Cosmic Ray Energetics And Mass for the International Space Station (ISS-CREAM)

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On behalf of the CREAM Collaboration

CREAM Collaborators and Institutions

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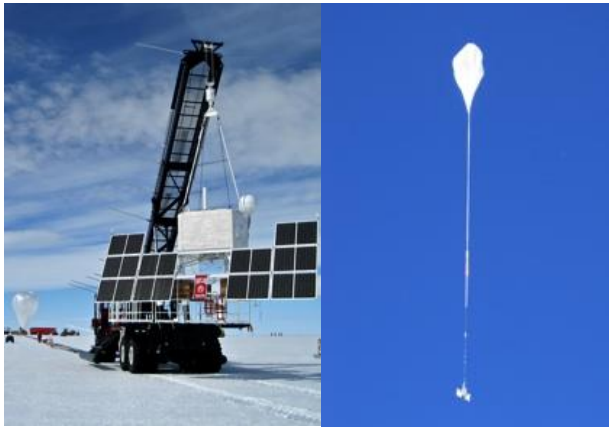
** Principal Investigator*

Balloon Heritage

CREAM (Cosmic Ray Energetics And Mass) Project

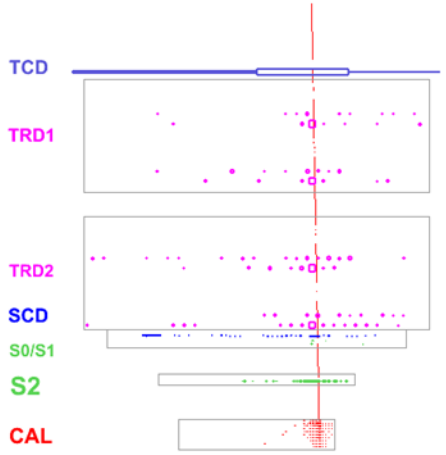
- The CREAM instrument measures elemental spectra of cosmic rays directly.
  - Energy range: 10^{12} – 10^{15} eV
  - Composition: proton to iron



Balloon Flight Heritage

- Six successful Long-Duration Balloon flights from McMurdo station, Antarctica
- ~161 days of cumulative exposures

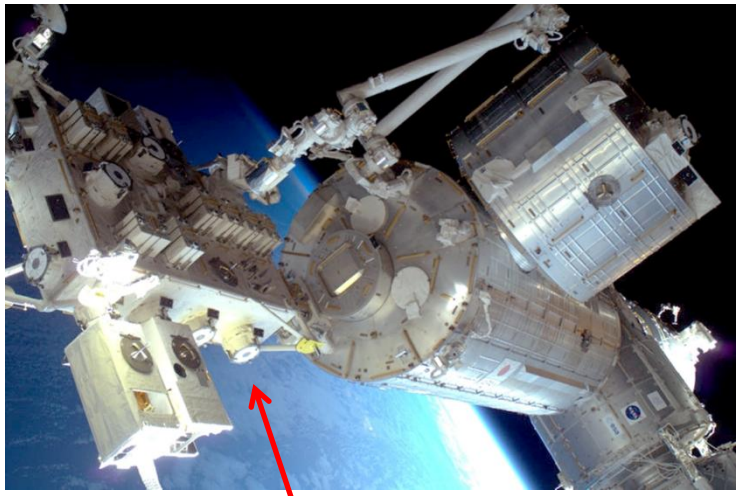
➔ Still more data are needed over 10^{14} eV.

