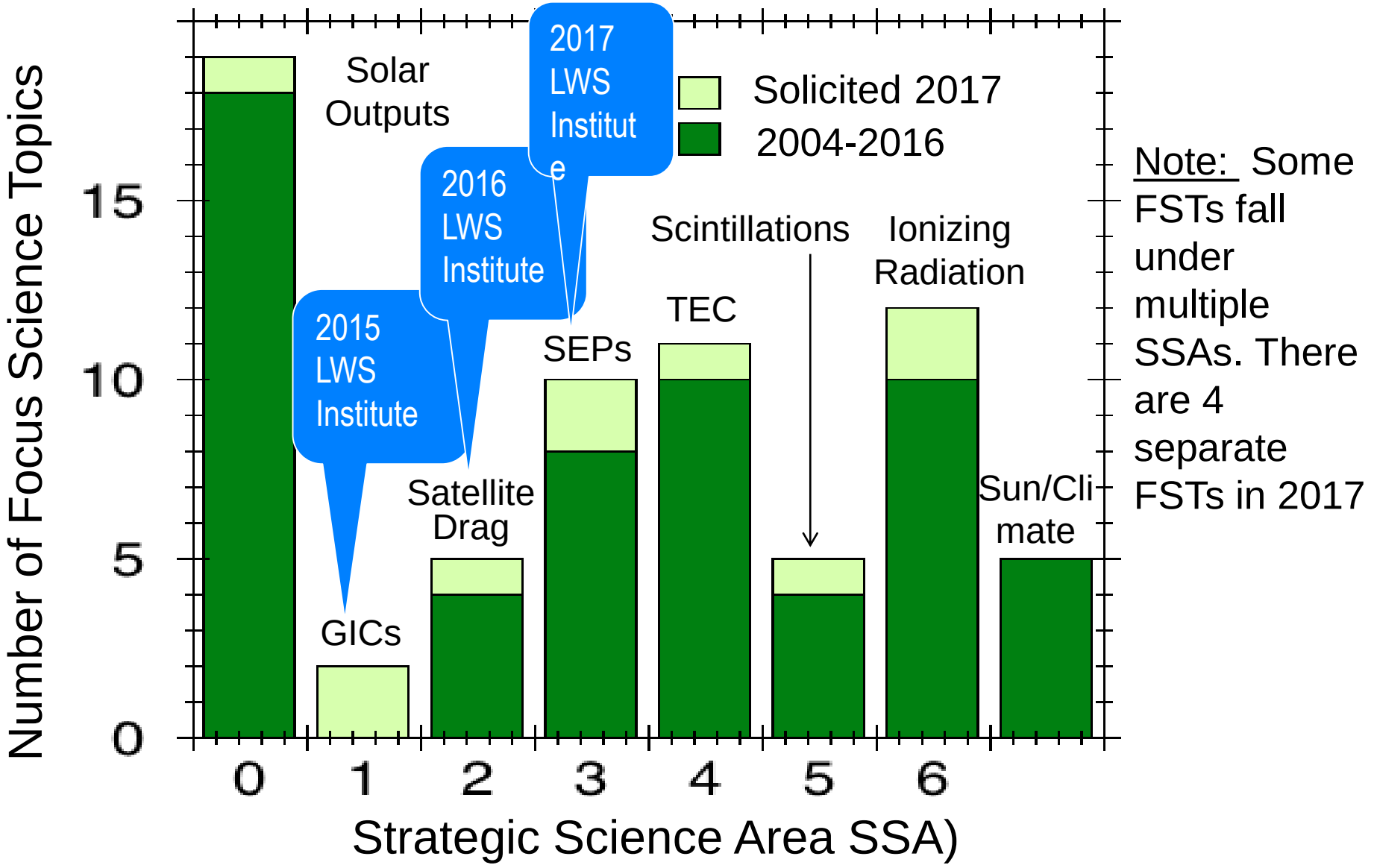
Largely line up with SWAP Benchmark topics. Synergisms expected in results:

1. Induced geo-electric fields
2. Ionizing radiation
3. Ionospheric disturbances
4. Solar radio bursts
5. Upper atmospheric expansion

SWAP Benchmark Steps:

1. Phase 1 benchmarks – close to completed
2. Assessment report of gaps submitted
3. Process for Phase 2 benchmarks – under discussion

LWS Focus Science Topics Related to Each Strategic Science Area (2004 - upcoming 2017)



Living With a Star Institutes

A typical award may include:

