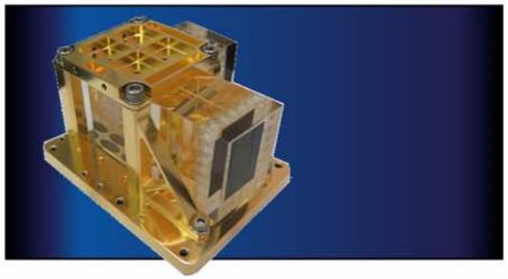
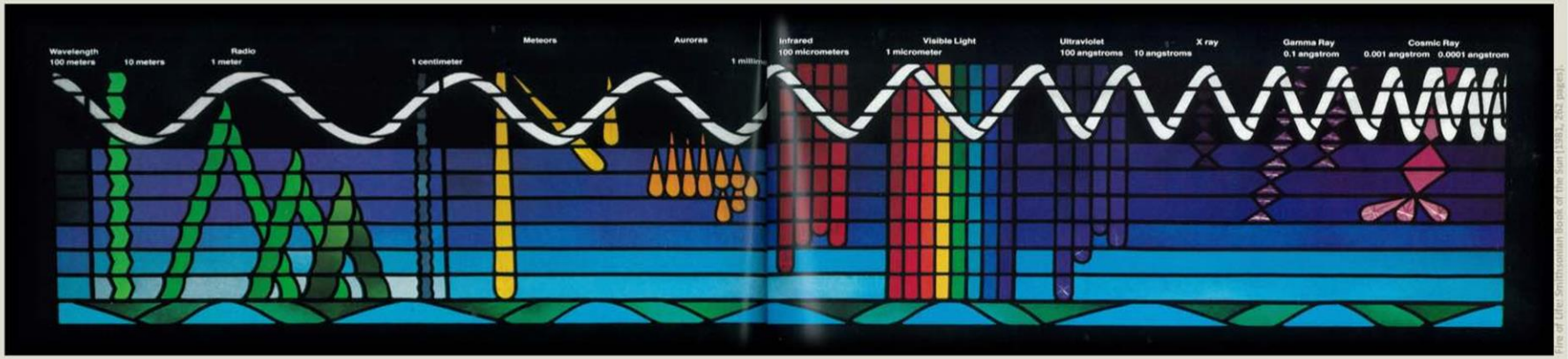
Heliophysics Subcommittee Report for the NAC Science Committee



Jill Dahlburg
NASA Heliophysics Subcommittee (HPS)

02 November 2015



NASA HELIOPHYSICS SUBCOMMITTEE

Heliophysics Subcommittee (HPS) Membership

HPS Membership -

- Vassilis Angelopoulos (University of California, Los Angeles)
- Spiro Antiochos (NASA Goddard Space Flight Center)
- Jill P. Dahlburg (Naval Research Laboratory, Chair)
- Bart W. De Pontieu (Lockheed Martin Space Systems Corporation)
- Mihir I. Desai (Southwest Research Institute)
- Heather A. Elliott (Southwest Research Institute)
- Maura Hagan (National Center for Atmospheric Research)
- Michael W. Liemohn (University of Michigan, Vice-Chair)
- Ralph L. McNutt, Jr. (The Johns Hopkins University)
- Neil Murphy (Jet Propulsion Laboratory)
- James M. Russell III (Hampton University)
- Roger W. Smith (University of Alaska Fairbanks)
- W. Kent Tobiska (Space Environment Technologies)

AGENDA -

- HPD Division Overview
- HPD Flight Program Status

} **Steven Clarke's Presentation**

- Heliophysics Science Performance Assessment Input
  to the FY2015 NASA Performance Assessment Report [PAR]
- Science Presentation: Community Coordinated Modeling Center [CCMC]
- Research Opportunities in Space and Earth Sciences [ROSES]
  Exit Survey for Proposers and Panelists
- Cost-to-benefit Ratio in Flight Project Reviews; and,
  Use of Payload Adapter Fittings [PAFs] in Competed Missions
- Technology Readiness Level [TRL] Discussion
- Geospace Management Operations Working Group [G/MOWG] Update
- Big Data Task Force
- Astronomy & Astrophysics Advisory Committee [AAAC] interim report:
  'Impact of Declining Proposal Success Rates on Scientific Productivity'

