

NASA's ISS Radiation Monitoring Plans and Developments

13th Workshop on Monitoring for the International Space Station

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Outline

- ▶ Status of Current Monitoring
- ▶ New Development Overview
- ▶ Timeline and Strategy
- ▶ Measurement Specifics
- ▶ Summary

Current Monitoring Status

▶ Passive Dosimetry:

- Crew Passive Dosimeter (CPD) – TLD, OSL, CR-39
- Radiation Area Monitor (RAM) – same as CPD
- No changes to Passive Monitoring Strategy

▶ Active Monitoring:

- ISS Tissue Equivalent Proportional Counter
 - ▶ Current on-orbit unit functioning nominally
 - ▶ Backup flight unit to launch on 17A, tentatively August, 2009
 - ▶ Minimize/eliminate gap in TEPC monitoring through delivery of replacement hardware
- IV-Charged Particle Directional Spectrometer
 - ▶ Failed, returned to ground
 - ▶ No plans for repair and re-flight, effort better applied to new development
- EV-Charged Particle Directional Spectrometer
 - ▶ 2 of 3 units operating
 - ▶ Fly to failure posture



New Development Overview

- ▶ Four functional areas identified - consistent with external advisory recommendations by the NCRP (National Council on Radiation Protection):
 - IV Tissue Equivalent Measurement
 - ▶ Direct operational use and consistent with regulatory dose limits/tissue equivalency
 - IV Charged Particle Spectroscopic Measurement
 - ▶ Important for risk estimation and fundamental field characterization
 - IV Neutron Spectroscopic Measurement
 - ▶ Neutron characterization
 - EV Electron and Proton Measurement
 - ▶ Characterization of EVA environment
 - ▶ Little to no insight into electron exposures in any IV measurement

- ▶ Design Solution Strategy
 - Leverage existing solutions – other NASA efforts, COTS, etc.
 - Four functional areas don't necessarily drive four unique designs. Plan for commonality, dual-use, etc. where possible
 - ▶ Efficiency in design and reduce development costs
 - ▶ Simplification of sustaining engineering and maintainability
 - ▶ Focused instrument characterization, data analysis and understanding, etc.

New Development Overview

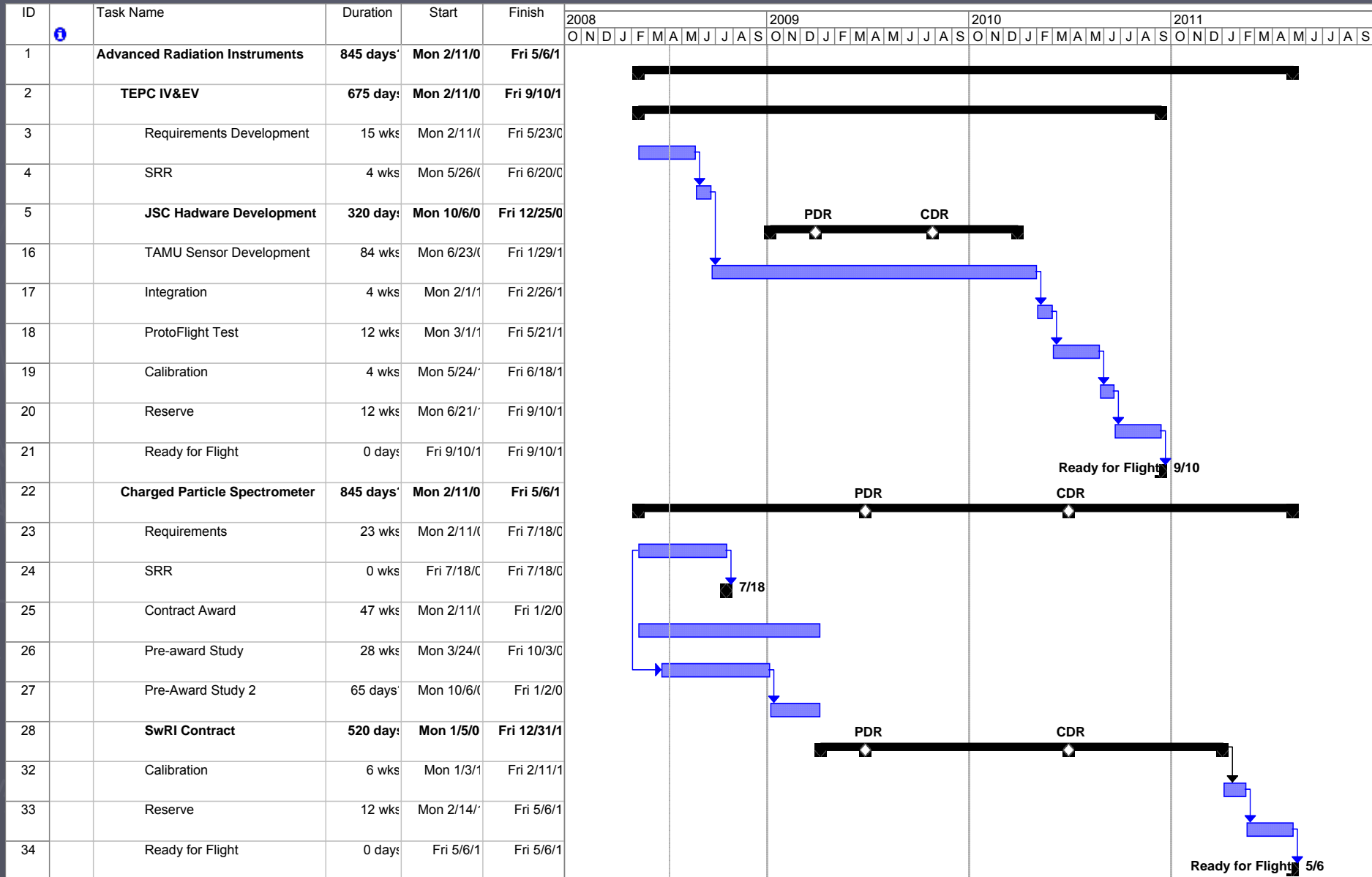
- ▶ Four functional monitoring areas essentially captured in two designs
 - Tissue Equivalent Proportional Counter (TEPC)
 - ▶ IV Tissue Equivalent Measurement
 - ▶ EV Electron and Proton Measurement
 - Radiation Assessment Detector (RAD)
 - ▶ IV Charged Particle Spectroscopic Measurement
 - ▶ IV Neutron Spectroscopic Measurement
- ▶ Tissue Equivalent Proportional Counter (TEPC) – IV and EV
 - In-house development effort leveraging experience and lessons learned from past TEPC projects – TEPC experience from Shuttle, MIR, and ISS
 - Approach and high-level design solution in place to satisfy both the IV Tissue Equivalent Measurement and EV Electron and Proton Measurement
 - Common design with different packaging for IV and EV environments
 - Sensor design by Dr. Les Braby, Texas A&M

