

NASA Technical Fellow for Space Environments

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Introduction and Outline

Today's presentation will highlight FY16 activities of the NASA Technical Fellow for Space Environments organization with emphasis on items of interest to the space weather community

- Capabilities Leadership Model
- Technical Discipline Team and Capabilities Leadership Team
- Technical Assessment and Support Activities
- Space Environment Test Facilities Review
- Space Environments Discipline Baseline Assessment
- Radiation Mitigation Action



Capabilities Leadership Model

Capability Leadership (CL) Model

- Championed by Robert Lightfoot/AA and Lesa Roe/AA
- Intent is to establish a more effective, affordable, and innovative approach for engineering to support NASA programs
- NASA is now working on the process to fully implement the CL Model
 - Buy-in from senior NASA management in OCE, EMB, APMC, and Mission Directorates
 - Process to formalize at Center and Program level is still in work

HQ is working to infuse the CL Model into the overall engineering management process

- Agency management control documents to be modified to include language for defining and institutionalizing CL Model
- Mission Support Council team working to define Center technical and programmatic roles and responsibilities
- CLT's will be asked to align disciplines to support Center alignment



Capability Leadership Roles

- Advises Agency and ensures *proper alignment* across Missions and Centers consistent with Agency and capability advancement needs.
- Establishes *plans based on Agency-Level roadmaps and strategic needs* to provide technical guidance to the Agency in the identification and prioritization of tasks necessary to enable discipline-level performance for future missions.
- Determine *gap areas* for advancement and strategic investment and document in Stewardship Plan.
- Advises on *capability sizing and strategic hiring of FTE and WYE*, across all Centers, so as to avoid Agency excess capacity, duplication in a capability area, or excessive contracting of intrinsic NASA technical capability areas.
- Assesses opportunities for *investments and divestments* within capability scope, including advising Centers on *assets*, and coordinates with other capability areas so as not to duplicate scope between areas.
- Solicits *innovative ideas from outside the capability area*, related to such things as technical content, new approaches, workforce skills, asset use, and disposition.
- Establishes *standards and specifications* within capability scope.