HPS Sept 2015 Comment

The HPS gladly welcomes new HPD Deputy Director Margaret (Peg) Luce, who brings a wealth of leadership experience to the HPD. She recently served as the NASA SMD Earth Science Deputy Director, where she provided oversight and advice on a portfolio of missions to increase the world's understanding of the Earth as a system.

The HPS anticipates that Peg's broad experience with complementary Earth Science missions will immensely benefit heliophysics research.

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HPS Sept 2015 GPRAMA, and the Heliophysics Science Performance Assessment on Strategic Objective 1.4

Jeff Newmark briefed the HPS about

GPRAMA (Government Performance and Results Act) *and*
the Heliophysics Science Performance Assessment on **Strategic Objective 1.4, which is to understand the Sun and its interactions with Earth and the solar system, including space weather.**

Jeff tasked the HPS to review the HPD Fiscal Year 2015 [FY15] progress in the area of this Objective, with focused attention on three Performance Goals:

1.4.1: Demonstrate progress in exploring the physical processes in the space environment from the Sun to Earth and throughout the solar system;

1.4.2: Demonstrate progress in advancing understanding of the connections that link the Sun, Earth, and planetary space environments, and the outer reaches of the solar system; and,

1.4.3: Demonstrate progress in developing the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

HPS Sept 2015 Heliophysics FY15 Science Performance Assessment, *cont.*

Resulting from substantial deliberation, under the leadership of HPC members Bart De Pontieu (for 1.4.1), Vassilis Angelopoulos (for 1.4.2), and Michael Liemohn (for 1.4.3), **on 30 Sept the HPS concluded that, for all three Performance Goals:**

> **Expectations for the HPD research program were fully met in the context of the resources invested and, moreover, the NASA Heliophysics Division has newly achieved original and generative contributions.**

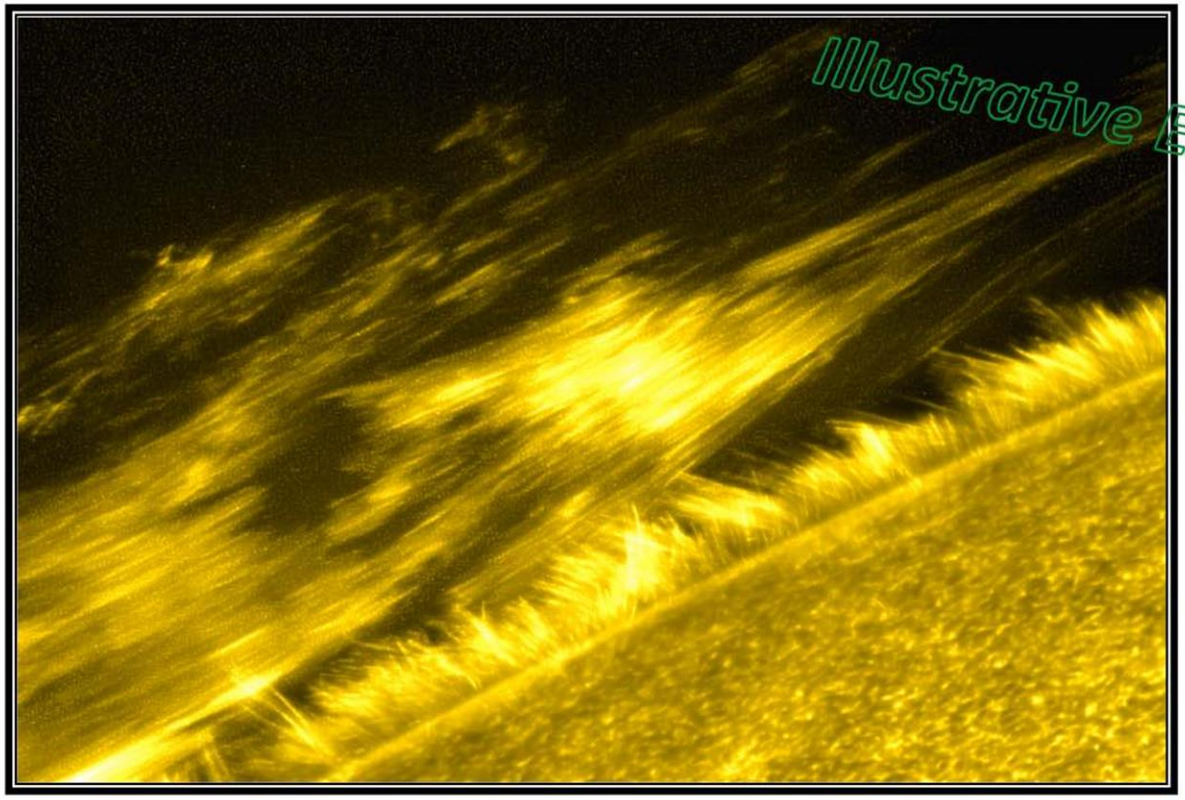
Accordingly, the HPS unanimously voted in favor of GREEN ratings for all three HPD Performance Goals 1.4.1, 1.4.2, and 1.4.3.

