National Aeronautics and
Space Administration

Heliophysics Explorers Program (HEP)
2019 Medium-Class Explorer (MIDEX)

Introduction to Proposals
Evaluation Process Overview

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NASA Science Mission Directorate

October 7, 2020

HEP19 MIDEX Solicitation

- All investigations proposed in response to this solicitation must support the goals and objectives of the Heliophysics Explorers Program (HEP) (Section 2), must be implemented by Principal Investigator (PI) led investigation teams (Section 5.3.1), and must be implemented through the provision of complete spaceflight missions (Section 5.2.1).
- Only AO-provided primary launch services may be proposed (Section 5.9.2.1). These include a dedicated launch as described in the Launch Services Program Information Summary document posted in the Program Library. Proposals shall define the required launch vehicle capability and demonstrate that the mission is compatible with at least one of the specified launch service scenarios.
- The PI-Managed Mission Cost, including all mission phases, excluding the cost of launch vehicle (Section 5.9.2), is capped at the AO Cost Cap of **$250M FY 2019 dollars**, or an Adjusted AO Cost Cap as applicable.
- A MIDEX investigation will be launched as the primary payload on a single launch vehicle that NASA will provide as Government Furnished Equipment (GFE). Standard launch services will be provided for MIDEX missions at no charge against the PI-Managed Mission Cost. *Any launch services beyond the standard launch services offered must be funded out of the PI-Managed Mission Cost, with appropriate unencumbered reserves*.
- The Phase A concept study is capped at $1.25M FY 2019 dollars, with a duration of 9 months. (See Section 5.6.2)
- Required minimum unencumbered cost reserves percentage: (See Section 5.6.3)
  - Phases B/C/D cost is 25%
  - Phase E cost have no specified minimum but must be justified.
- The sun of external contributions from both U.S. and non-U.S. sources is not to exceed one-third (1/3) of the proposed PI- Managed Mission Cost. (See Section 5.6.7)

2019 MIDEX Phase A Mission Selections

19-HPMIDEX19-0003, “MUSE: Multi-slit Solar Explorer,”

Dr. Bart De Pontieu, Lockheed Martin Inc.

19-HPMIDEX19-0004, “STORM: Solar Terrestrial Observer for the Response of the Magnetosphere,”

Dr. David Sibeck, NASA Goddard Space Flight Center

19-HPMIDEX19-0005, “HelioSwarm: The Nature of Turbulence in Space Plasmas”,

Dr. Harlan Spence, Univ. of New Hampshire

19-HPMIDEX19-0008, “ARCS: Auroral Reconstruction CubeSwarm”,

Dr. Krystina Lynch, Dartmouth College

19-HPMIDEX19-0013, “Solaris: Revealing the Mysteries of the Sun’s Poles”,

Dr. Donald Hassler, Southwest Research Institute

MUSE MULTISLIT SOLAR EXPLORER

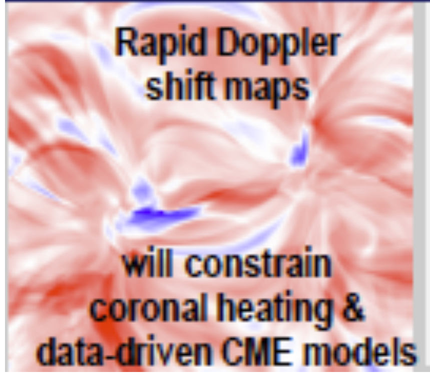
Revolutionary imaging spectroscopy to accomplish breakthrough physics of space weather & the corona

2019 HEP MIDEX

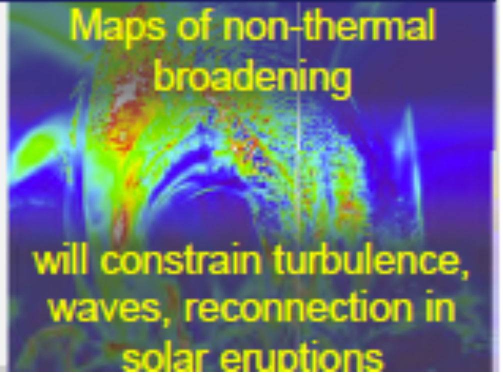
Goal: Understand mechanisms driving coronal heating & eruptions at the foundation of space weather

Science Objectives

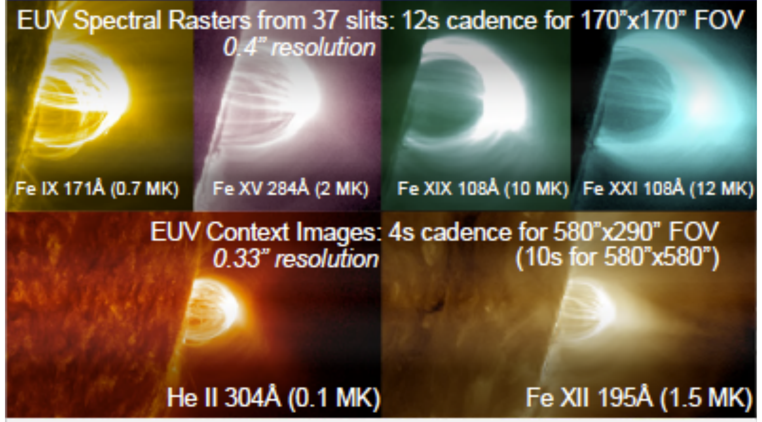
Science Objectives



1. Diagnose importance of coronal heating from braiding, wave dissipation, spicules
2. Constrain initiation mechanisms, role of reconnection, and impact on surrounding corona of flares & CMEs
3. Determine initial plasma conditions for data-driven models of flux-rope driven CMEs that impact space weather
4. Constrain models of fundamental physical plasma processes like particle acceleration, plasma instabilities, turbulence, and onset of fast reconnection



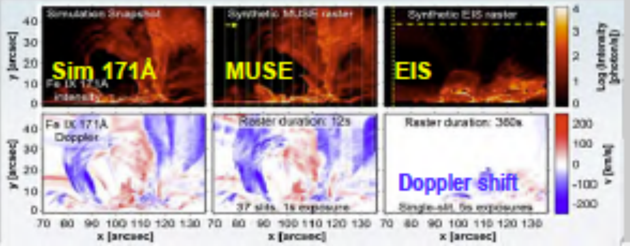
Observations at 20-100x data rate of other spectrographs



- Enabled by avg. data rate: 13.9 Mbit/s, 12 Ka-band passes/day (9 KSAT, 3 NEN); 20x (IRIS, EUVST) and >100x (SoLO) more data than other solar spectrographs

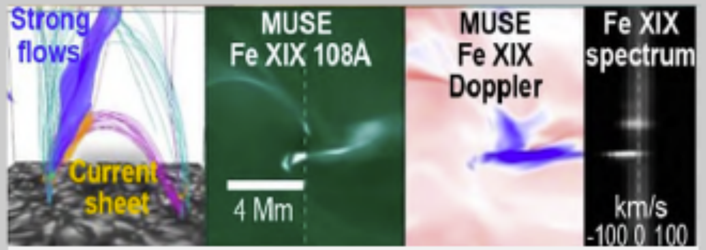
Science Breakthrough: ~10x higher resolution, 100x faster rasters, and state-of-the-art numerical models

3D radiative MHD model of solar flare/CME



- MUSE's 37 slits provide ***a 100x improvement in spectral raster cadence*** to:
  - Freeze plasma evolution in flares, CMEs, & corona for first time w/ spectrograph
  - **Reveal processes that remain invisible to current and planned instruments**

3D radiative MHD model of coronal heating



- Computational advances have led to new advanced numerical models (incl. data-driven flare/CME, left)
- **MUSE will break stalemate and directly validate/reject models through constraints on spatio-temporal scales where they make testable & distinguishable predictions**

STORM SOLAR-TERRESTRIAL OBSERVER FOR THE RESPONSE OF THE MAGNETOSPHERE FACT SHEET

2019 HEP MIDEX

GLOBALLY IMAGING THE SOLAR WIND-MAGNETOSPHERE INTERACTION

Principal Investigator: D.G. Sibeck Deputy PI: M.R. Collier

STORM OBSERVES DYNAMIC PLASMA ENVIRONMENTS TO DEFINE THE BIG PICTURE OF THE SOLAR WIND-MAGNETOSPHERE INTERACTION.

STORM is the first stand-alone mission to observe the big picture of Space Weather. STORM takes simultaneous solar wind measurements and global images to quantify the magnetospheric response including the magnetopause, auroral oval, and ring current dynamics. STORM makes continuous observations on all relevant Space Weather time-scales.