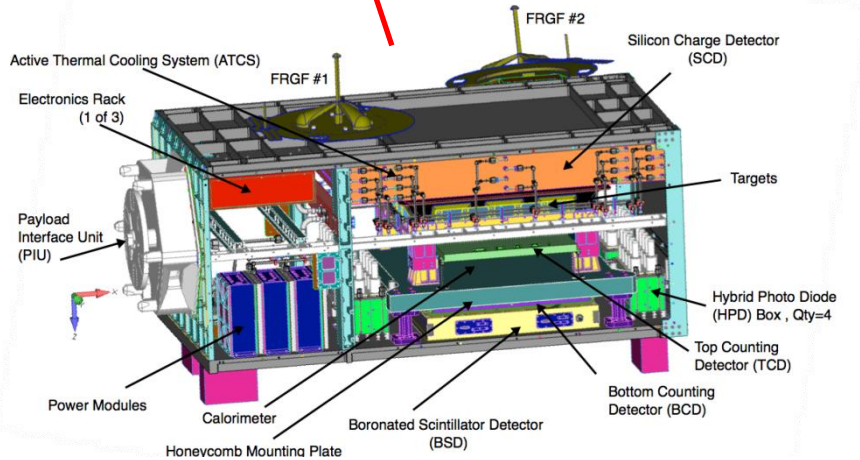


CREAM on the ISS

Mission Design

- Launch in Dec. 2014
  - SpaceX-6 (External Cargo)
- ISS Location: JAXA's JEM-EF 2
- Mass
  - Up Mass: Payload- 1342 kg with reserves
  - Down Mass: 0 kg
- Power: Payload- 755 Watts
- Data rate: 350 kbps





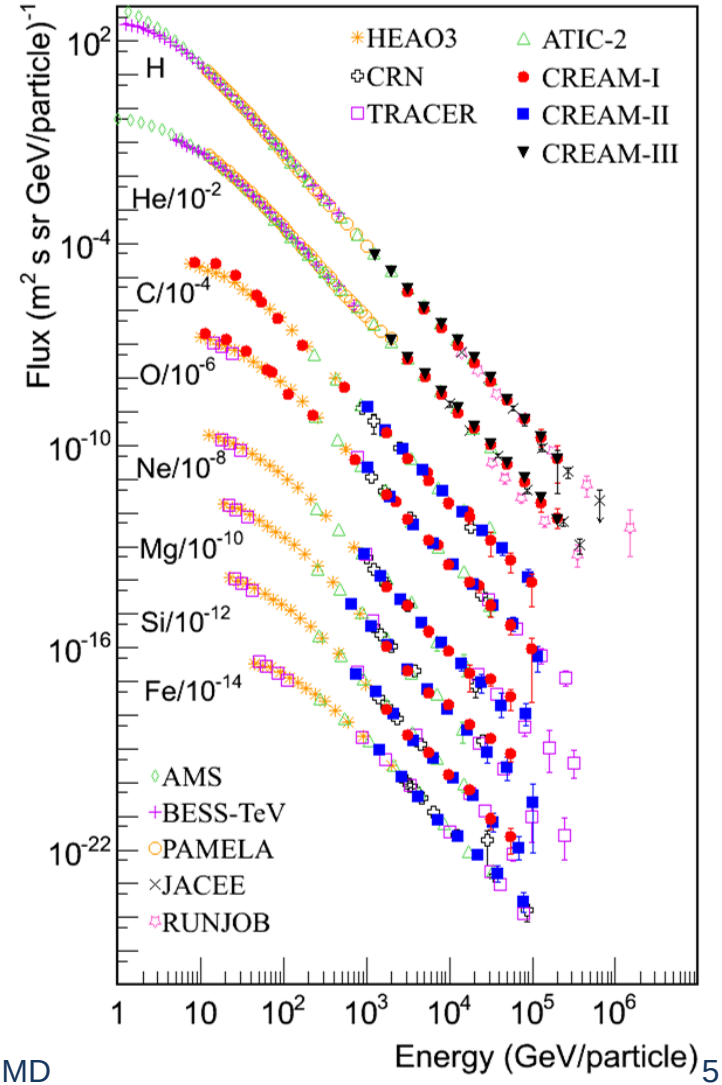
Cosmic Ray Elemental Spectra

Science Questions to be Addressed

- Do supernovae supply the bulk of cosmic rays?
- What is the history of cosmic rays in the galaxy?
- What is the origin of the “knee” around 3×10^{15} eV in the cosmic ray energy spectrum?
- Can the energy spectra of cosmic rays result from a single mechanism?