Exploring the physical processes that structure and drive our space environment is essential for the utilization and the human exploration of space and, consequently, is one of the great challenges for NASA's science program.

The HPS substantiated its unanimous GREEN rating for the associated Performance Goal 1.4.1 as follows.

The HPD has made major progress recently in the area of fundamental space environmental exploration, as exemplified by new understanding of the physical mechanisms underlying the heating of the solar corona, the energization of the magnetosphere as illustrated by the identification of solar sources of charged particles in near-Earth space, and planetary-scale dynamics of the Earth's upper atmosphere.

HPS Sept 2015 Heliophysics FY15 Science Performance Assessment: Goal 1.4.1



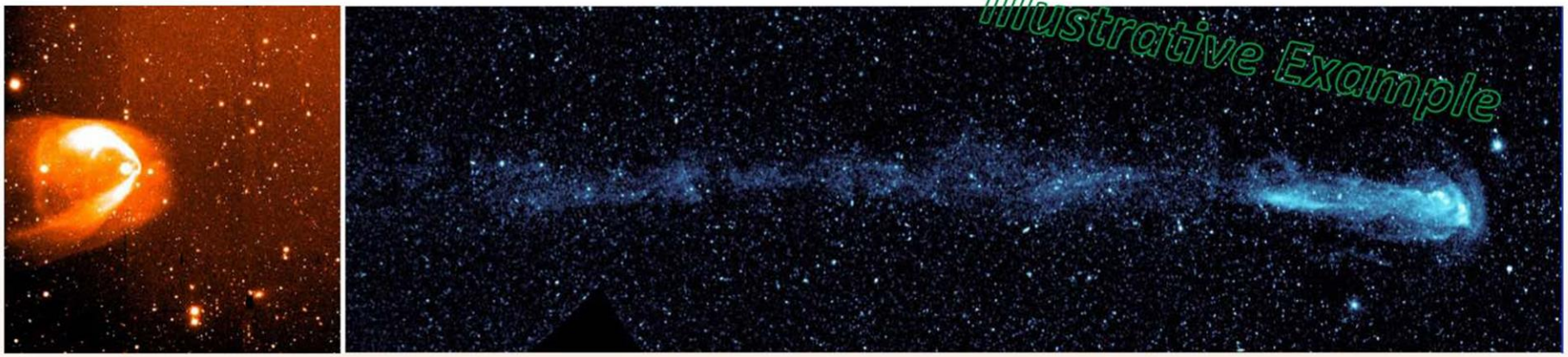
Solar filament observations reveal one of the mechanisms behind coronal heating. This image shows a filament on the Sun just above the solar limb – a giant ribbon of relatively cool solar material threading through the Sun's atmosphere, the corona. The individual threads that make up the filament are clearly discernible. Researchers studied the rotational motion and temperature changes of the individual strands to reveal heating via magnetically driven waves. *(Image, 19 Oct 2013: Solar Optical Telescope onboard JAXA/NASA's Hinode solar observatory)*