STORM MISSION OVERVIEW

QUANTIFYING THE GLOBAL CIRCULATION OF THE ENERGY THAT POWERS SPACE WEATHER

STORM SCIENCE - OBSERVING FROM ABOVE AND BELOW

DETERMINE THE GLOBAL DRIVERS OF THE SOLAR WIND-MAGNETOSPHERE INTERACTION MODES VIA MULTI-SPECTRAL AND NEUTRAL ATOM IMAGING WITH IN-SITU MONITORING OF THE SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD.

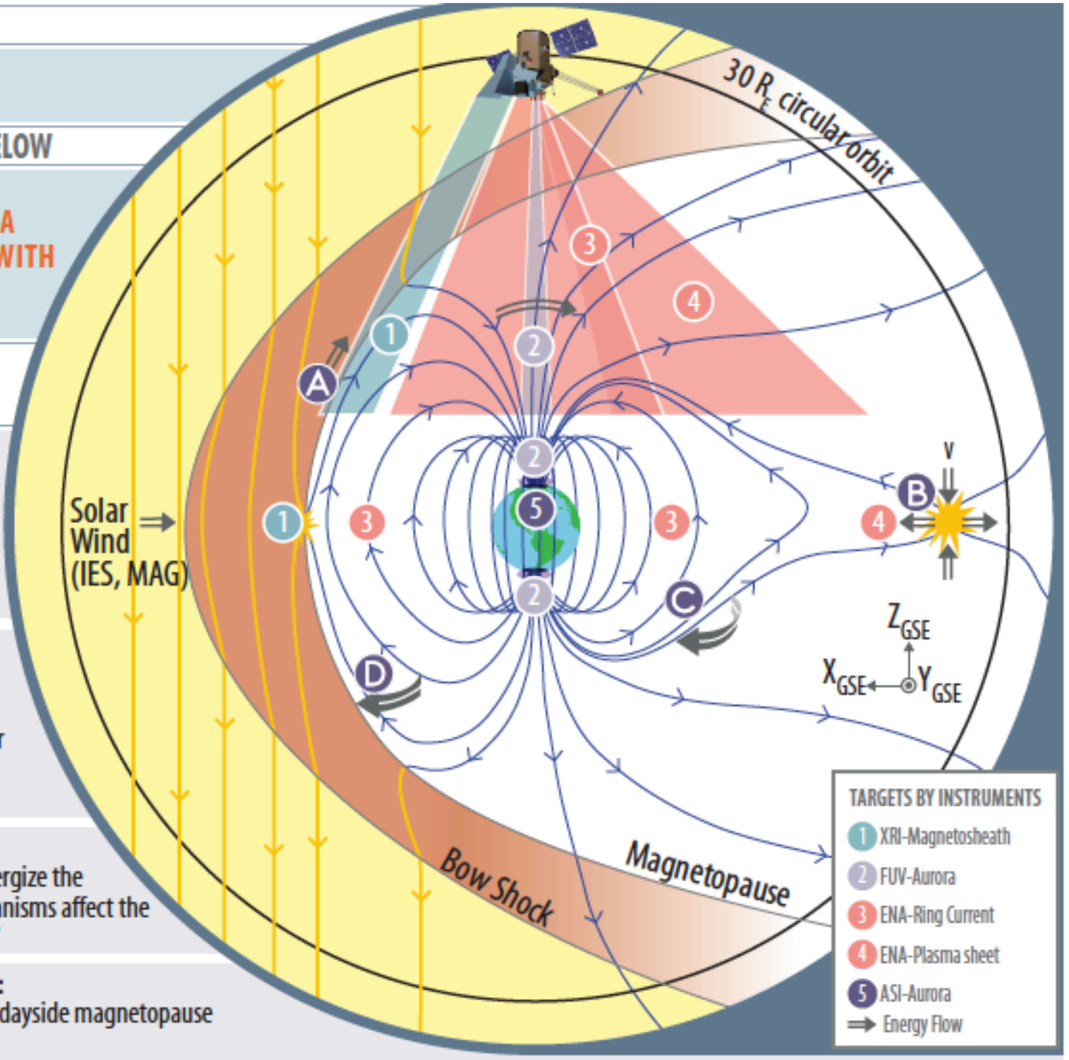
STORM'S SCIENCE OBJECTIVES ANSWERS KEY HELIOPHYSICS QUESTIONS

A **Energy transfer at the Dayside Magnetopause:** How does global magnetopause reconnection control the flow of solar wind energy into the magnetosphere? What are the spatial and temporal properties of this interaction as a function of solar wind conditions?

B **Energy Circulation and Transfer Through the Magnetotail:** How does magnetotail reconnection regulate the circulation of energy from the dayside, through the magnetotail and into the inner magnetosphere. What controls the occurrence and significance of differing reconnection modes?

C **Energy Sources and Sinks for the Ring Current:** How efficiently do magnetotail response modes energize the ring current ions? How do transport and loss mechanisms affect the subsequent evolution of the energized ring current?

D **Energy feedback from the inner magnetosphere:** How does the ring current affect the location of the dayside magnetopause and the occurrence of reconnection in the tail?



- STORM science determines the coupling of Earth's magnetosphere and ionosphere to solar inputs and characterize fundamental processes within the heliosphere.
- STORM addresses the fundamental mysteries of global reconnection and particle acceleration and determines how the magnetosphere and ionosphere respond to external forcing.

INSTRUMENTS					
	Name	Provider	TRL	Key Function	Heritage
Imagers	XRI	GSFC	6	Image magnetopause	DXL, DXL2, CuPID (2020)
	FUV	UCB	6	Image auroral oval	IMAGE FUV
	ENA	JHUAPL	6	Image ring current	JUICE JENI (2022) IMAGE ENA
In Situ	MAG	GSFC	9	Measure IMF input to magnetosphere	Wind MFI, Van Allen Probes MAG
	IES	SWRI	6	Measure SW plasma input to magnetosphere	Rosetta
Ground-Based	ASI	JHUAPL	9	Image nightside auroral oval	Gakona, Fairbanks
Contributed	LAICA	Rikkyo Univ	6	Image outer exosphere	PROCYON

STORM conducts end-to-end system science by imaging the global magnetopause (XRI), auroral oval (FUV), and ring current (ENA) responses together with in situ measurements of the solar wind (IES) and interplanetary magnetic field (MAG). A dedicated array of all sky imagers (ASI) observes the auroral microstructures in the red and green lines related to substorms. A contributed instrument observes the exosphere (LAICA, Japan) in Lyman α to improve ENA and XRI analysis.

HelioSwarm transforms our understanding of the physics of space plasma turbulence. The solar wind is the only laboratory for probing the universal turbulence processes that cascade energy from larger to ever smaller spatial scales, ultimately heating cosmic plasmas.

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Science

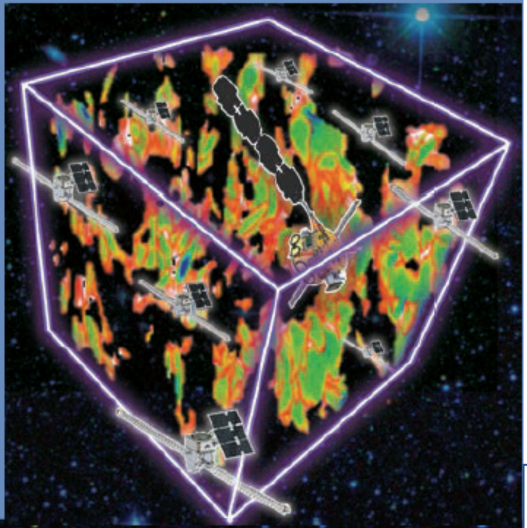
HelioSwarm science is tightly aligned with NAS 2013 Heliophysics Decadal Survey and NASA SMD Priorities: Turbulence identified as a Decadal Science Goal ("Understand the origins and effects of turbulence") and a Decadal Imperative ("Implement . . . a multispacecraft mission to address cross-scale plasma physics")

Goal #1: Reveal the 3D spatial structure and dynamics of turbulence in a weakly collisional plasma.