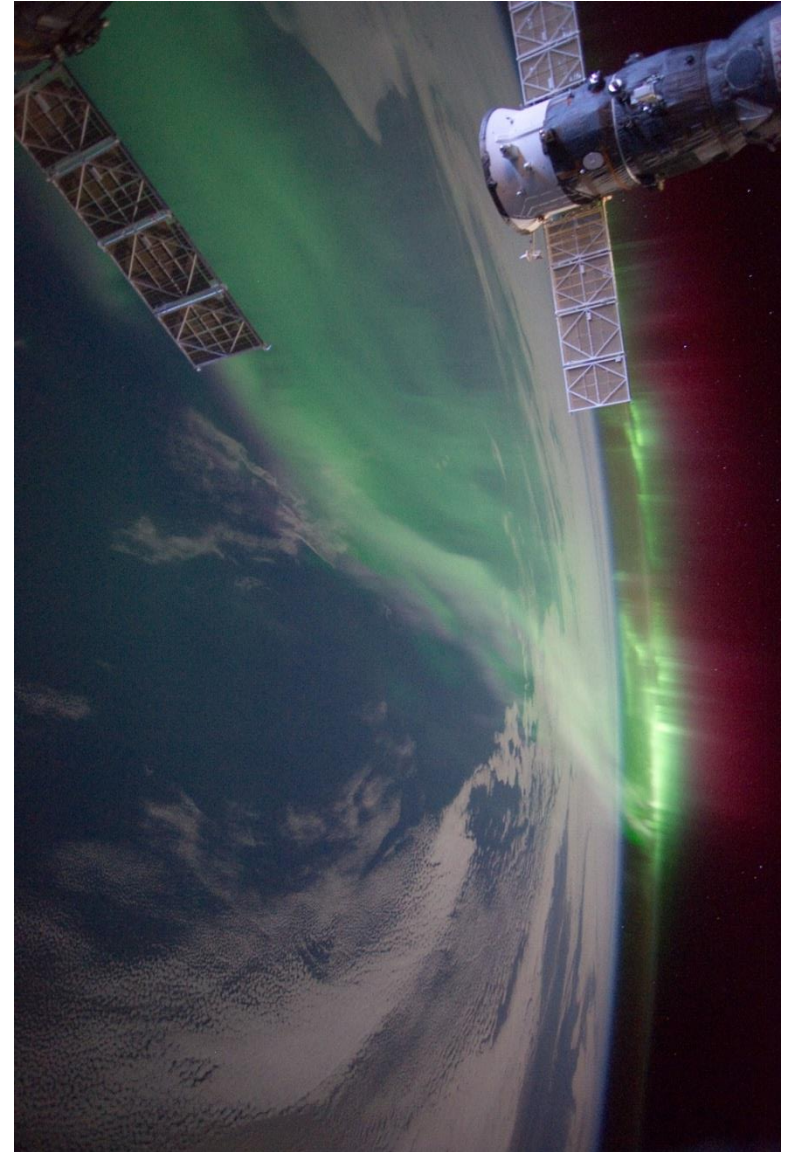


Space Environments Technical Responsibilities

Space environments and their effects that impact design, construction, and operation of NASA human and robotic space systems

Specific environments include:

- Ionizing radiation, neutral energetic particles
- Space plasma, spacecraft charging
- X-ray, UV/EUV, visible, IR photons
- Meteors and orbital debris
- Vacuum, neutral atmosphere, atomic oxygen
- Electric and magnetic fields
- Microgravity
- Applied space climate and space weather





Tech Fellow Space Environments Organization

Technical Discipline Team (TDT)

- Tech Fellow selected personnel from GRC, GSFC, JPL, JSC, LaRC, MSFC, WSTF, Utah State University, NOAA Space Weather Prediction Center, and Air Force Research Laboratory
- Space environments and effects discipline experts contribute to technical assessments and technical support activities
- Team represents modeling, measurement, test, and analysis capabilities for space environments engineering and applied space weather
- Provide guidance to NASA on space environments engineering discipline technology gaps and needs to improve discipline readiness to support NASA Programs and Mission Directorates

Capability Leadership Team (CLT)

- NASA representatives from ARC, GRC, GSFC, JPL, JSC, KSC, LaRC, and MSFC selected by Center Engineering Directors to represent Center interests
- Team is led by a Tech Fellow selected Deputy representing TF and OCE interests
- Address space environments engineering discipline policy and strategy actions
- Implement Capability Leadership Model processes and procedures for Agency



Office of the Chief Engineer (OCE) Capability Leaders

Discipline CLT's Leadership by OCE and NASA Tech Fellows

Aerosciences:
David Schuster

Materials:
TBD

Avionics:
Oscar Gonzalez

Mechanical Systems:
Michael Dube

Cryogenics:
TBD

NDE:
William Prosser

Electrical Power:
Chris Ianello

Passive Thermal:
Steven Rickman

Flight Mechanics:
Daniel Murri

Propulsion:
Thomas Brown

Guidance Navigation, and Control:
Neil Dennehy

Software:
Michael Aguilar

Human Factors:
Cynthia Null

Space Environments:
Joseph Minow

Instrument and Sensors:
Upendra Singh

Structures:
Ivatury Raju

Life Support/Active Thermal: Henry Rotter

Systems Engineering:
Jon Holladay

Loads and Dynamics:
Curtis Larsen

System CLT's Interim leadership by OCE

Entry, Descent, and landing: David Schuster

In Situ Resource Utilization: Jerry Sanders

Rendezvous and Capture: Neil Dennehy

Autonomous Systems: TBD

Integration lead for all OCE discipline and system capabilities: Teresa Spagnuolo