The solar wind permeates the heliosphere and has profound effects on planetary environments and planetary evolution, and it interacts with Earth's ionosphere and atmosphere and drives dynamic processes at the edge of the solar system.

The HPS substantiated its unanimous GREEN rating for the associated Performance Goal 1.4.2 as follows.

The HPD has recently made seminal contributions in our understanding of the connections that link the heliosphere, as illustrated by new insights concerning the Sun's interaction with the subsurface of Mercury -- both presently and at ancient time-scales, the competing effects of space currents heating and atmospheric CO_2 cooling of the Earth's ionosphere, and the surprisingly dynamic interactions of the variable solar wind with the interstellar medium.

HPS Sept 2015 Heliophysics FY15 Science Performance Assessment: Goal 1.4.2



The magnetic bubble around our Sun may look more like the shortened one as seen in this image of the star BZ Cam (left), as opposed to a long one as seen around the star Mira (right). [Image: NASA/Casalegno/GALEX; URL: http://solarsystem.nasa.gov/news/2015/03/03/NASA-funded-study-finds-two-solar-wind-jets-in-the-heliosphere]

IBEX (Interplanetary Boundary Explorer), Voyager, and Cassini illuminate our heliosphere's structure and its interstellar interactions. Scientists combined state-of-the-art simulations with space-based observations, and found that the heliosphere looks a lot more like a crescent moon rather than a comet and has two giant jets of material shooting backwards over the north and south poles of the Sun. With this and other unique insights, Voyager, IBEX and Cassini have delivered unprecedented understanding of our Sun's interaction with interstellar space, and new directions to explore universal stellar phenomena in our own astrophysical neighborhood.

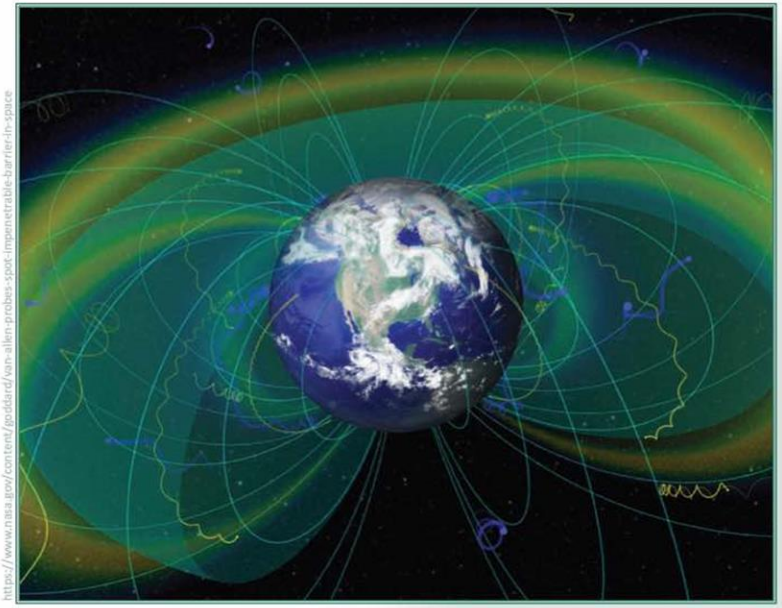
HPS Sept 2015 Heliophysics FY15 Science Performance Assessment: Goal 1.4.3

All space-based capabilities are subject to effects of the space environment. NASA mission data and NASA-funded numerical models, across all heliophysics disciplines ranging from solar through magnetospheric to upper atmospheric physics, are used to advance knowledge about space weather phenomena capable of adversely affecting life and society here on Earth as well as human and robotic explorers beyond Earth.