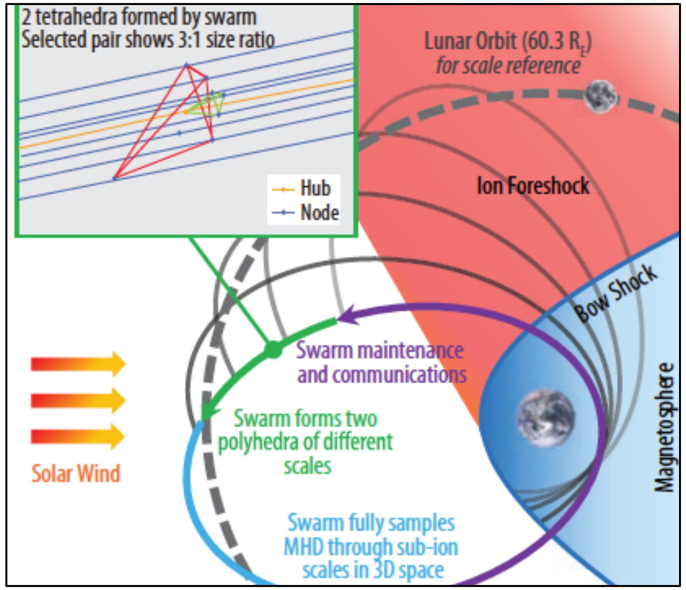
- O1: Reveal how turbulent energy is transferred in most probable,undisturbed solar wind plasma and distributed as a function of scale and time.
- O2: Reveal how turbulent cascade of energy varies with background magnetic field and plasma parameters in different environments.
- O3: Quantify transfer of turbulent energy between fields, flows, and protons.
- O4: Identify thermodynamic impacts of intermittent structures on proton distributions.

Goal #2: Ascertain the mutual impact of turbulence near boundaries and large-scale structures.

- O1: Determine how solar wind turbulence affects and is affected by large-scale structures.
- O2: Determine how strongly driven turbulence in the foreshock, magnetosheath, and magnetosphere differs from that in the undisturbed solar wind.



HelioSwarm's first-ever simultaneous multipoint, multiscale measurements disentangle spatial and temporal variations in solar wind plasmas that connect MHD scale turbulence with sub-ion scale heating.



Science Instruments

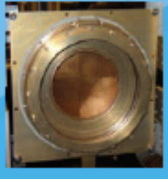
High-TRL, high-heritage instrument suite optimized for solar wind turbulence measurements.

HUB & NODE

Fluxgate Magnetometer (FGM)
- Vector DC magnetic fields
- Solar Orbiter post-environmental heritage and JUICE design heritage

Search Coil Magnetometer (SCM)
- Vector AC magnetic fields
- JUICE design heritage

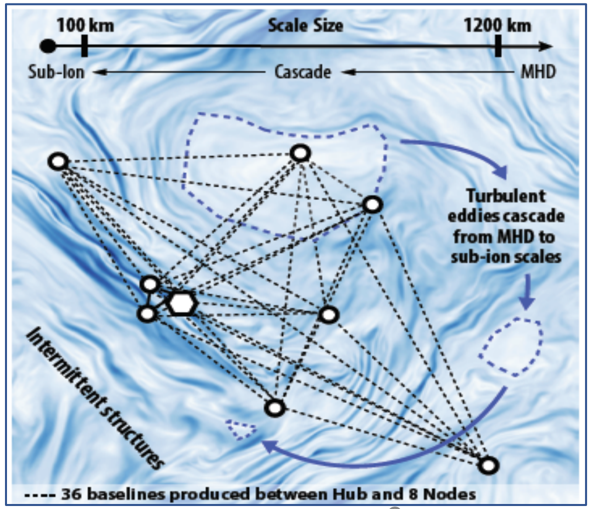
Faraday Cup (FC)
- Solar wind plasma density and velocity
- Parker Solar Probe, WIND, DSCOVR flight heritage



HUB ONLY

Ion Electrostatic Analyzer (iESA)
- Ion velocity distributions
- Solar Orbiter post-environmental heritage and MAVEN flight heritage

SW turbulence as rendered by stronger (blue) and weaker (white) magnetic field strength, revealing eddies and intermittent structures. HelioSwarm characterizes the fragmentation of solar wind eddies and measures the turbulence structures in 3D and in time that lead to plasma heating.

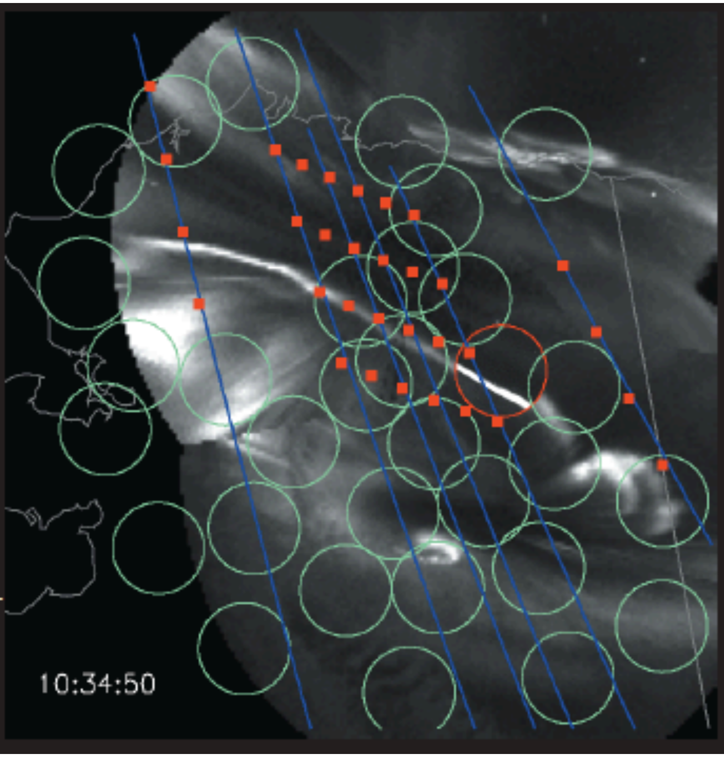


AURORAL RECONSTRUCTION CUBESWARM

ARCS — Connecting the Dots: A distributed high-fidelity map for decoding the auroral ionosphere

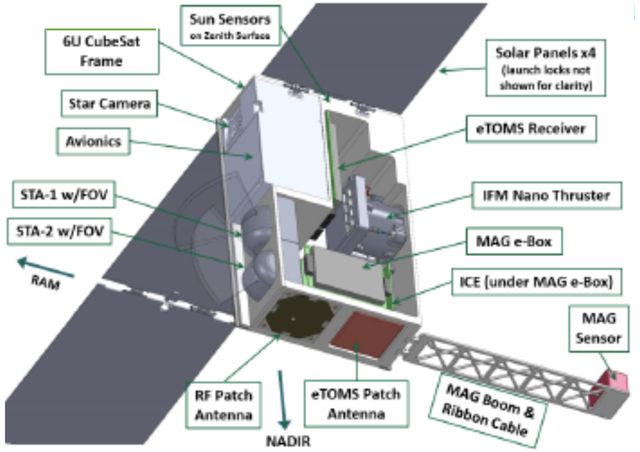
2019 HEP MIDEX

ARCS addresses Key NASA Goals by exploring auroral processes at mesoscales. These scales have consequences, not only for the ionosphere-thermosphere (IT) system but significantly for the global dynamics of the entire magnetosphere. ARCS directly aligns with NASA Strategic Goals and Objectives and with NASA SMD's strategic objectives to explore processes in the space environment active throughout the solar system and the universe. Specifically, ARCS's focus is to fill key knowledge gaps of "how the IT system responds to, and regulates magnetospheric forcing over... regional and local scales" (AIMI-1).



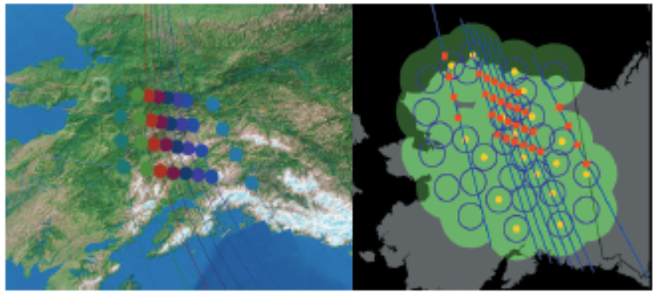
ARCS Science Objectives:

- **SO-1**: Map the 2D mesoscale structure and temporal evolution of plasma flows and currents in the auroral ionosphere.
- **SO-2**: Determine how these 2D maps of plasma flows and currents self-consistently evolve in conjunction with auroral ionospheric density responses
- **SO-3**: Determine the roles of the physical mechanisms regulating the relationships between the flows, currents, auroral forms and precipitation in the auroral ionospheric system.



The ARCS swarm produces low-resource observations for system science enabling progress toward the "Diversified and Distributed Sensor Deployment Strategy" envisioned in the NAS Decadal Appendix C.

