HEOMD VIEW OF SPACE
WEATHER AND SPACE
WEATHER NEEDS

John R. Allen
HEOMD/Crew Health and Safety
EXPLORATION CHALLENGES TO HUMAN HEALTH
Radiation Exposure on Human Health
COUNTERMEASURES

- http://www.nasa.gov/topics/journeytomars/index.html

(Starwars.wikia.com)
EXPLORATION CHALLENGES TO SYSTEMS
• Single Event Upsets
• Electrical Charging
• Spacecraft Drag
## Radiation Monitoring and Shielding

### ISS Technology Demonstration Plan

<table>
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<tr>
<th>Capability Gap</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
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<th>FY26</th>
<th>FY27</th>
<th>FY28</th>
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<tbody>
<tr>
<td>Radiation Monitoring and Shielding</td>
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- [Data] represents the status of each technology demonstration plan from FY14 to FY28.

### Notes:
- Each cell indicates the level of funding or progress for each year.
- Red indicates no committed funding.
- Green indicates sufficient funding to ISS demo.
- Orange indicates insufficient funding for ISS demo.
- Blue indicates funded ISS demo.

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**Radiation Monitoring and Shielding**

- ISS Technology Demonstration Plan
- Radiation Monitoring and Shielding

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[Diagram and Table Representation]
COUNTERMEASURES

- Warp Drive
- Teleportation
- Muscle
  - Exercise
- Bone
  - Exercise
  - Pharmaceuticals?
- Behavioral Health
  - Virtual/autonomous systems
- Radiation
  - Shielding?
  - Pharmaceuticals?
IN-SPACE POWER & PROPULSION:
- High efficiency 40kW SEP extensible to Mars cargo missions
- Power enhancements feed forward to deep-space habitats and transit vehicles
We want to have our cake and eat it too.
NEEDS

- WE WANT IT ALL, AND WE WANT IT NOW…
- We want space weather to be predictable…
- We want all of the good and none of the bad…
- We want to know
  - When we can safely launch
  - When we can safely operate
  - When will an event happen
  - How big will it be
  - How long will it last
  - Will it adversely impact humans
  - Will it adversely impact space-based and/or ground-based systems
WHAT CAN BE DONE?

• Continued research and development
• Improved propulsion may reduce human and systems exposure
• Improved shielding may improve our protection for humans and systems
• More and improved space weather models and forecasting will benefit both humans and systems
• *Space Weather Operations Research and Mitigation Strategic Plan and Action Plan* point to the importance of R2O and O2R
  • Close collaborations across directorates, centers, agencies, nations