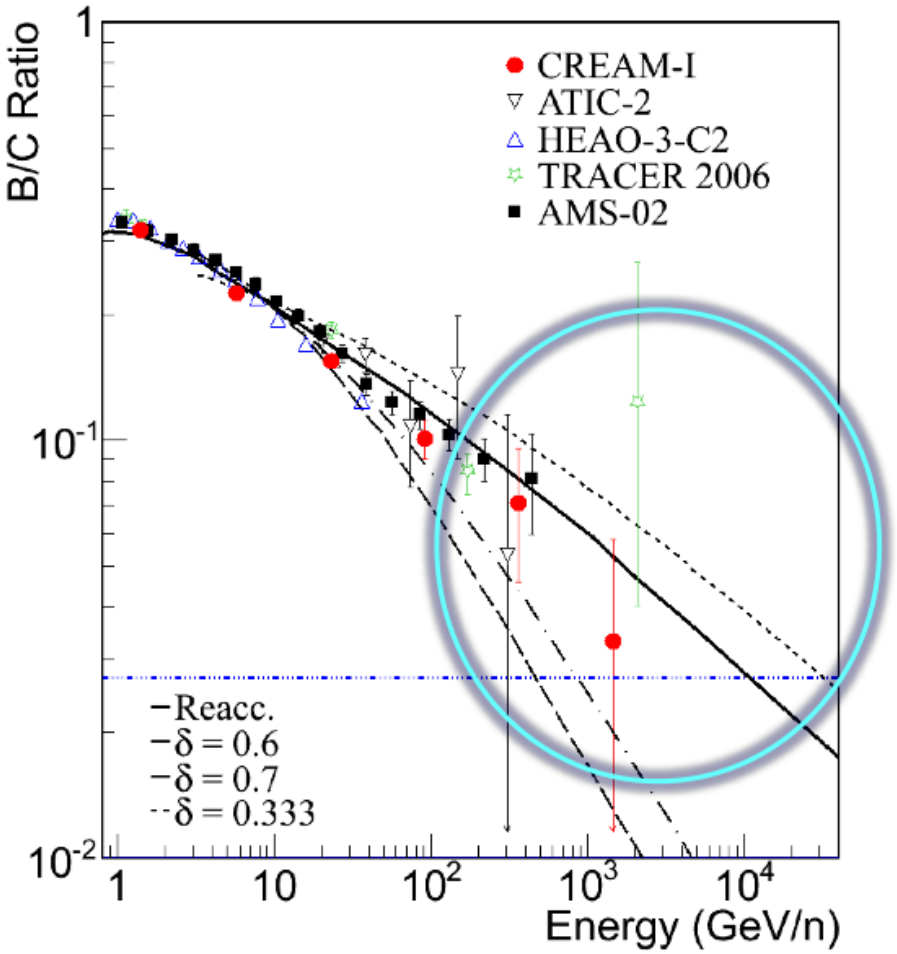
Mission Goal

- Extend the energy reach of direct measurements of cosmic rays to the highest energy possible to investigate cosmic ray origins, acceleration and propagation.



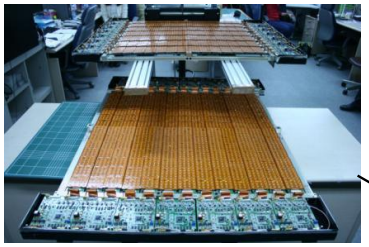
Cosmic Ray Propagation History

- Measurements of the relative abundances of secondary cosmic rays (e.g., B/C) in addition to the energy spectra of primary nuclei will allow determination of cosmic-ray source spectra at energies where measurements are not currently available
- Measure boron to carbon ratio at high energies to help distinguish between propagation models