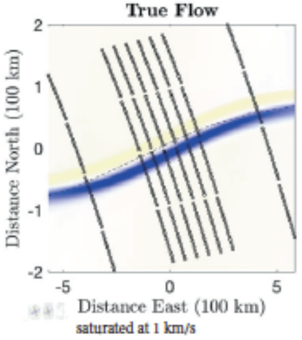
ARCS CUBESWARM OVER ALASKA



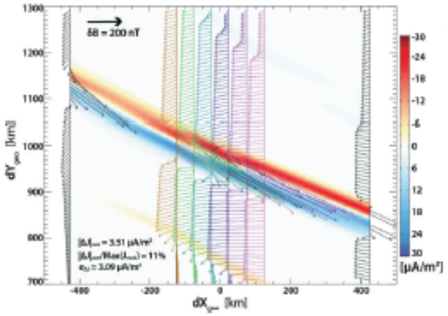
Orbit: 32 satellites in 8-planes with repeat Ground Tracks Over Alaska (GBO Sites) at 10 UT (2230 MLT). Orbit is sun-sync at 561km altitude and 97° inclination.

32 GBO sites
Full FOV 120° (green)
<E> & Q inversion FOV 80° (plum)
eTOMS transmitters (gold)
Swarm (red)

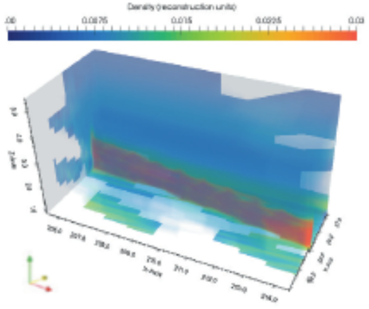
Plasma Flow (STA)



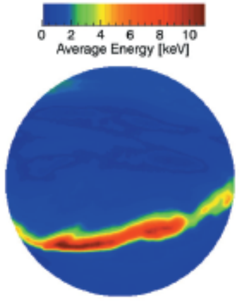
Field Aligned Currents (MAG)



Electron Density (eTOMS)



Precipitation Energy (GBO)



The ARCS MISSION GOAL: decode the aurora by exploring the relationship between the visible aurora and distributed currents and flow fields, to unlock critical physics of the auroral ionosphere at mesoscales.

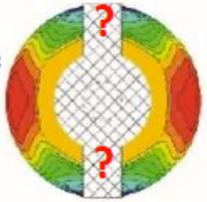
SOLARIS — Revealing the Mysteries of the Sun's Poles

2019 HEP MIDEX

Science Goals

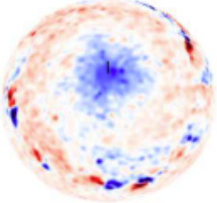
Solaris transforms our understanding of the solar activity cycle and the global heliosphere through direct imaging of the solar poles and the ecliptic-plane corona viewed at all longitudes simultaneously. *Solaris* has three primary science goals (FO1):

1) To understand how polar magnetic fields and flows shape the solar activity cycle

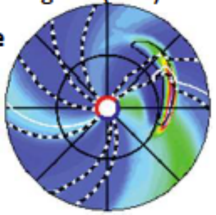


Sub-surface flows: ecliptic view

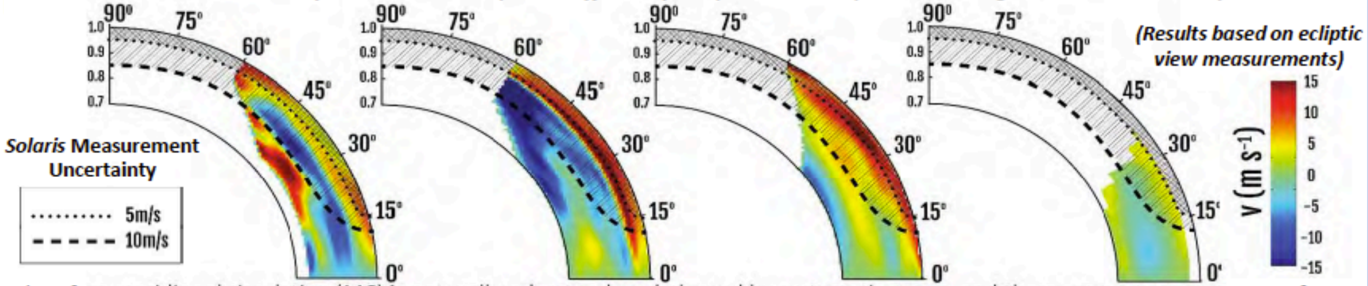
2) To determine how high-latitude coronal magnetic fields connect the Sun and Heliosphere


Model magnetic flux: polar view

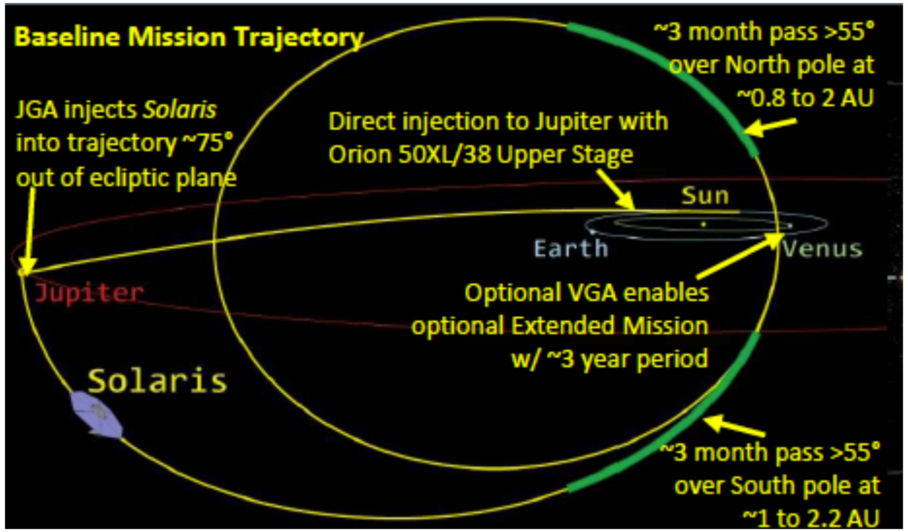
3) To determine the role of transient dynamics in structuring the solar wind

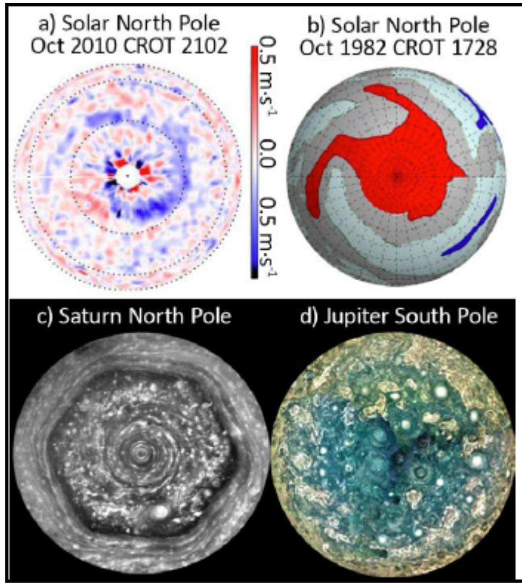

Model CME/solar wind: polar view

Solaris Measurement Depths – *Solaris will probe sufficiently deep at the solar poles to distinguish between solar dynamo models*



Subsurface meridional circulation (MC) is not well-understood, and plagued by systematic errors, and there are no measurements of its high-latitude structures; current results differ depending on techniques used and/or temporal evolution (left to right: Zhao et al. 2013; Jackiewicz et al. 2015; Rajaguru & Antia 2015; Lin & Chou 2018). ***SOLARIS will obtain MC measurements at high latitudes with noise levels < 5 m/s (10 m/s) to a depth of 0.05 R$_\odot$ (0.15 R$_\odot$) from the solar surface as shown by dotted (dashed) lines.***

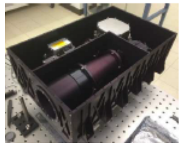




The polar view offers unprecedented opportunities for discovery. (a) Ring-diagram analysis of near-surface flow anomalies and (b) ecliptic observations of high-latitude large-scale magnetic features hint at what to expect, but recent images from planetary missions, including (c) Cassini (NASA JPL) and (d) Juno suggest Solaris will reveal far more complex structure.

A CDM (Compact Doppler Magnetograph)

Derived from GONG, opto-mech. subsystem modified & engineered for *Solaris* in a very compact package, with a build-to-print camera from Solar Orbiter/PHI. Performance and environmental testing (to TRL 6) of flight-like prototype (see photo) to be completed by end of Phase A.