- Two 5-day meetings for up to 15 team members including: travel, catering, meeting room and audiovisual costs (Please note that UCAR cannot support travel for federal employees).
- A ½ day team meeting at either AGU or AMS including meeting room rental and audiovisual.
- Teleconferencing using Go-to-Meeting or Ready Talk
- Publication costs

2015: Principles in relation to the effects of geomagnetically induced currents (GICs) during CME-driven geomagnetic disturbances (GMDs)

2016: Now-casts of atmospheric drag for LEO spacecraft

2017: Now-casts of radiation storms (proton events) at energy levels that could create a radiation hazard for aircrew and passengers

2017/18: Two new institutes will be solicited

ROSES – H-LWS 2016

- ROSES 2016 LWS FSTs developed incorporating inputs from previous Steering Committee reports and *informed* by SWAP science priorities.
- Proposals were due November 2016.
- A total of 63 Step-2 proposals were received by NSPIRES.
- Three FST Teams (20 proposals) were selected.
- Kickoff Workshop planned
  - All new FST teams will meet and develop comprehensive work plans for team member activities.
  - Goal is to have teams produce a clear set of targets and plan of action at the outset of the FST.

Advances Toward a Near Real Time Description of the Solar Atmosphere and Inner Heliosphere

PI/ Institution	Investigation Title
DeForest /SWRI	FRAN: Fluxon Rapid Assimilative Nowcasting
Schuck /GSFC	Developing Vector Magnetic Maps from SDO/HMI that can Drive Space Weather Models
Leake /GSFC	Implementing and Evaluating a Vector-Magnetogram-Driven Magnetohydrodynamic Model of the Magnetic Field in the Low Solar Atmosphere
Sokolov /U Mich.	Matching EUV observations to a flare model with self-consistent energy release
Gibson /UCAR	Plasmoid Instabilities and Supra-Arcade Downflows: Validating Theory and Simulation with Observations
Warren /NRL	Data-driven Simulations of Active Region Evolution and CME Initiation-SOLR
Jackson /UCSD	Dynamics of solar flares: synthesis of NASA space data with microwave imaging spectroscopy from EOVSA
Gopalswamy /GSFC	The Global State of the Solar Atmosphere and Inner Heliosphere during Cycles 23 and 24

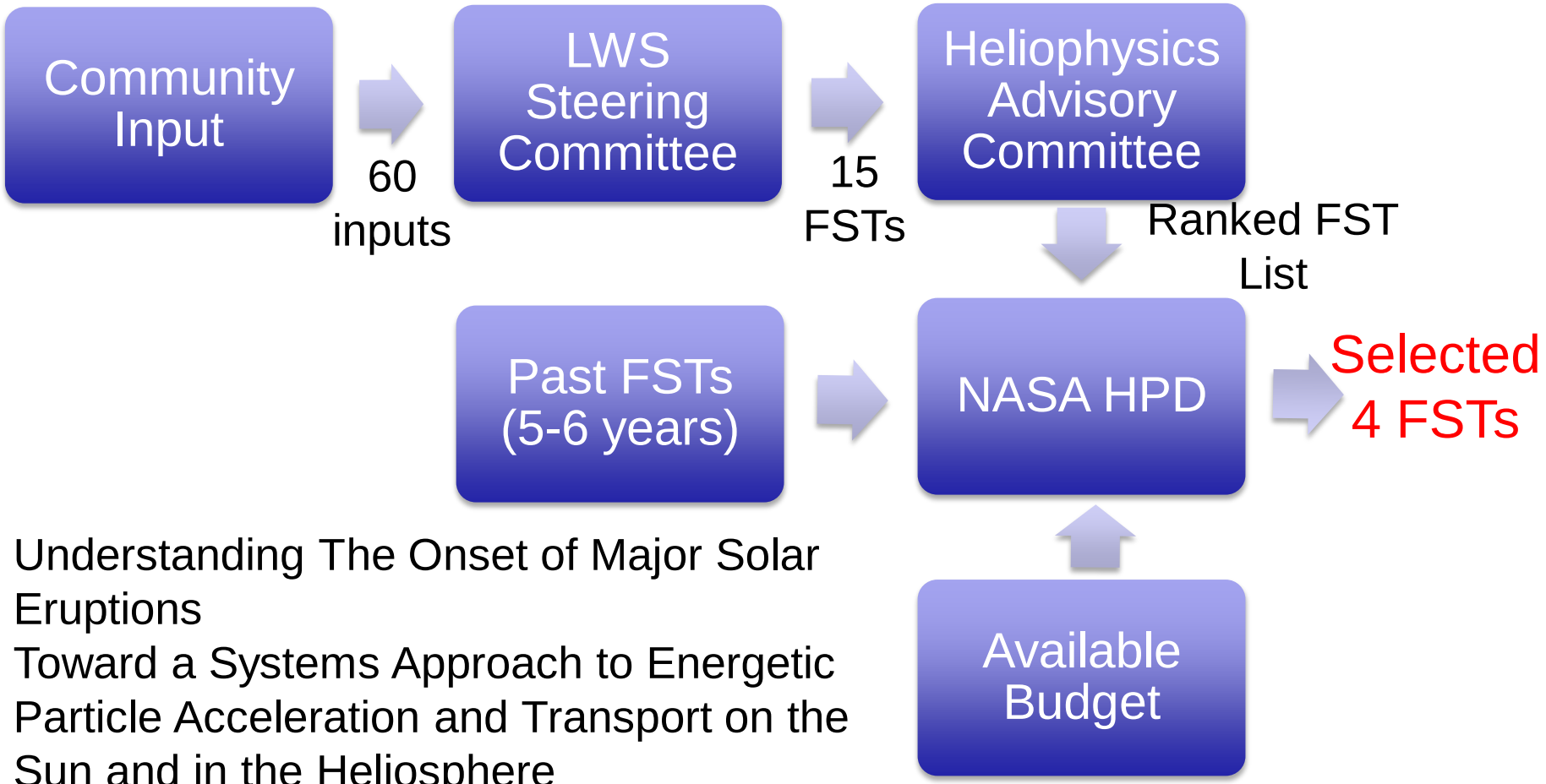
Characterization of the Earth's Radiation Environment