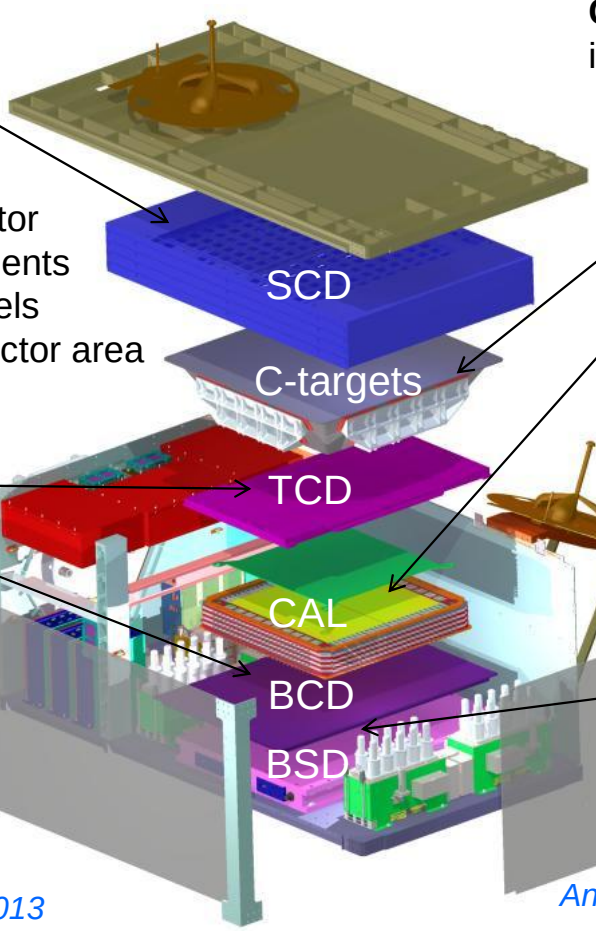


CREAM Instrument

*Ahn et al., NIM A **579**, 1034, 2007; Amare et al. 33rd ICRC #0630, 2013*



4 layer **S**ilicon **C**harge **D**etector
- Precise charge measurements
- 380-μm thick 2.12 cm^2 pixels
- 79 cm x 79 cm active detector area



Carbon **Targets** (0.5 λ_{int})
induces hadronic interactions