The HPS substantiated its unanimous GREEN rating for the associated Performance Goal 1.4.3 as follows.

The HPD recently has substantively advanced our ability to detect and predict extreme conditions in space by discovering that coronal dimming serves as a proxy for coronal mass ejection strength, finding that the inner radiation zone contains no high energy electrons, and quantifying a remarkably strong statistical relationship which predicts the appearance of equatorial ionospheric scintillation.

HPS Sept 2015 Heliophysics FY15 Science Performance Assessment: Goal 1.4.3



https://www.nasa.gov/content/goddard/van-allen-probes-spot-impenetrable-barrier-in-space

Illustrative Example

Electrically charged particle populations in geospace, showing the Van Allen radiation belts in yellow-red shading and the cool, dense material of the plasmasphere in blue-green shading. The light blue lines sketch the configura-tion of the magnetic field and the yellow spiral lines are sample trajectories of energetic particles. *(Image: NASA/GSFC/ Scientific Visualization Studio)*

The Inner Radiation Zone contains no high energy electrons. The Van Allen Belts, named for their discoverer James Van Allen, are two toroidal regions encircling Earth, where charged particles from the Sun and space are trapped by our planet's magnetic field. Their populations wax and wane in response to incoming energy from the Sun, sometimes swelling enough to expose satellites in low-Earth orbit [LEO] to damaging radiation. Researchers used data from NASA's twin Van Allen Probes to discover a sharp inner edge in the outer belt that acts as a barrier, preventing high-energy electrons from coming closer to Earth. This work enables us to better quantify the dangers to astronauts and technological assets that are orbiting at LEO.

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HPS Meeting Information Presentations, Sept 2015

Masha Kuznetzova

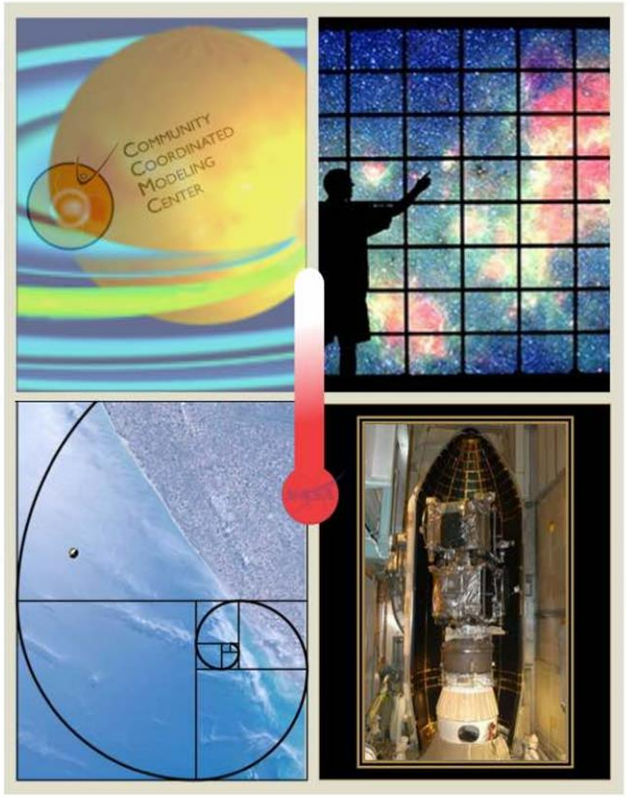
briefed the HPS about the NASA/ GSFC Community Coordinated Modeling Center [CCMC]. Providing space weather model runs on request, visualization and analysis tools, and validation and metrics information, the CCMC is a powerful capability for heliophysics research.