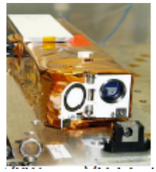


B S-COR (Coronagraph)

S-COR (Coronagraph) - High heritage, build-to-print opto-mechanical subsystem from GOES/CCOR and camera from Solar Orbiter/PHI.

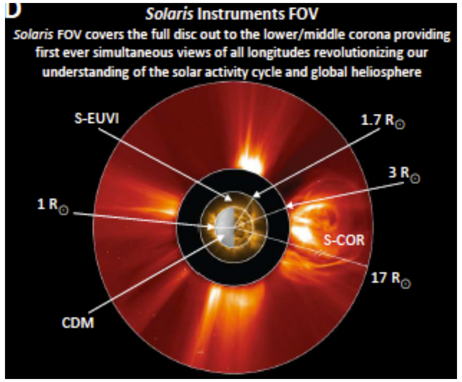
C S-EUVI (Extreme Ultraviolet Imager)

S-EUVI (Extreme Ultraviolet Imager) - High heritage, build-to-print opto-mechanical subsystem from PROBA-2/SWAP and camera from Solar Orbiter/EUI.



D *Solaris* Instruments FOV

Solaris FOV covers the full disc out to the lower/middle corona providing first ever simultaneous views of all longitudes revolutionizing our understanding of the solar activity cycle and global heliosphere



Guidelines for Websites and Social Media

If you choose to create new websites or new social media campaigns, web features on existing websites, about your mission concept, please follow these guidelines:

1. NASA-provided Phase-A funding should not be used to create or manage such activities without the prior approval of the appropriate SMD Division Director.
2. The NASA name and emblems should not appear on social media accounts or website banners. So if your mission name is Next Great Mission, NGM, then your website shouldn't be named NASA-NGM.edu nor should your official Twitter account be @NASA_NGM; NextGreatMission.edu or @NextGreatMsn are both fine, though.
3. Websites and social media campaigns cannot be lobbying efforts aimed at affecting the Step-2 down-selection.
4. All content must accurately portray the status of the mission concept with regards to overall selection process. So, don't describe your investigation as a "NASA mission" until after the down-selection. A Phase A selection is for a "Concept Study" of a particular investigation.

Consistent with the language of the Announcement of Opportunity, press releases and web articles should be coordinated with NASA HPD Communications.

Evaluation and Debrief

- Individual debriefs provided tomorrow
  - Important information for Phase A work
  - Minor weaknesses are not considered in Step 1 evaluation poll
  - Minor weaknesses *will be* considered in CSR evaluation poll
- The following presentation is a statement on NASA debrief policy
  - Improve efficiency in the discussion tomorrow
  - Describe Step 1 Evaluation Process
  - Outline the Step 2 (CSR) Evaluation Process

Debriefing Policy (NASA FAR Supplement 1872.504)

(c) Unsuccessful proposers shall be offered in their non-selection letter an oral debriefing on the evaluation and subsequent decision about their proposal. It is a good practice to offer debriefings also to successful proposers as the evaluations contain feedback that will be valuable in the implementation of the investigation.

1) The primary purposes of the debriefing are to convey to the proposers the rationales for the decisions on their proposals and to demonstrate that the evaluation and selection processes were thorough, expert, and fair.
2) A specific and sufficient time limit shall be set in advance for each debriefing.
3) The Division Program AL (Acquisition Lead) is responsible for conducting the debriefings. It is a good practice to have the Technical, Management, and Cost (TMC) Acquisition Manager (AM) in attendance to provide any clarifications required concerning the TMC reviews. Other NASA personnel who do not have any conflicts of interest, who can contribute materially to the debriefing can be invited by the Division Program AL to participate. Other observers, except the Directorate AL, are not permitted.

Debriefing Policy (cont'd)

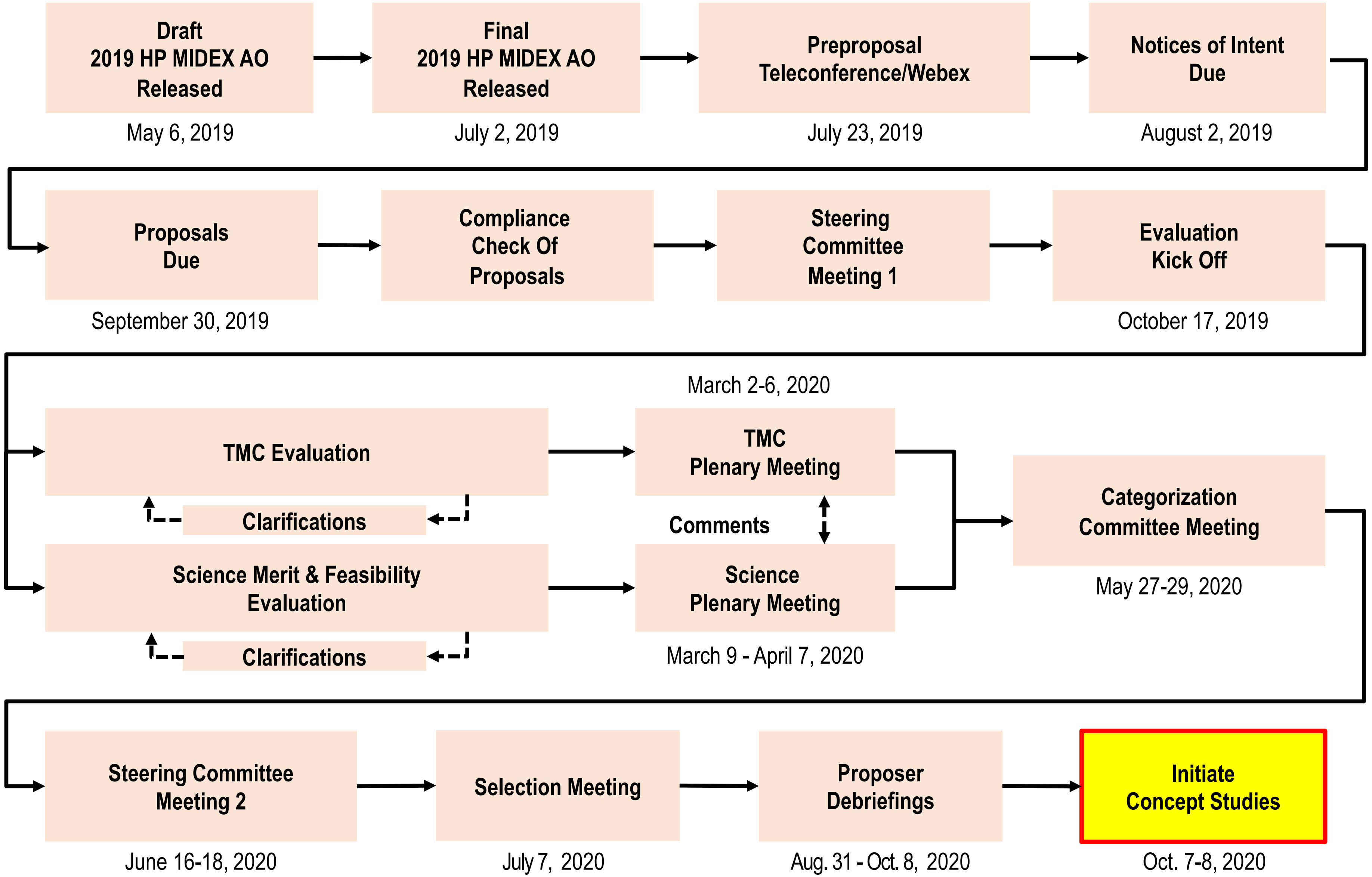
4. The Division Program AL may prepare written debriefing materials for the debriefing. Such written debriefing materials will include (i) a brief description of the evaluation (assessment, categorization, validation, accommodation (if applicable)) and selection process with sufficient detail to convey that all proposals received a fair and competent review; (ii) the key findings from all evaluation forms that were used as the basis for the selection or non-selection decision, and (iii) the signed selection statement. Properties of other proposals or outcomes of their reviews shall not be briefed or discussed.
5. A limit shall be set to the number of attendees from the proposal team.
6. Other than a record of attendees, written records shall not be kept by NASA of the debriefing. The written debriefing materials are the notes for the debriefing, and the debriefing content shall follow closely these written materials. Materials provided to attendees shall be provided in advance (e.g., via NSPIRES, two days or more before the meeting).
7. No recording shall be permitted. For telecon debriefings, a good practice is for the proposer to provide the dial-in line and access to it so the proposer is responsible for its security.
8. Whether or not other written debriefing materials are provided, a hardcopy or electronic copy of the Selection Official's selection statement shall be given to the proposal Principal Investigator.
9. Care shall be taken that all debriefings share the same structure and corresponding information for all proposals.