Calorimeter (20 layers W + Scn Fibers)
- Determine Energy
- Provide tracking
- Provide Trigger

Top & **B**ottom **C**ounting **D**etectors
- Each with 20 x 20 photodiodes and a plastic scitillator for e/p separation
- Independent Trigger

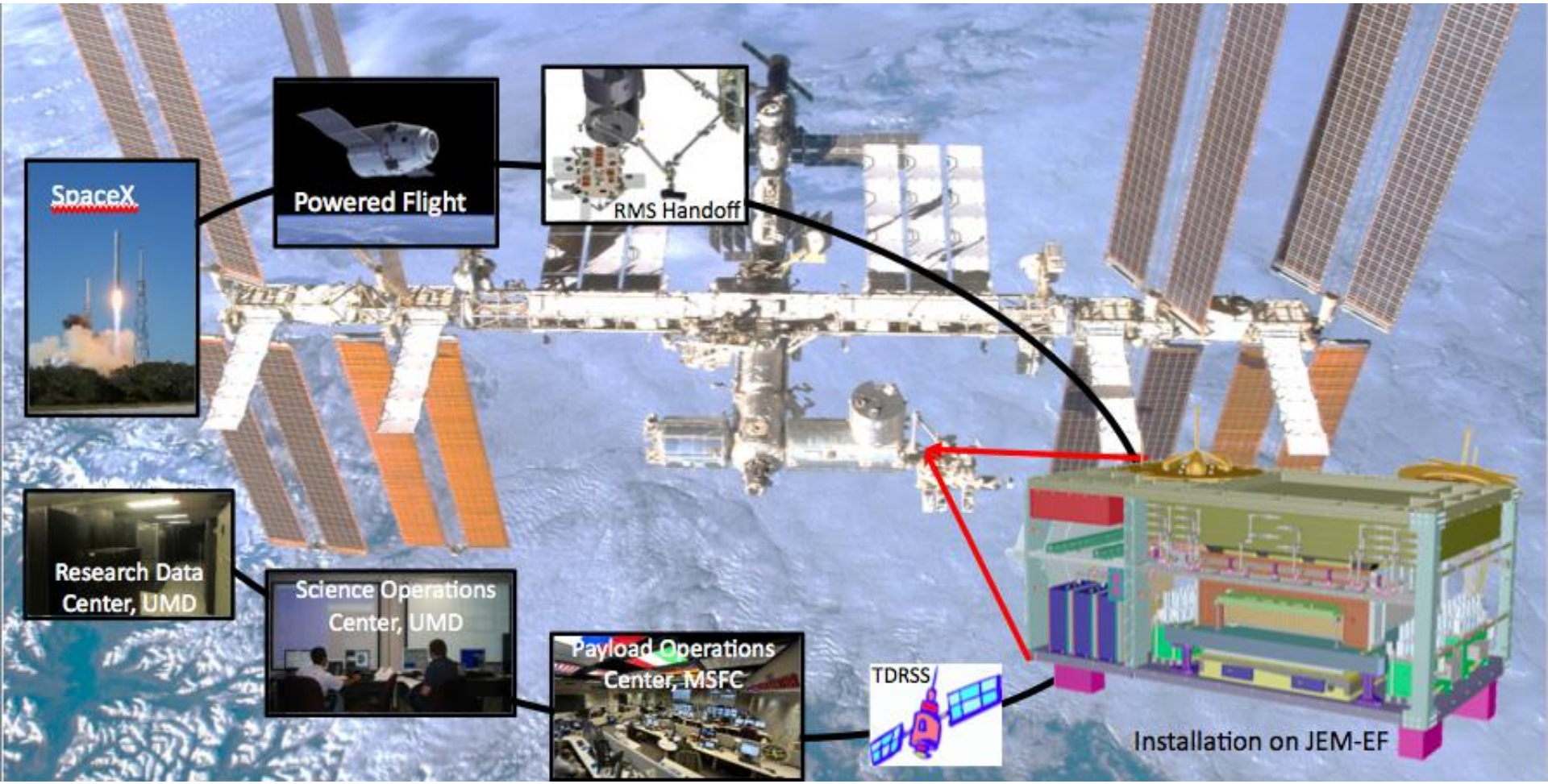
Park et al. 33rd ICRC, #1015, 2013
Hyun et al. 33rd ICRC, #1017, 2013