Jeff Newmark & Elsayed Talaat

provided a discussion about TRLs as related to future Announcements of Opportunity [AOs]; the HPS is looking forward to further information.

Mona Kessel

shared an update about the ROSES panel process exit survey that was suggested by the HPS in June 2015. She envisions leveraging an existing Planetary Science Division Survey to start things off. The HPS concurred.



Elaine Denning

contributed a briefing about NASA's Big Data Task Force. The HPS noted strong agreement with the goal of better data transparency across the SMD Divisions.

J. Todd Hoeksema

spoke about the AAAS interim report. A key question for the HPS -- which arose from the statistics that indicated that for the heliophysics community the number of submitted proposals/ PI is approximately unchanging, and the demographics are about the same -- was: Why are there so many new HPD proposing PIs? The HPS hypothesized that in the past many heliophysics researchers had been funded via big NASA spaceflight projects but, recently, instrument project funding has become much smaller and as a consequence a considerable number of this cadre now needs to propose for research funding individually in order to continue with heliophysics research.

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HPS Sept 2015 Geospace MOWG Update

Dr. Doug Rowland provided an update about the May 2015 G/MOWG meeting. He reported five G/MOWG findings; these are highlights:

i) On technology development: Consider funding suitable Explorer proposals rated Category-3 (Class C/D) and announcing this well before the AOs appear.

ii) On strategic planning for Living with a Star [LWS] and Solar Terrestrial Probes [STP] missions, which used to be frequent and now occurs for the most part only at a cadence driven by the Decadal Survey: Consider starting Science Definition Teams [SDTs] now for foreseeable 'reference' missions such as IMAP (Interstellar Mapping and Acceleration Probe), DYNAMIC (Dynamical Neutral Atmosphere-Ionosphere Coupling), MEDICI (Magnetosphere Energetics, Dynamics, and Ionospheric Coupling Investigation), and GDC (Geospace Dynamics Constellation).

iii) On increasing Explorer flexibility: Consider releasing a non-binding 'Notice of Intent' to give the community maximum time to prepare excellent concepts.

iv) On Guest Investigator [GI] funding for MMS: Since it is anticipated that the data from MMS will be released to the public in March 2016, consider issuing a dedicated MMS GI call in the summer of 2016, and allow for broadened scope of investigations as compared with limiting to official MMS goals.

v) On a framework for sounding rocket mobile campaigns: Consider implementing a proposal framework and schedule that would allow mobile campaigns to become a regular part of the Heliophysics Technology and Instrument Development for Science [HTIDeS] program.

The HPS endorsed all five findings as valuable and important towards strengthening excellence in research directions and in the workforce.

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HPS Sept 2015 Two Areas of Discussion

Finally, the HPS discussed two ongoing topics: i) flight project risks and future potential costs of risk intolerance; and, ii) the use of payload adapter fittings [PAFs] in competed missions.