Debriefing Ground Rules

2019 HEP MIDEX

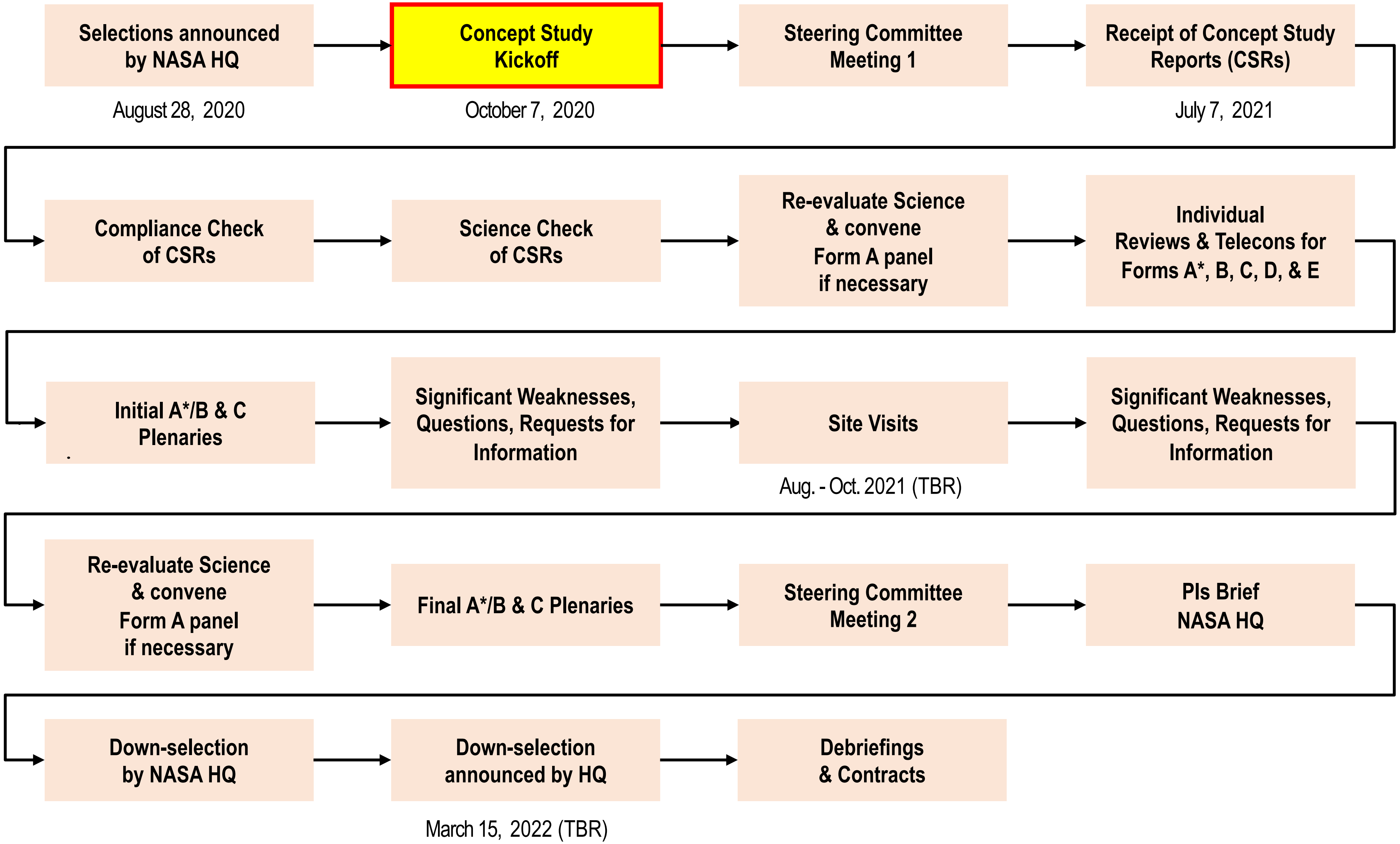
1. This debriefing is a service to the proposing teams and is intended to provide constructive feedback regarding the findings of the evaluation process. Please do not attempt to debate these findings; the evaluation is complete.
2. The debriefing can *only* cover what the Evaluation process found with respect to *your* proposal. Details of the Categorization and Selection will *not* be discussed.
3. NASA will not comment about the results of the evaluation process of other proposals.
4. Questions may be asked at any time, however, the debriefing period is limited, therefore, to assure that all findings are covered, all will need to be disciplined about our pace of progress.
5. This is the sole debriefing that your team will be given. Only in rare cases will questions be answered, or actions be completed at any later time.
6. NASA will provide the findings and summary rationale for the Science Merit and the Science Implementation Merit, and the Technical, Management, and Cost (TMC) Risk rating for your proposal. The TMC risk rating will be provided in writing. It is NASA's intention that debriefings (except for findings) be identical for all proposal teams in all respects to the extent possible.
7. These are the findings of *many* people, not of any one individual; approximately 50 people were involved in producing the findings that will be related to you.
8. This debriefing may not be recorded.

Evaluation and Selection Overview



What Follows Selection?

2019 HEP MIDEX



* If required due to change in Science. If not required, use Forms A from Step1

Investigation Evaluation Criteria (HPMIDEX19 AO § 7.2)

- **Scientific Merit (~40%)**
  - Compelling nature and scientific priority of the proposed investigation's science goals & objectives
  - Programmatic value of the proposed investigation
  - Likelihood of scientific success
  - Scientific value of the Threshold Science Mission
- **Scientific Implementation Merit and Feasibility (~30%)**
  - Merit of the instruments and mission design for addressing the science goals and objectives
  - Probability of technical success
  - Merit of the data analysis, data availability, data archiving plan, and/or sample analysis plan
  - Science resiliency
  - Probability of science team success
- **Technical, Management, and Cost (TMC) Feasibility (~30%)**
  - Adequacy and robustness of the instrument implementation plan
  - Adequacy and robustness of the mission design and plan for mission operations
  - Adequacy and robustness of the flight systems
  - Adequacy and robustness of the management approach and schedule, including the capability of the management team
  - Adequacy and robustness of the cost plan, including cost feasibility and cost risk

Science Panel Composition and Organization

- The HEP Program Scientist (PS) leads the Science Panel
- Science Panel evaluators are typically, but not exclusively, recruited from the academic, governmental, and industrial research communities.
- The approach to evaluator identification will be reviewed by an SMD Steering Committee convened by the Deputy Associate Administrator for Research (DAAR)
- The Science Panel evaluates **Scientific Merit of the Proposed Investigation** (7.2.2) and **Scientific Implementation Merit and Feasibility of the Proposed Investigation** (7.2.3).
- The science evaluation will be conducted via a single Science Panel, and sub-panels may be employed, depending on the number and variety of proposed investigations.
  - Any sub-panel will be led by a NASA Civil Servant (CS) and may be co-chaired by a member from the scientific community.
  - Sub-panels may have an Executive Secretary.
- Each proposal will be reviewed by assigned panel members.
  - The Lead Reviewer for each proposal will lead the discussion. At least two secondary (supporting) reviewers will be assigned to each proposal.
  - At the request of the Lead Reviewer, a Supporting Reviewer will take notes on the discussion.
- The TMC Panel may provide comments and questions to the Science Panel, and vice versa.
- The Science Panels will request Scientific Merit (Form A) and/or Scientific Implementation Merit and Feasibility (Form B) clarifications from proposers on Potential Major Weaknesses (PMWs) identified during the evaluation process.

TMC Panel Composition and Organization

- The Acquisition Manager, who is a Civil Servant in the NASA Science Office for Mission Assessments (SOMA) at NASA Langley Research Center (LaRC), leads the TMC Panel.
  - NASA SOMA works directly for NASA Headquarters and is firewalled from the rest of NASA LaRC.
- TMC Panel evaluators are a mix of the best non-conflicted contractors, consultants, and CSs who are experts in their respective fields.
  - Evaluators read their assigned proposals.
  - Evaluators provide findings on their assigned proposals.
  - Evaluators provide ratings of proposals that reflect findings.
- Additionally, specialist evaluators may be called upon in cases where technical expertise that is not represented on the panel is needed.
  - Specialist Evaluators evaluate only those parts of a proposal that are specific to their particular expertise.
  - Specialist Evaluators provide only findings; they do <u>not</u> provide ratings.