SMD, OCS, MSD Capability Leaders

Research Capabilities Leadership by SMD, OCS

Earth Science Research (SMD): Jack Kaye

Heliophysics Research (SMD): Steven Clarke

Astrophysics Research (SMD): Paul Hertz

Planetary Research (SMD): Jim Green

Life Science Research (OCS): Craig Kundrot

Service Capabilities Leadership by MSD and others

Aircraft Operations: Richard Schlatter

Mission Operations: Steve Koerner

**Space Environments Testing Management
Office:** Michael Mastaler



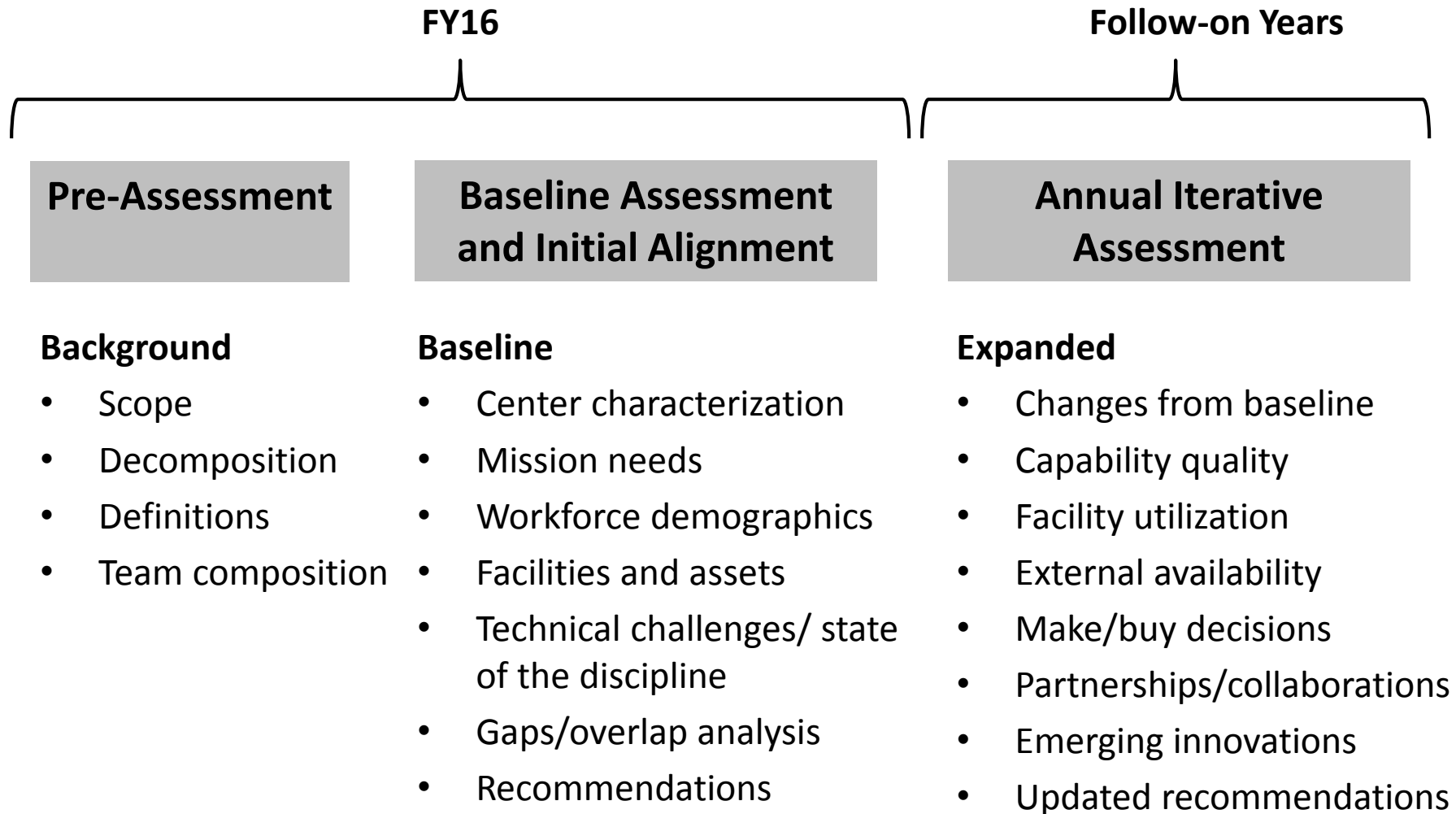
Space Environments Capability Leadership Team

| Center* | Deputy | Primary | Alternate |
|---------|------------|---------------|----------------|
| | John Alred | | |
| ARC | | Ryan Vaughan | |
| GRC | | Sharon Miller | |
| GSFC | | Jonny Pellish | Renee Reynolds |
| JPL | | Henry Garrett | Insoo Jun |
| JSC | | Michael Montz | Martin McClean |
| KSC | | Carlos Calle | |
| LaRC | | Drew Hope | Mark Thornblom |
| MSFC | | Glenn Overbey | Mary Nehls |

*AFRC, SSC declined to provide representatives



Technical Assessments/State of the Capability





Technical Discipline Team Activities

- Monthly teleconference to discuss team activities
- Joint TDT/CLT face-to-face meeting at JPL in June 2016 to coordinate space environment technical activities across Agency and develop list of space environments investment needs and technology gaps to be included in the Space Environments CLT discipline assessment
- Operate the monthly Space Environments Virtual Seminar (teleconference)
- Technical assessment and support activities
 - TI-15-01079 JWST Space Environment Launch Constraints
 - TI-15-01107 Chandra X-Ray Observatory ACE Real-Time Data Support
 - TI-16-01108 ISS Plasma Interaction Model Independent Review
 - TI-16-01123 CubeSat Radiation Environments and ISS Radiation Dose Data
 - TI-16-01159 Space Weather Action Plan Extreme Surface/Internal Charging Environment Benchmarks



