NASA SCIENCE MISSION DIRECTORATE

An Integrated Program Enabling Great Science

Innovation & Discovery

HELIOPHYSICS  EARTH SCIENCE  PLANETARY SCIENCE  ASTROPHYSICS  JASD
SCIENCE FLEET

OPERATING & FUTURE EXPLORERS
## Explorers and the SMD Portfolio

<table>
<thead>
<tr>
<th>Flagship Class</th>
<th>Large Class</th>
<th>Medium Class</th>
<th>Smallsat/Cubesat</th>
</tr>
</thead>
<tbody>
<tr>
<td>High priority</td>
<td>High priority</td>
<td>Medium priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>Very high significance</td>
<td>High significance</td>
<td>Medium significance</td>
<td>Low to medium significance</td>
</tr>
<tr>
<td>High complexity</td>
<td>High to medium complexity</td>
<td>Medium to low complexity</td>
<td>Medium / low complexity</td>
</tr>
<tr>
<td>Long mission lifetime</td>
<td>Medium mission lifetime</td>
<td>Short mission lifetime</td>
<td>Short mission lifetime</td>
</tr>
<tr>
<td>High cost</td>
<td>High to medium cost</td>
<td>Medium to low cost</td>
<td>Low cost</td>
</tr>
<tr>
<td>Critical launch constraints</td>
<td>Medium launch constraints</td>
<td>Few launch constraints</td>
<td>Few to no launch constraints</td>
</tr>
<tr>
<td>No in-flight maintenance</td>
<td>Difficult in-flight maintenance</td>
<td>May have in-flight maintenance</td>
<td>Planned in-flight maintenance</td>
</tr>
<tr>
<td>No re-flight opportunities</td>
<td>Few or no re-flight opportunities</td>
<td>Some or few re-flight opportunities</td>
<td>Re-flight opportunities</td>
</tr>
</tbody>
</table>
EXPLORERS AND THE SMD PORTFOLIO

Medium Class (MIDEX)
- ICON
- Investigations characterized by definition, development, mission operations, and data analysis costs under $180 to $200 million to NASA
- In Development:
  - ICON, TESS
- Operational:
  - ACE, Swift, THEMIS

Small Explorers (SMEX)
- IXPE
- Investigations characterized by definition, development, mission operations, and data analysis costs under $120 million to NASA
- In Development:
  - IXPE
- Operational:
  - AIM, IBEX, IRIS, NuSTAR, RHESSI

Universities, Internationals, Missions Of Opportunities
- GOLD
- University-Class Explorers (UNEX)
  - Investigations characterized by definition, development, mission operations, and data analysis costs under $15M (real year dollars) to NASA, launched in low cost methods
- Missions of Opportunity (MO)
  - Investigations characterized by being part of a non-NASA space mission and having a total NASA cost under $55M
  - Conducted on a no-exchange-of-funds basis with the organization sponsoring the mission
  - In Development: GOLD, NICER
- Internationals
  - Operational Missions: INTEGRAL
SMD's goal is to raise the bar on scientific discovery: Identify a larger number of technologies of high mission impact and put them into space.

Collaboration with NASA Centers, along with commercial and academic partners, is key to achieve this goal.
ENHANCED TECH INFUSION

TRL 3-5
SMD Technology Programs
Coordination with STMD Game-Changing Development (GCD) Program

TRL 5-8
Ground, Suborbital & In-Space Validation
Coordination with STMD Technology Demonstration Mission (TDM) Program

TRL 6-9
Announcements of Opportunity
+ Enhanced technology demonstrations
+ Increased technology infusions
+ Expanded rideshare opportunities
• Utilize AOs and SMD missions proactively for technology infusion and flight
• Prioritize technologies of high impact for the SMD portfolio
• Measure needs, impact and effectiveness of our technology investments, and pivot where needed
BACKUP
THE VALUE OF A BALANCED SMD PORTFOLIO

Flagship Missions

Encompassing civilization-scale science

High priority missions with less impact to cost and schedule

Medium Class Missions

Moderate risk missions often PI-led with medium priority science objectives

SmallSat/CubeSat Missions

Lower priority, focused, higher risk missions in a shorter time frame and limited budget often increase technology readiness
• Five SMEX missions in Phase A Competition, LRD ~ 2022
  – Meme-x
  – Foxsi
  – Muse
  – Tracers
  – Punch
• Two SMEX selections and one MO selection develop space weather techniques directly applicable to space weather capabilities

AO 2016 SMEX SELECTIONS [1/2]
Three MOs selected to proceed
- Two MOs (SunRISE, AWE) in Phase A Competition, LRD varies
- One partner MoO: THOR-US, contingent on selection of ESA M5 mission

Tech development funding for Cat-3 MO: COSIE

Several selections use multiple CubeSats/SmallSats
- Technology development that can be leveraged for future Decadal Survey missions