Conflicts of Interest (COI) Prevention Requirements

- The NRESS contractor will cross-check all the Science Panel members against the lists of personnel and organizations identified in each proposal submitted to determine whether any organizational COI exists.
- Cornell Technical Services (CTS) will cross-check all contracted TMC Panel members against the lists of personnel and organizations identified in each proposal submitted to determine whether any organizational COI exists.
- Additionally, all contracted evaluators must divulge any other financial, professional, or potential personal conflicts of interest, and whether they work for a profit-making company that directly competes with any profit-making proposing organization.
- All CS and Intergovernmental Personnel Act (IPA) Assignee evaluators will self-certify their COI status by reviewing a combined listing of individuals and organizations associated with the MIDEX proposals.
- The Science evaluators must notify the HEP PS, Dr. Dan Moses, in case of a potential conflict that arises during the evaluation. The TMC evaluators must notify the NASA SOMA Acquisition Manager, James Florance, in case there is a potential conflict that arises during the evaluation.
- All known conflict of interest issues are documented, and a COI Mitigation Plan is developed to minimize the likelihood that an issue will arise in the evaluation process. Any potential COI issue is discussed with the HEP PS and the SMD DAAR and documented in the COI Mitigation Plan. All determinations regarding possible COIs that arise will be logged as an appendix to the COI Mitigation Plan.
- If any previously unknown potential conflict of interest arises during the evaluation, the conflicted member(s) will be notified to stop evaluating proposals immediately, and the Panel Chair will be notified immediately. If a COI is confirmed, the conflicted member(s) will be immediately removed from the evaluation process, and steps will be taken expeditiously, to remove, mitigate, or accept any actual or potential bias imposed by the conflicted member(s). The steps will be documented in the COI Mitigation Plan.
- Members of the Science and TMC panels are prohibited from contacting anyone outside their panel for scientific/technical input, or consultation, without the prior approval of the HEP PS.

Proprietary Data Protection

- All proposal and evaluation materials are considered proprietary.
- Viewing of proposal materials will be only on a need-to-know basis.
- Each non-CS or non-IPA evaluator will sign a Non-Disclosure Agreement (NDA) that must be on file at NRESS prior to any proposals being distributed to that evaluator.
  - CS and IPA evaluators are under statutory obligations.
- The proposal materials that each evaluator has access to is documented.
- Evaluators are not permitted to discuss proposals with anyone outside their Science or TMC Panel.
- All proprietary information that must be exchanged between evaluators will be exchanged via the secure NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES), via the secure Remote Evaluation System (RES), via the secure NASA Large File Transfer (LFT) system, via secure Webex, via NASA Google docs or via encrypted email, parcel post, fax, or regular mail.
- Teleconferences among Panel evaluators will be conducted via controlled teleconference lines.
- Evaluators' electronic and paper evaluation materials will be deleted/destroyed when the evaluation process is complete. Archival copies will be maintained in the NASA SOMA vault.

Finding Definitions

Science

Major Strength: An aspect of the proposal response that is judged to be of superior merit and can substantially contribute to the ability of the project to meet its scientific objectives.

Minor Strength: An aspect of the proposal that is judged to contribute to the ability of the project to meet its scientific objectives.

Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its scientific objectives.

Minor Weakness: A deficiency or set of deficiencies taken together that are judged to weaken the project's ability to meet its scientific objectives.

Note: Factors for which the proposal's discussion is considered as expected for a mission concept at this stage of maturity will be documented as "As Expected" on Forms A and B.

TMC

Major Strength: A facet of the implementation response that is judged to be well above expectations and can substantially contribute to the ability of the project to meet its technical requirements on schedule and within cost.

Minor Strength: A strength that is worthy of note and can be brought to the attention of Proposers during debriefings but *is not a discriminator in the assessment of risk*.

Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its technical objectives on schedule and within cost.

Minor Weakness: A weakness that is sufficiently worrisome to note and can be brought to the attention of Proposers during debriefings but *is not a discriminator in the assessment of risk*.

Note: Findings that are considered "as expected" are not documented in the Form C.

TMC Evaluation Product: Risk Ratings

Based on the narrative findings, each proposal will be assigned one of three risk ratings, defined as follows:

- **Low Risk:** There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation well within available resources.

- **Medium Risk:** Problems have been identified but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Mission design may be complex and resources tight.

- **High Risk:** One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

Note: Only Major Findings are considered in the risk rating.

Cost Threat Matrix

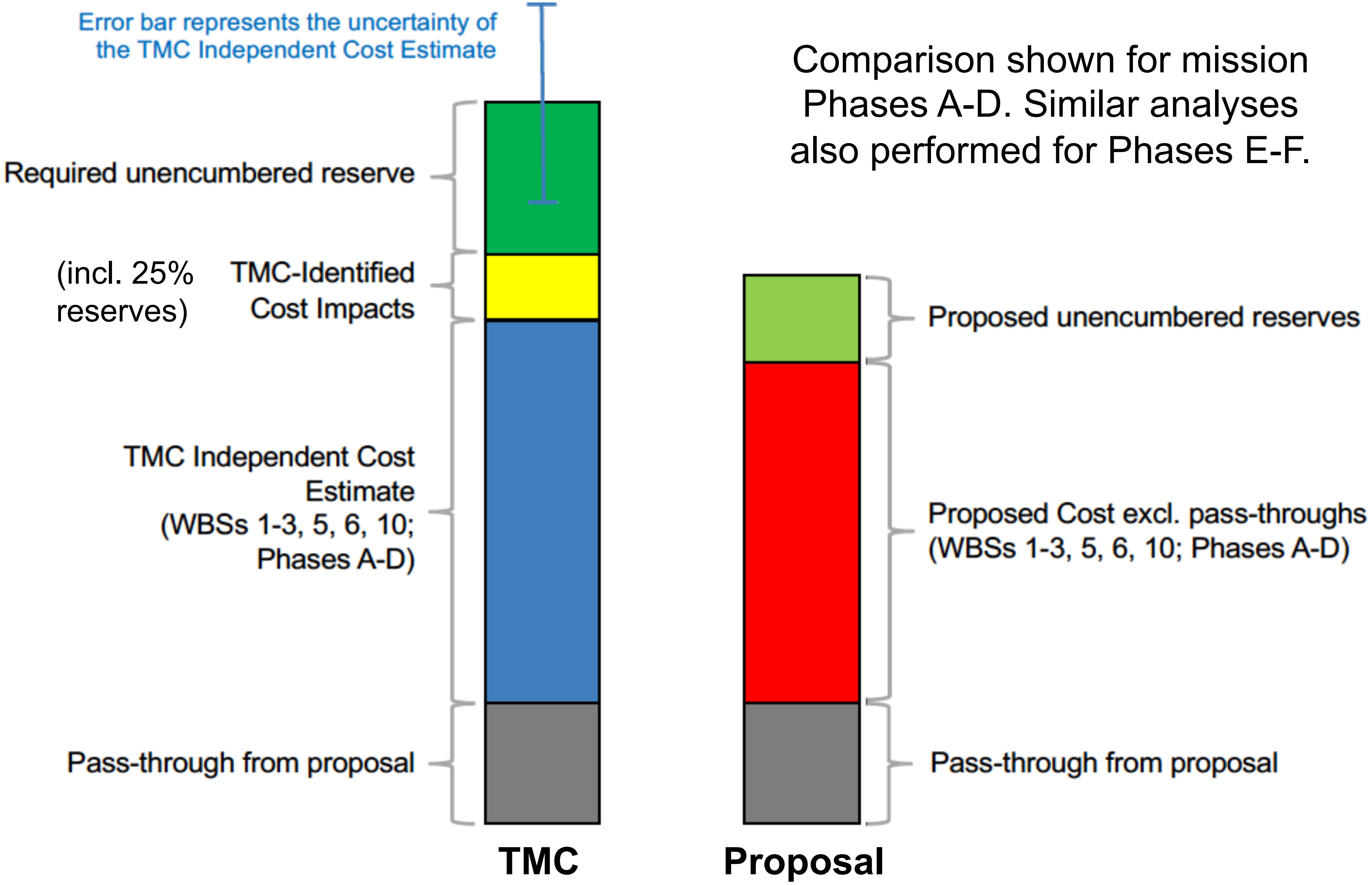
2019 HEP MIDEX

- The *likelihood* and *cost impact*, if any, of each weakness is stated as “This finding represents a cost threat assessed to have an Unlikely/Possible/Likely/Very Likely/Almost Certain likelihood of a Minimal/Limited/Moderate/Significant/Very Significant cost impact being realized during development and/or operations, which results in a reduction from the proposed unencumbered reserves.”
  - The *likelihood* is the probability range that the *cost impact* will materialize.
  - The *cost impact* is the best estimate of the range of costs to mitigate the threat.
- The cost threat matrix below defines the adjectives used to describe the *likelihood* and *cost impact.*
- The minimum cost threat threshold is $1M.