CLT Activities

Completed Mission Support Council Action to review status of space environments specialty test facilities and look for consolidation, divestment, and investment opportunities

- Ionizing radiation (GSFC, JPL, MSFC)
- Atomic oxygen (GRC, MSFC)
- Magnetic field (GSFC, JPL)
- MMOD (JSC/WSTF, MSFC)
- Solar spectrum (GRC, MSFC)

CLT consensus recommendation was to retain nearly all internal NASA specialty space environments test facilities as active to support current and future NASA programs

- Approved by Engineering Management Board (March 2016)
- Approved by Mission Support Council (May 2016)

Completed the Space Environments discipline baseline assessment of readiness to support NASA Mission Directorates

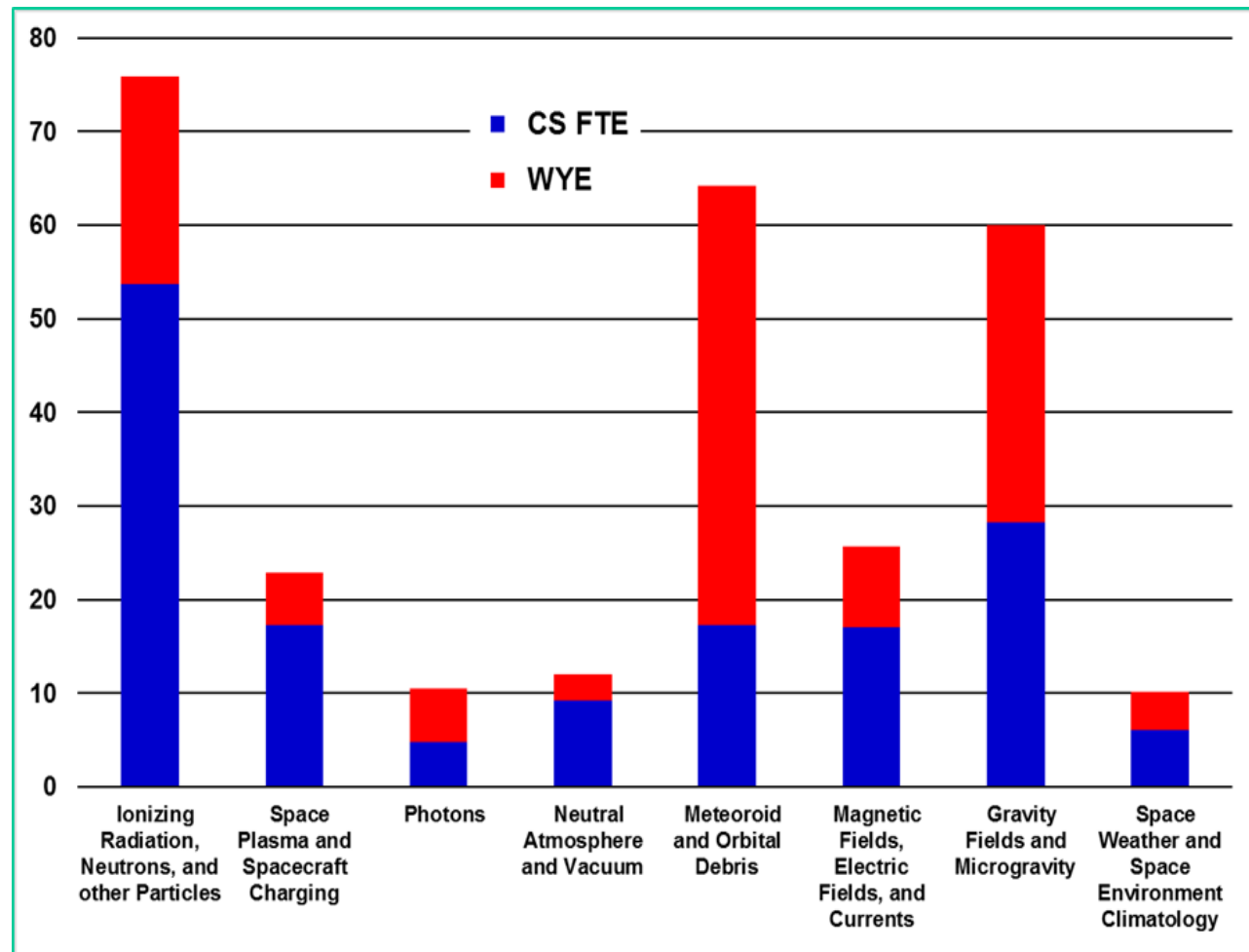
- Briefed EMB on state-of-capability, challenges to discipline, and recommendations for investments and programmatic opportunities for improving discipline (August 2016)
- Briefed Agency Program Management Council on discipline health with examples of model/tool and external radiation test facility funding needs (September 2016)