Boronated **S**cintillator **D**etector
- Additional e/p separation
- Neutron signals

Anderson et al. 33rd ICRC, #0350, 2013

Eun-Suk Seo, ISS-CREAM CDR, 2013

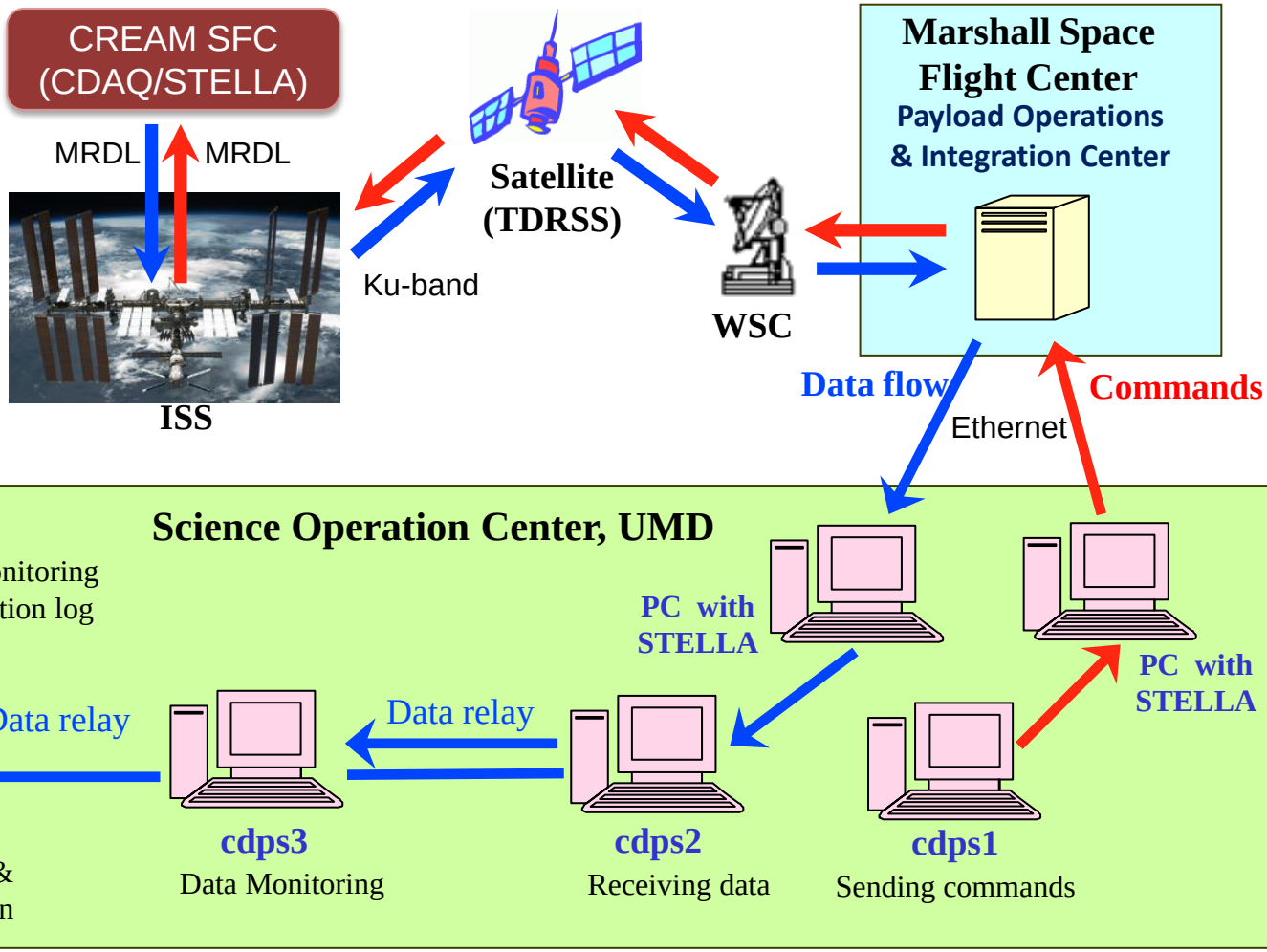
Mission Phase Overview



Command and Data Flow Overview

LRDL
(Low Rate Data Link)
–1553 based

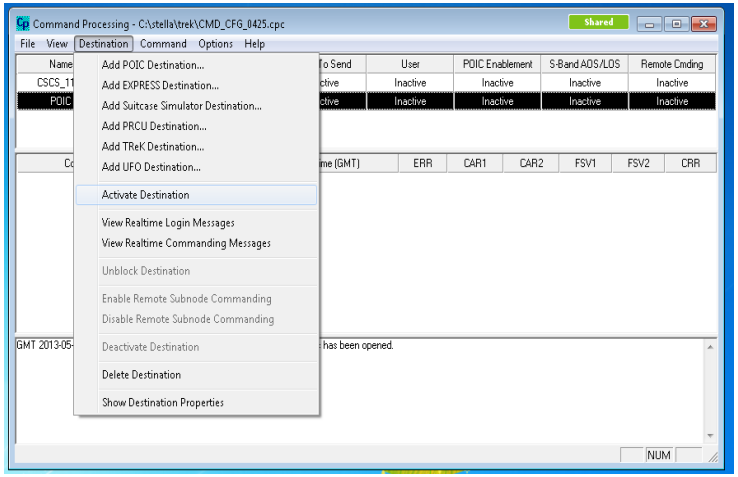
MRDL
(Medium Rate Data Link)
– Ethernet based