PI/ Institution	Investigation Title
Denton /SSI	Characterizing the Earth's Radiation Environment: A Flux Model of the Inner Magnetosphere
Tenishev /UMich	Effect of solar variability on the geospace radiation environment
Tobiska /SET	RADiation environment using ARMAS data in the NAIRAS model (RADIAN)
Ukhorskiy /JHU APL	Data-constrained predictive model of radiation belt dynamics
Glocer /GSFC	Predicting radiation variability in Earth's magnetosphere
Elkington /LASP, CU	Effects of advective and diffuse transport of trapped energetic particles in radiation belt models

Studies of the Global Electrodynamics of Ionospheric Disturbances

PI/ Institution	Investigation Title
Verkhoglyadova/ JPL	Understanding the Impacts of Dynamic Drivers on Global Storm-time Ionosphere-Thermosphere (IT) System
Lu /UCAR	Global Ionospheric Electrodynamics and Its Influence on the Thermosphere
Fang /UCO	Quantifying the variability of equatorial electrodynamics during disturbed geomagnetic conditions using first-principle models
Raeder /UNH	Storm Enhanced Density, Tongues of Ionization, and Sub Auroral Polarization Streams
Sazykin /UT Dallas	Ionospheric Storm-Time Electrodynamics: Coupling Across Latitudes and Magnetospheric Imprint
CROWLEY /ASTRA	Ionospheric Electrodynamics – A Quantitative Characterization

FST Development and Selection Process (ROSES 2017)



1) Understanding The Onset of Major Solar Eruptions
2) Toward a Systems Approach to Energetic Particle Acceleration and Transport on the Sun and in the Heliosphere
3) Ion Circulation and Effects on the Magnetosphere and MI-Coupling
4) Understanding Physical Processes in the Magnetosphere & Ionosphere Thermosphere / Mesosphere System During Extreme Events

2017 ROSES – LWS TR Solicitation

- ROSES 2017 LWS Step-1 and Step-2 submissions delayed until after the ROSES 2016 selections.
  - Delay in part due to delay in announcement of NASA budget.
- Revised ROSES 2017 LWS Amendment to be announced shortly. Four chosen FST topics not altered. Changes:
  - Location of the “Relevance Discussion” & it’s evaluation
  - Clarification of the data usage for LWS FST studies.
- <u>Target dates</u>
  - Step-1 late September/early October
  - Step-2 late November/early December
- Should still be able to access any previous STEP-1 work done on the NSPIRES web site.

LWS Science looking forward

LWS Steering Committee reconstituted as the LWS Analysis Group (LPAG).