Space Environments Baseline Assessment

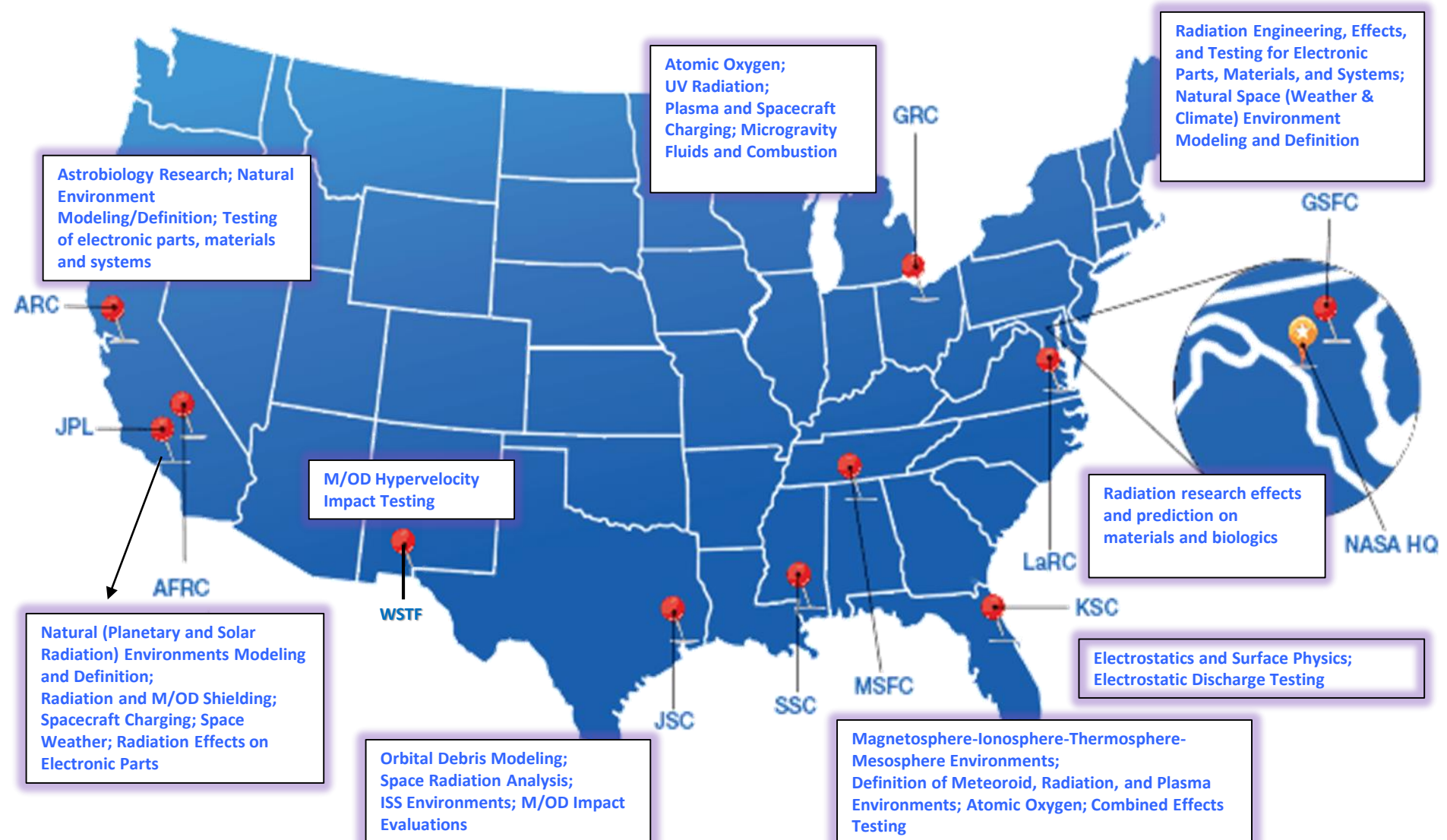
Workforce

- **155 FTE + 127 WYE**
= 282 total in Agency
- **Personnel located in 8 of 10 Centers**
- **Primary customers (75%) are SMD and HEOMD**