Connection Test

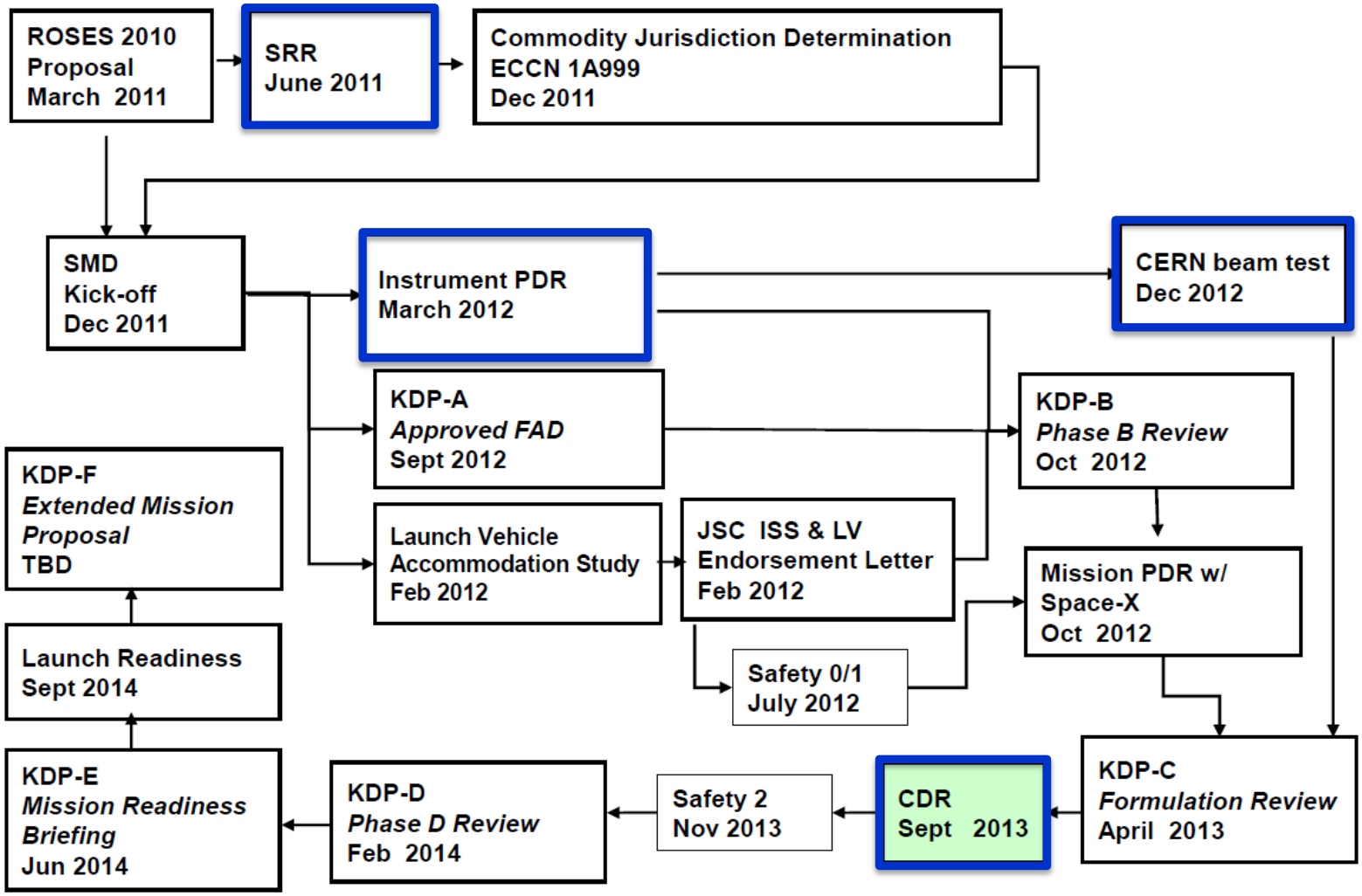
Connection Test between HOSC and SOC

- Connection test was performed from April 29 to May 3, 2013.
- During software development test, connection tests between HOSC (MSFC) and SOC (UMD) were carried out.
- Payload Rack Checkout Unit (PRCU) was used for testing.
- Data flow using STELLA between SFC and SOC via HOSC was confirmed.
- Transferring commands from SOC to SFC via HOSC was confirmed.
- Sending playback data by STELLA was tested and confirmed.



Snapshot of connection test

Project Checkpoints



Timeline

- February: Payload Integration and performance test
- March: Thermal/vacuum/vibration testing
- July: Mission Readiness Briefing
- August: Flight Simulation with MSFC
- September: Delivery of Payload to KSC. *Launch Readiness*
- December: Launch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– ISS-CREAM –


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Thank you!