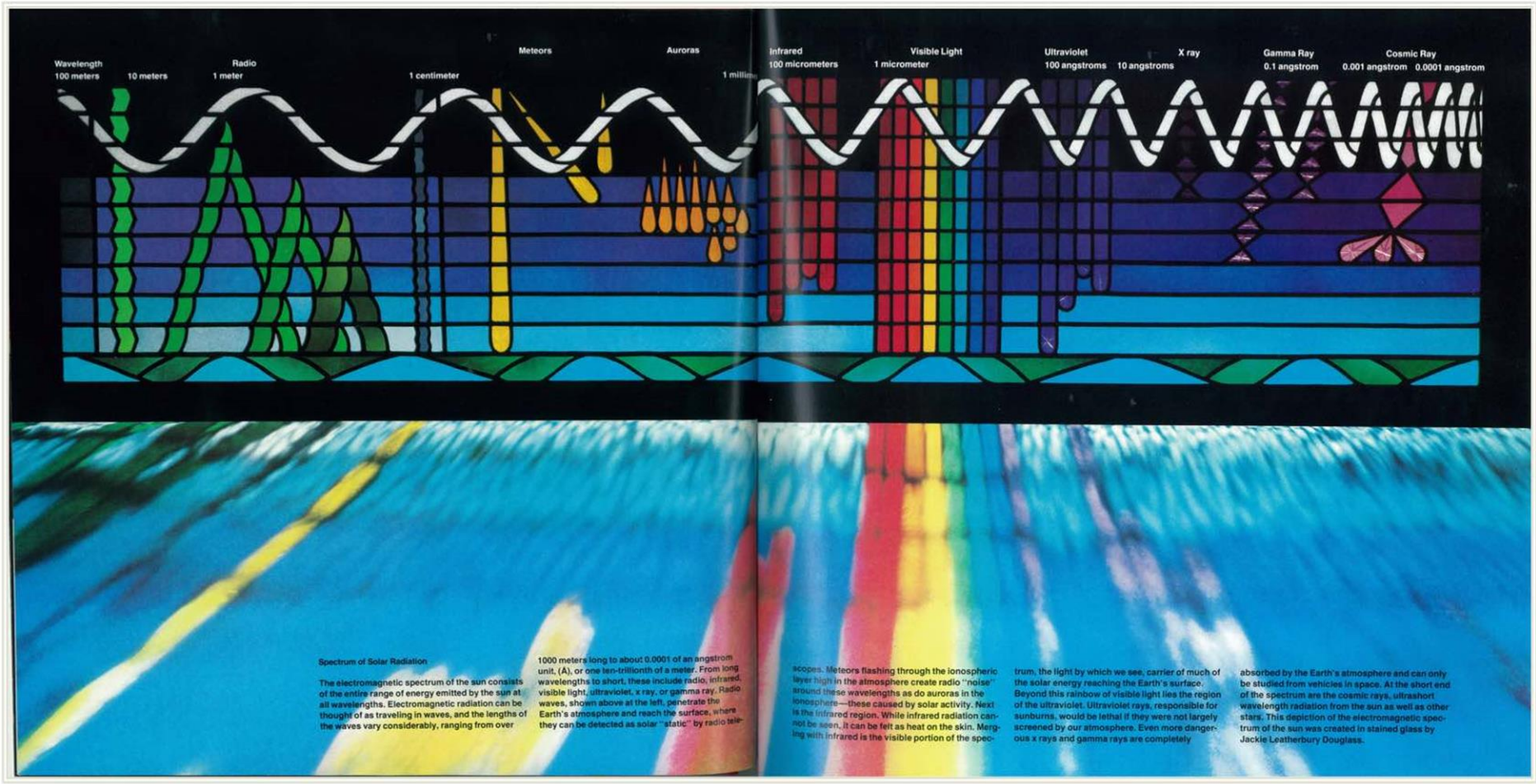
i) On the topic of risk intolerance: Dr. Neil Murphy summarized the July 2015 NAC SC meeting discussion, and noted that the NAC SC indicated that a next good step would be for relevant facts -- such as current oversight demands for a Class-D mission -- to be collected, towards assessing if the oversight requirements are approaching those of a Class-B or even Class-A mission level.

The HPS will further address this, at its next meeting.