Space Environments at NASA





Space Environments Discipline Health

| Discipline | 2015 Health Assessment | 2016 Health Assessment | 2016 Health Assessment Drivers | | | |
|--------------------|------------------------|------------------------|--------------------------------|--------------|------------|-------------------|
| | | | Workforce | Tools/Models | Facilities | Research/Tech Dev |
| Space Environments | | ↓ | ↓ | ↓ | ↓ | ↓ |

Space Environments discipline health is good overall, with some areas of concern:

- **Workforce good for now (green).** Retirements could impact workforce in future (↓)
- **Existing tools/models are adequate but there is no assured funding source that can be used to invest in maintenance of current and development of new tools/models (yellow).** No plan to provide necessary funding to address discipline priorities has been identified (↓)
- **Internal facilities good for now (green).** Pressure for consolidation and/or divestment of internal NASA specialty test facilities could be threat in future; significant threats to NASA access to external high energy radiation test facilities (↓)
- **Some research/technology development is funded by HEOMD, SMD, and possibly STMD (yellow).** However, there is not a good source of funding that can be applied to space environment community priorities for model/tool development and support, laboratory testing, and other discipline specific research and technology development (↓)



Space Environments Discipline Challenges

Discipline requires a technically adept workforce with access to space environment flight data, environment models and effects tools, and test facilities in order to support NASA programs. Challenges exist to the capability in each of these areas:

- **Workforce**
 - Current workforce of subject matter experts in space environment sub-disciplines are co-located with NASA programs at 8 of 10 NASA Centers. Expertise is adequate to support NASA but future retirements without ability to backfill in time to capture expertise could compromise discipline capability
- **Environment Measurements**
 - Need flight opportunities for testing new technologies in space environment
 - Leverage Air Force investment in low cost/power/mass space weather sensors for NASA spacecraft
 - In-situ measurements of orbital debris environment in the millimeter size range at 600 to 1000 km altitude needed to characterize M/OD threat and temporal variations in debris environment
 - Better access to NASA spacecraft engineering data and anomaly reports to validate space environment effects models, fund analysis of the data
- **Test facilities**
 - Access to high energy proton and heavy ion facilities for single event effect testing is getting more difficult due to facility closures and pressure on remaining facilities
 - Develop hypervelocity ground test capabilities for speeds >7 to 10 km/s to address meteoroid environment
- **Models/Tools**
 - Need for NASA funding to support existing models/tools and development of new tools



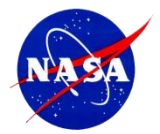
EMB Radiation Mitigation Action

- Mr. Ralph Roe, NASA Chief Engineer, proposed establishment of a new Radiation Systems CLT (EMB F2F, March 2016)
 - Purpose is to coordinate radiation mitigation activities across NASA as a cross-discipline, system level function
 - Establish a new System CLT with ST level management to coordinate NASA radiation activities
- EMB discussion on proposal indicated mixed opinions on the need for a new NASA organizational structure to coordinate radiation mitigation activities
 - Does NASA need additional System CLT's? Any additional working groups?
 - Multiple organizations already exist to work radiation issues within HEOMD, OSMA, OCE, SMD and other organizations: EMB or appropriate authority simply needs to direct the necessary work.
 - Technical Fellow for Space Environments within OCE authority has space radiation responsibilities
- EMB deferred decision with action given to Space Environments CLT to
 - Identify existing NASA organizations with significant radiation environments, radiation protection, and radiation mitigation elements
 - Bring recommendation(s) to EMB for options to coordinate radiation mitigation work



EMB Radiation Mitigation Action

- Space Environments CLT recommendation to EMB (August 2016):
 - Expand existing Space Environments CLT to include membership from Mission Directorates, radiation organizations, and other space environment and effects organizations to coordinate all space environment activities
 - Reminder: CLT role is advisory in nature, goal is to provide a voice for space environments and effects organizations with access to senior NASA management
 - Approved by EMB
- FY17 forward work:
 - Collect information on existing space radiation and other space environment organizations
 - Work with Mission Directorates, Centers, OSMA, OCS, OCE, OCHMO, and other relevant NASA leadership to determine appropriate level for CLT representation
 - Determine appropriate representation on Space Environment CLT



Questions?