			Cost Impact (CI) % of PI-Managed Mission Cost to complete Phases B/C/D or % of Phase E not including unencumbered cost reserves or contributions					
	Likelihood of Occurrence	**Weakness**	**Very Minimal** 0.5% < CI ≤ 2.5% ($0M < CI ≤ $0M) 1% < CI ≤ 2.5% ($0M < CI ≤ $0M)	**Minimal** 2.5% < CI ≤ 5% ($0M < CI ≤ $0M) 2.5% < CI ≤ 5% ($0M < CI ≤ $0M)	**Limited** 5% < CI ≤ 10% ($0M < CI ≤ $0M) 5% < CI ≤ 10% ($0M < CI ≤ $0M)	**Moderate** 10% < CI ≤ 15% ($0M < CI ≤ $0M) 10% < CI ≤ 15% ($0M < CI ≤ $0M)	**Significant** 15% < CI ≤ 20% ($0M < CI ≤ $0M) 15% < CI ≤ 20% ($0M < CI ≤ $0M)	**Very Significant** CI > 20% (CI > $0M) CI > 20% (CI > $0M)
Likelihood (L, %)	Almost Certain (L > 80%)							
	Very Likely (60% < L ≤ 80%)							
	Likely (40% < L ≤ 60%)							
	Possible (20% < L ≤ 40%)							
	Unlikely (L ≤ 20%)							

Note: For each proposal the percentages in the above table will be converted to dollars by the cost estimator.

TMC Evaluation Product: Cost Validation



Comparison shown for mission Phases A-D. Similar analyses also performed for Phases E-F.

Categorization (HPMIDEX19 AO § 7.1.2)

Subsequent to the evaluation process, NASA will convene a Categorization Committee, composed wholly of CS and IPA appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for SMD.

The Categorization Committee will consider the Scientific Merit, Scientific Implementation Merit and Feasibility, and TMC Feasibility of the Proposed Mission Implementation and, based on the evaluations, categorize the proposals in accordance with procedures required by NFS 1872.404. The categories are defined in NFS 1872.404(k) as follows:

Category I. Well-conceived, meritorious, and feasible investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and that data can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well-conceived, meritorious, and feasible investigations that are recommended for acceptance, but at a lower priority than Category I, whatever the reason.

Category III. Meritorious investigations that require further development. Category III investigations may be funded for further development and may be reconsidered at a later time for the same or other opportunities.

Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

For the HPMIDEX AO procurement, only Category I investigations were considered for selection. Materials for all investigations were included in the selection materials.

Selection Process (HPMIDEX AO § 7.1.3)

- Selection Official: Associate Administrator for the Science Mission Directorate or designee.
- The Selection Official may consult with senior members of SMD and the Agency concerning the selections.
- As part of the selection decision, a decision will be made as to whether or not any Category III proposals will receive funding for technology development.
- The results of the proposal evaluations based on the criteria and the categorizations will be considered in the selection process. Additional selection factors are described in AO § 7.3: In the 2019 MIDEX selections, the programmatic factors important for selection include available funding, maintaining a programmatic and scientific balance across SMD, and planning and policy considerations. Science balance and technological innovation were specific programmatic factors in the selection.

Backup Slides

Science Panel Procedures

- Each Science Panel member will review Proposals as directed by the Chair.
  - If special science expertise is required, the Science Panels may utilize non-panel/mail-in reviewers to assist with one or more proposals.
  - Non-panel/mail-in reviewers will evaluate only those parts of proposals pertinent to their scientific specialties.
- Each proposal may be discussed by the evaluators in teleconferences.
  - Findings in the form of Strengths and Weaknesses will provide the basis for initial panel discussions.
  - Each Evaluator will provide an individual evaluation prior to teleconferences.
  - The proposal and the evaluations by the individual evaluators, including non-panel evaluators, will be discussed during teleconferences.
  - Following the teleconferences, the Lead Evaluator captures/synthesizes individual evaluations, including discussion, and will generate the Draft Evaluation including draft findings.
  - The draft findings will include PMWs to be sent to the proposers for clarification.
  - No overall merit grade is assigned prior to receiving the responses to the PMW clarification requests.
- A Science Panel Meeting will be held upon completion of individual reviewer evaluations for all proposals.
  - The Science Panel will compile all of the findings for each proposal.
  - For each proposal, the Chair or designated Lead Reviewer will lead the discussion, summarize the proposed investigation, and document the results.
  - The PMWs clarifications provided by the PIs will be considered and the Science Panel will compose a panel summary review for each proposal.
  - Evaluations of all proposals are reviewed during the Science Panel Meeting to ensure that standards have been applied uniformly and in an appropriate and fair manner.
  - After the discussion, each member of the Panel or sub-panel assigns a merit rating for Scientific Merit (Form A) and for Scientific Implementation Merit and Feasibility (Form B) to each proposal. Non-panel reviewers do not assign ratings.

Form A and B Grade Definitions

- **Excellent:** A comprehensive, thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the AO as documented by numerous and/or significant strengths and having no major weaknesses.
- **Very Good:** A fully competent proposal of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
- **Good:** A competent proposal that represents a credible response to the AO, having neither significant strengths nor weaknesses and/or whose strengths and weaknesses essentially balance.
- **Fair:** A proposal that provides a nominal response to the AO but whose weaknesses outweigh any perceived strengths.
- **Poor:** A seriously flawed proposal having one or more major weaknesses (e.g., an inadequate or flawed plan of research or lack of focus on the objectives of the AO).

Note: Only Major Findings are considered in the adjectival rating.

Typical Science Panel Products (Forms A & B)

For each proposal, this process results in Form A and Form B, each of which includes

- Proposal title, PI name, and submitting organization;
- Proposal summary;
- Based on findings, adjectival median ratings for Scientific Merit of the Proposed Investigation (Form A) and for Scientific Implementation Merit and Feasibility of the Proposed Investigation (Form B), ranging from “Excellent” to “Poor”; half-grades (e.g. Very Good/Good) are permitted during polling, resulting in nine polling bins*;
  - If the median rating falls between two grades (e.g. Very Good and Very Good/Good), the median rating will be rounded in favor of the higher grade (e.g. rounded to Very Good)*;
- Polling distribution for each median rating*;
- Summary rationale for the median rating;
- Narrative findings, identified as major or minor strengths or weaknesses;
- Comments to PI, comments to NASA*, and comments to the TMC Panel*. (optional)

*Note: not provided to proposers

TMC Panel Product (Form C)

For each proposal, the TMC Evaluation will result in a Form C for that contains:

- Proposal title, PI name, and submitting organization;
- Based on the findings, an adjectival median risk rating for the TMC Feasibility of the Proposed Mission Implementation of "Low Risk", "Medium Risk" or "High Risk";
- Polling distribution for each median risk rating*;
- Summary rationale for the median risk rating;
- Narrative findings, identified as major or minor strengths or weaknesses;
- Comments to the Proposers, comments to the Selection Official*, and comments to the Science Panel*.

**Note: not provided to proposers*

Mission Category and Payload Risk Classification: AO Section 5.2.8

- MIDEX missions selected from this AO have been determined to be Category 2 missions (per NPR 7120.5E) with Class C payloads (per NPR 8705.4, at the deployed investigation level). Proposers must incorporate appropriate work effort and support in their proposals accordingly.
- Q&A – 19: **Given that the payload Class C (per NPR 8705.4) designation for MIDEX investigations, if an investigation involves more than one observatory, does each observatory need to be Class C?**

  No, the designation applies at the deployed investigation level. This is in-line with the NPR 8705.4 allowance for lower Class designations for sub-elements:

  Any equipment that constitutes a payload, or part of a payload, may be separately classified. For example, a Class A satellite may incorporate multiple instruments individually classified A through D.

  Note that proposers of constellations are highly encouraged to provide reliability assessments demonstrating the probability of meeting the mission lifetime requirements for both the Baseline and Threshold Science Missions. Also, particular attention should be paid to the possibility of systemic issues arising in the design of lower-Class observatories.
- NPR 8705.4 does not provide a quantitative reliability requirement for each Risk Class, so NASA will be relying on the evaluators to determine if a constellation of observatories meets the Class C designation.
- Q-19 answer encourages providing reliability assessments and noting potential systemic issues that are not required in the AO, no stand-alone weaknesses will be given for not providing reliability assessments or potential systemic issues. However, strengths and weaknesses can be given on the quality of the reliability assessments or systemic issue discussions provided.