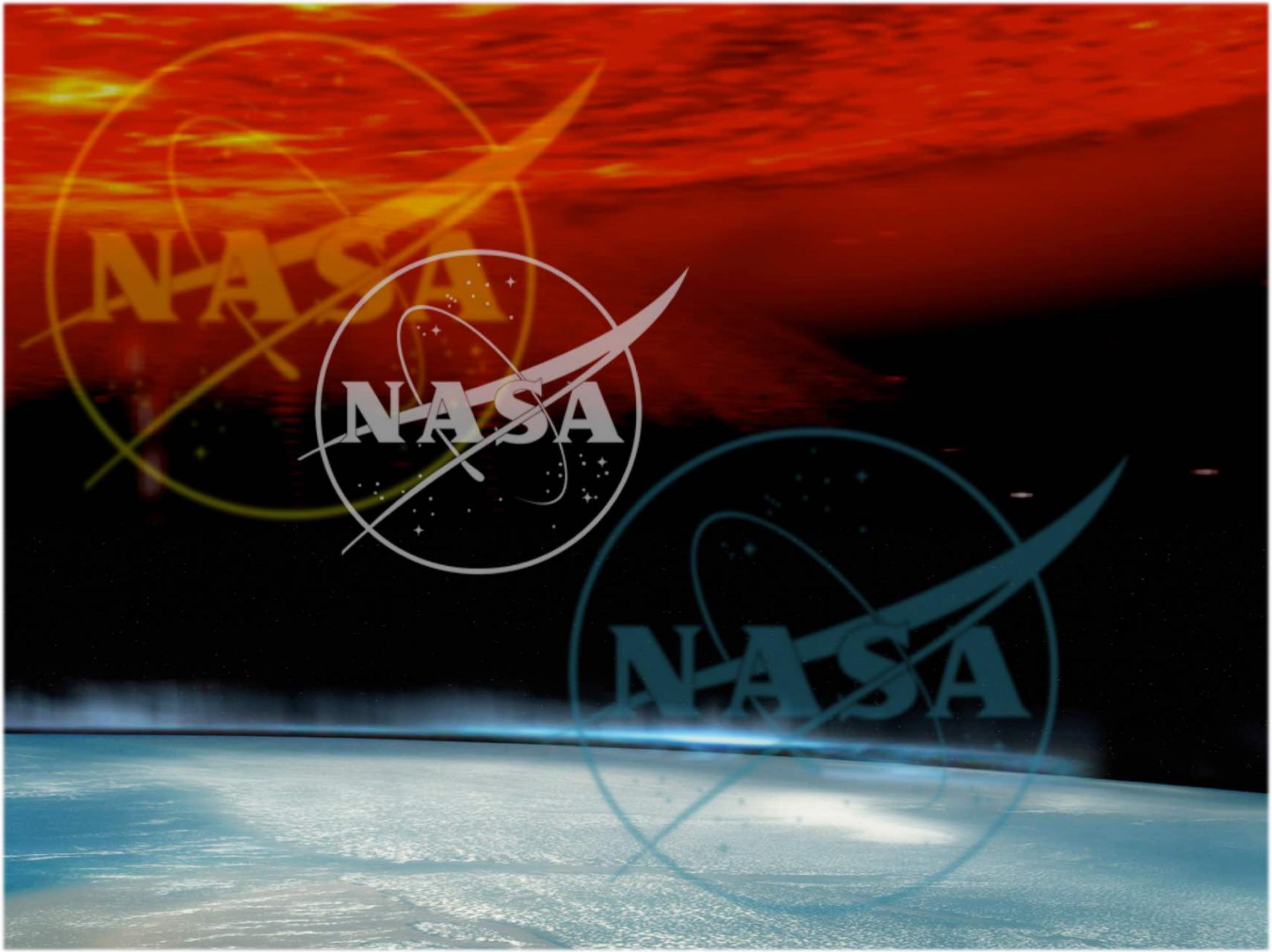
ii) On the topic of the competitive use of PAFs: Steve Clarke offered that the HPD headquarters staff will take on the task of developing an assessment about PAF capabilities that will be distributed to the HPS, and, as interest warrants, to the NAC SC, when complete.

The HPS gladly accepted this offer.

Electromagnetic Spectrum of the Sun



REF: 'The Smithsonian Book of the Sun: Fire of Life,' pp 50-51, Smithsonian Exposition Books, WW.Norton & Co. New York, 263 pages (1981).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