Defining Potential HEOMD Instruments for Mars 2020

A Work in Progress...

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HEOMD: Some Context

- HEOMD needs to address gaps in knowledge that will inform human mission and system design.

- These Strategic Knowledge Gaps (SKGs) are the basis for HEOMD’s investment strategy.

- The Advanced Exploration Systems (AES) Division identifies, prioritizes, and addresses SKGs.
  - Science-focused missions provide measurement opportunities to fill SKGs

- The AES Program will develop the HEOMD-contributed instruments or technology demonstrations for Mars 2020.

- HEOMD’s contribution may leverage investments by the Space Technology Program.
Objectives

◆ Collaborate across Mission Directorates on Mars 2020 mission to achieve science, human exploration, and technology objectives (Agency goal).

◆ Identify dual purpose science and exploration measurements.

◆ Define potential instruments or technology demonstrations that HEOMD could contribute to the Mars 2020 mission to fill high priority Strategic Knowledge Gaps.
Process for Defining Potential HEOMD Instruments

- Use team of subject matter experts to review results of MEPAG (P-SAG) and MPPG studies on Mars Strategic Knowledge Gaps (SKGs)

- Identify high priority SKGs that will not be addressed by current or planned Mars missions.

- Identify dual purpose science and exploration measurements.

- Define notional instrument concepts or technology demonstrations to address the highest priority remaining SKGs. (Feb. 15)

- Assess capability of Mars 2020 mission to accommodate HEOMD instrument concepts (mass, volume, power, data, etc.) (Mar. 15)

- Develop cost and schedule estimates for each instrument concept through the FY14 Advanced Exploration Systems (AES) Program budget process. (Apr. 19)

- Down select concepts, and obtain approval from senior management to proceed with development. (May 10)

- Formulate an acquisition strategy for instrument development (in-house competed (or directed) vs. fully competed)

- Initiate development in AES Program in FY14. (Oct. 1)
## HEOMD Instrument Team

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<thead>
<tr>
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<th>Expertise</th>
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Teams have been evaluating precursor measurement requirements within NASA and with support from the community since the early 90’s.

Some human specific payloads have already flown on Mars science missions to understand more about the planet surface and a lot has been learned (e.g., MEDLI and RAD on MSL)

MEPAG revisited the human precursor requirements in 2010, referred to as (MEPAG) Goal IV.

DRA 5 made some reasonable assumptions which we should use to guide prioritization of measurements.

The Precursor Strategy Analysis Group (P-SAG) revisited the human precursor measurements in 2012 and identified and prioritized SKGs.

The HAT Mars Destination Team further assessed the P-SAG SKG analysis from crew safety and mission risk perspectives.

The HEOMD Instrument Team will make specific measurement recommendations and define instrument concepts for Mars 2020.
Why do we need measurements? (1)

There are three classes of environmental measurements needed:

1. **Architecture drivers** – measurements that allow us to design vehicles and the mission more efficiently
   - **Atmospheric density and winds**: current uncertainty is large due to limited flight data and diurnal/seasonal variability, and when dust storms are active.
     IMPACT: Landed mass, available landing sites (lower altitude) (**MSL**)
   - **Resources**: allows for ISRU, dependent on the strategy.
     IMPACT: Landed mass (consumables and prop required to transport)

2. **Crew Safety/hazards** – measurements that allow us to keep the crew safe.
   - **Radiation**: Determine surface and/or orbital GCR levels (**MSL RAD**)
   - **Biohazards**: Determine if extant life is present on the surface and poses a hazard to the crew and public.
   - **Toxicity**: Determine if there are materials such as dust with known toxic effects on humans.
Why do we need measurements? (2)

3. **Operational** – measurements that allow us to operate **safely**
   - **Trafficability**: Determine surface hazards at the landing site (drives site selection)
   - **Dust effects on systems**: Determine mechanical properties of dust (drives lander/rover/EVA suit/equipment dust tolerance and operations)
   - **Forward Planetary Protection**: Determine how organisms from Earth may survive and possibly contaminate special regions on Mars (landing site selection and operations)
   - **Atmospheric electricity**: Characterize the electric field magnitude and frequencies, atmospheric and surface conductivity (drives lander/rover/suit/equipment grounding design and operations)