- Interdisciplinary forum for soliciting & coordinating community input in support of LWS objectives
- Two LPAG Co-Chairs and an LPAG Executive Committee (EC) – organize meetings, collect & summarize community input, prepare reports to HPD Director
- The full LPAG consists of all members of the community who participate in the open meetings.
- NSF, NOAA ex officio members; adding DOD
- DCL soliciting candidates for the LPAG will be out shortly

Core LWS Science activities continue:

ROSES – 2017, … LWS FST calls

ROSES – 201X LWS Strategic Capabilities (with NSF)

Partnerships:

Joint NSF-NASA – Computational Aspects of Space Weather

Space weather focused aspects of Heliophysics Science Centers

Seeking to enable Space Weather-oriented opportunities:

R2O & O2R tools, SBIR's, Space Weather-oriented tech development

R2O Concept of Operations

NSF-NASA "*Computational Aspects of Space Weather*"
- 3 -Year Grants (FY18-20)
- ~ $2M/YR from LWS Science

NSF-NASA MOU

Tri-agency O2R pilot in development

Joint R2O modeling. Approved 18 May

NOAA-NASA MOU

Fundament-al Research

Targeted Modeling Research and Development

LWS Focus Science Teams

LWS Strategic Capabilities

CCMC

SWPC (& 557th Weather Wing) Operational Models

Access to best models, implements int'l metrics, leverages expertise & access to information, rapid implementation & testing, access portal to simulation results & observations

RFI closed 9/5
~20+ responses
Planned start FY18

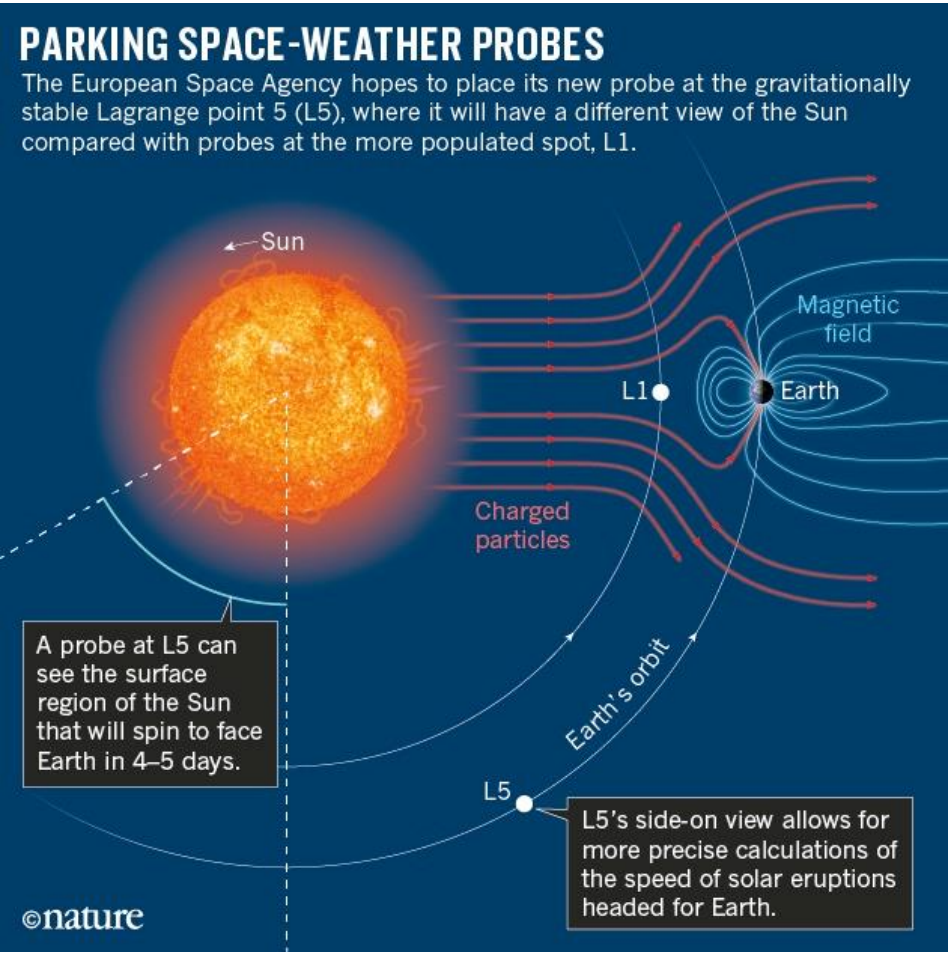
International Contributions/Partnerships

Most recently **Europe** (L5), **Japan** (NGSPM), **Korea** (SW model, rocket) **India** (L1, SW modeling)

Thank you.