New Development Overview

▶ Radiation Assessment Detector (RAD)

- Existing, partially NASA-funded solution selected as best-suited to meet ISS requirements for IV charged particle spectroscopy - SwRI/DLR/CAU developed instrument for Mars Science Laboratory (MSL)
- MSL RAD has a neutron performance requirement consistent with ISS neutron requirement
- RAD Overview/Attractiveness
 - ▶ Technical performance in a minimized package
 - ▶ Extensive characterization and scientific investigation underway – utilize that effort to understand and characterize the ISS version
 - ▶ Phasing lines up well with our schedule, RAD team intact, active work is ongoing

Development Timeline



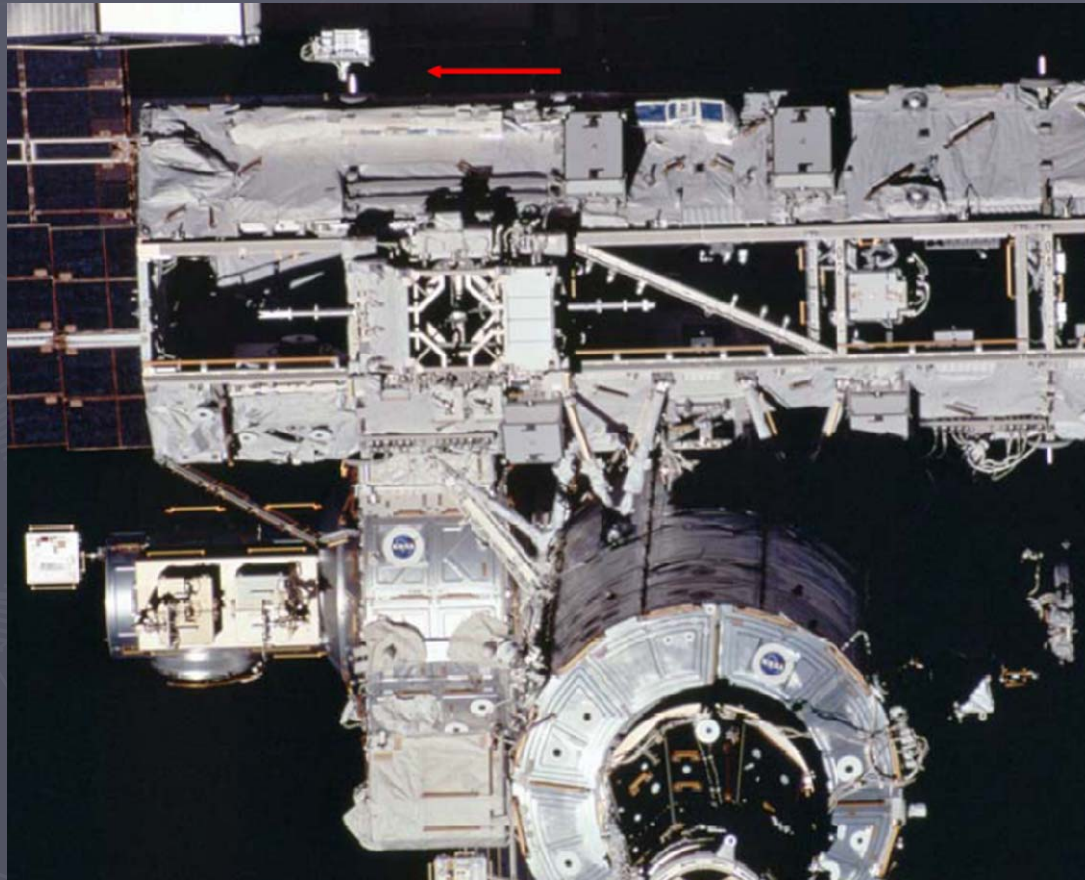
Measurement Specifics – IV TEPC

- ▶ Segmented Spherical Detector – mitigate differences in response based on orientation, as seen with present right circular cylinder design
- ▶ Lineal energy from 0.2 – 1000 keV/ μm
- ▶ Resolution:
 - 0.1 keV/ μm for 0.2 - 20 keV/ μm
 - 2 keV/ μm for 14 - 1000 keV/ μm
- ▶ Simulated site size of 1-5 micrometers in diameter
- ▶ Sensitive volume at an average tissue depth greater than or equal to 2mm
- ▶ Potentially two detectors, with one having a diameter $\sim 1/3$ of the other – high rate capability



Measurement Specifics – EV TEPC

- ▶ The same functional measurement as the IV TEPC
- ▶ EV-TEPC detector(s) shall have a material mass thickness of no more than 0.5 gm/cm² Aluminum-equivalent, in 2 pi steradians (intent to be equivalent to EMU shielding)