LWS International Collaborations

L5 Mission - Europe



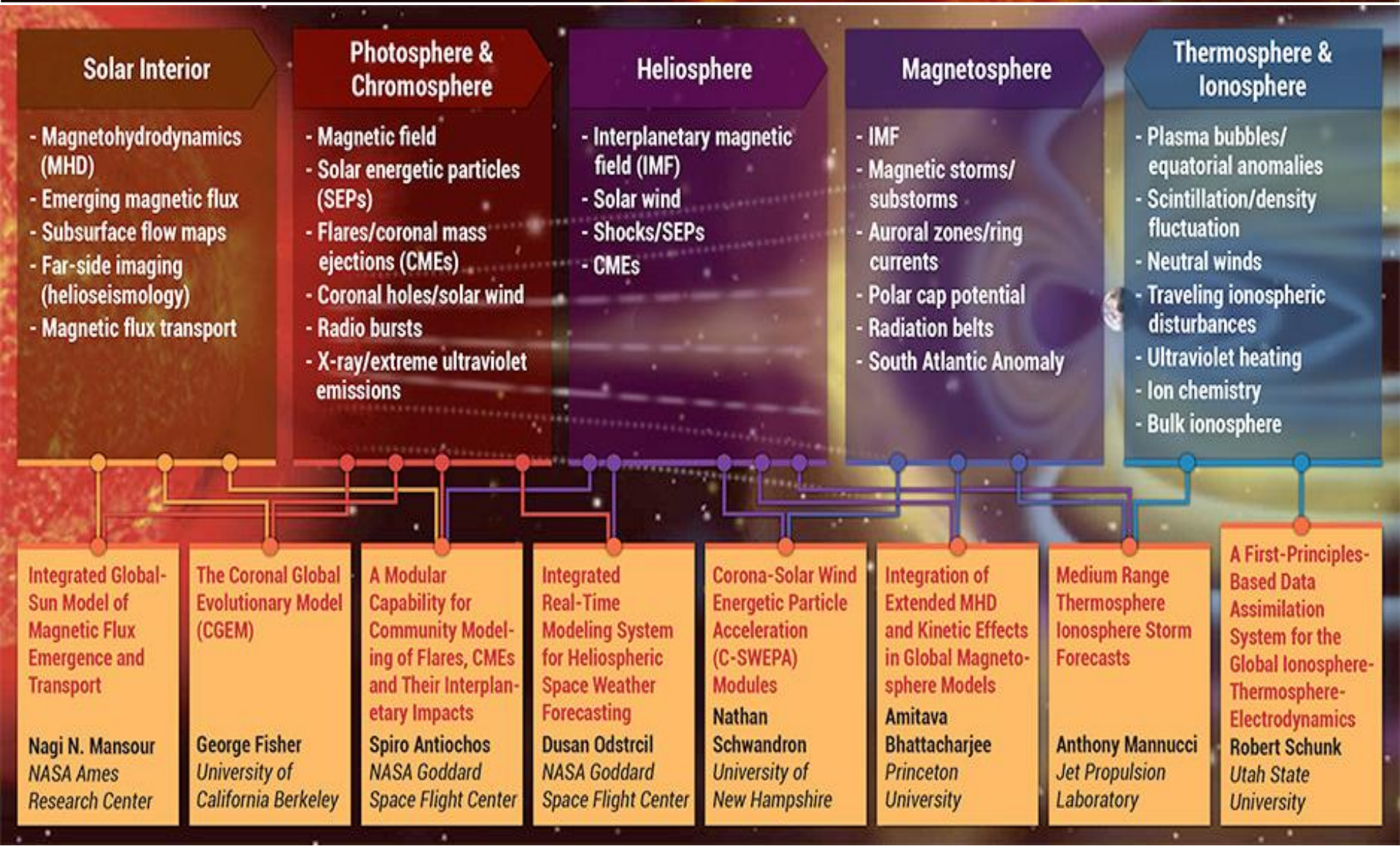
Next Generation Solar Physics Mission (NGSPM)

- Agreement among NASA, JAXA and ESA for the study of a possible multilateral solar physics mission concept.

Aditya - L1 First Indian mission to study the Sun

- launch during 2019 – 2020 timeframe
- 6 experiments
- observations of Sun's Photosphere (soft and hard X-ray), Chromosphere (UV) and corona (Visible and NIR). In addition, particle payloads will study the particle flux emanating from the Sun and reaching the L1 orbit, and the magnetometer payload will measure the variation in magnetic field strength at the halo orbit around

NASA-NSF Partnership for Collaborative Space Weather Modeling



On May 31, the Solar Probe Plus was renamed the Parker Solar Probe in honor of the discovery of the solar wind by Eugene Parker. During the ceremony he received the NASA Distinguished Public Service Award.

SOHO (E

ACE

Solar Probe Plus

Voyager (2)

Solar Orbiter (ESA)

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WIND

Geotail (JAXA)

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Voyager 40th Anniversary 20 Aug 2017