Measurement Specifics – ISS RAD

Trade studies ongoing to extend direct neutron/charged particle measurement

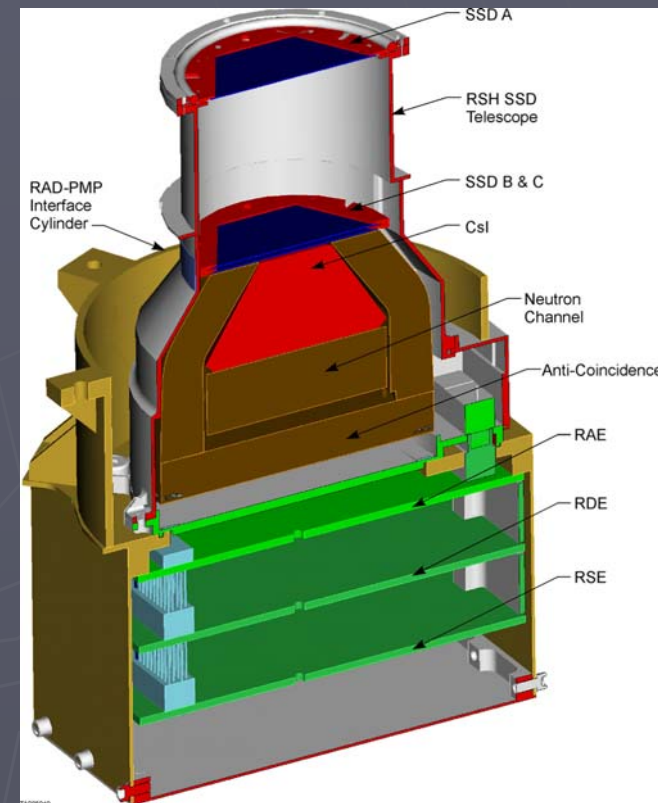
- Extension of Bicron scintillator
- Change of Bicron material/doping

Charged Particles

- Time-resolved energy spectra of charge-identified particles (protons and heavy ions up to Fe) ($1 \leq Z \leq 26$)
- Shall detect incident protons with energy greater than 20 MeV
- Proton flux once per minute in three distinct energy bands within the energy range $20 \text{ MeV} < E \leq 100 \text{ MeV}$
- Differential flux of charged particles of $Z < 3$ in the energy range of 30 to 200 MeV/nucleon and the flux for the range $Z = 3$ to 26 in the energy range of 100 to 200 MeV/nucleon

Neutrons

- Time-resolved energy spectra of neutrons in the energy range 0.5 to 80 MeV



Summary

▶ Present Suite

- TEPC on orbit functioning nominally, backup to fly on 17A (tentative)
- Charged particle telescopes will not be repaired – fly to failure
- Passive measurement to continue without change

▶ New Suite

- 3 Instruments, IV and EV TEPC and ISS RAD
- Delivery to ISS likely in 2011 – manifest permitting
- Goal is to maintain this suite for remaining life of ISS

▶ Exciting times ahead for the monitoring community with the potential to compare measurements from the MSL and ISS versions of RAD



Thank You,
Questions?