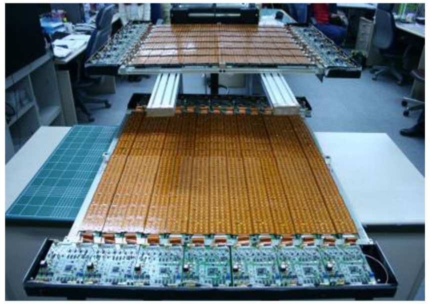
ISS-CREAM: CREAM on the ISS

Scott Nutter
Poster 696
ICRC2021

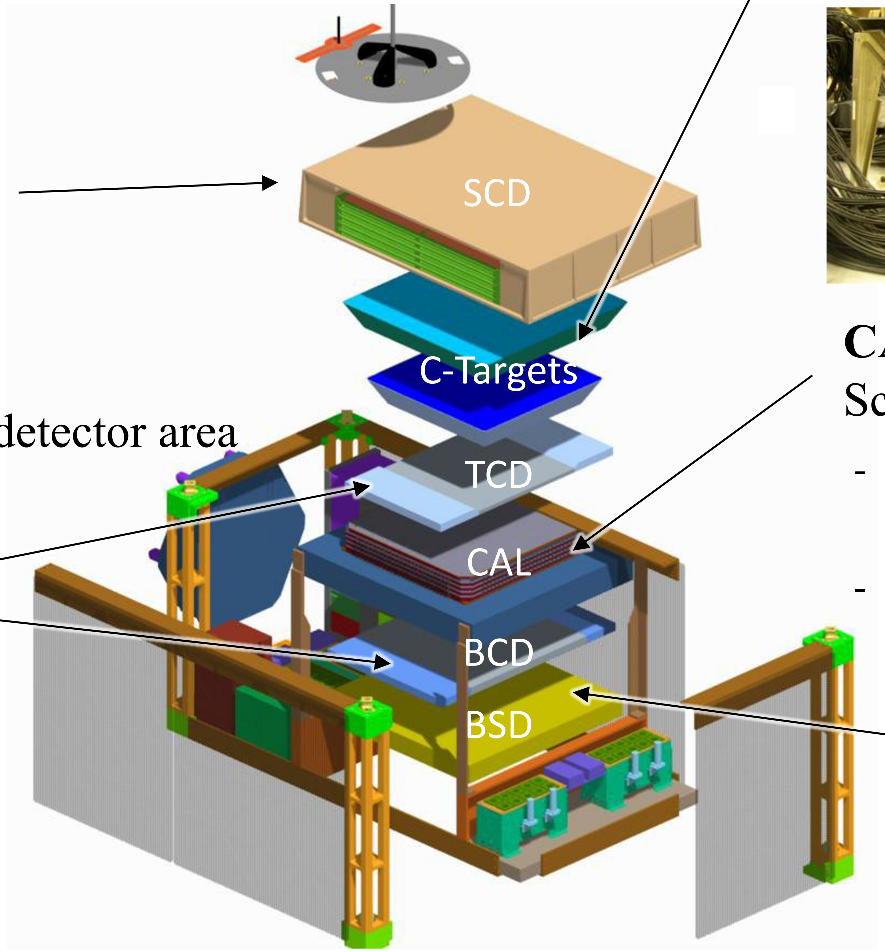


4 layer **S**ilicon **C**harge **D**etector

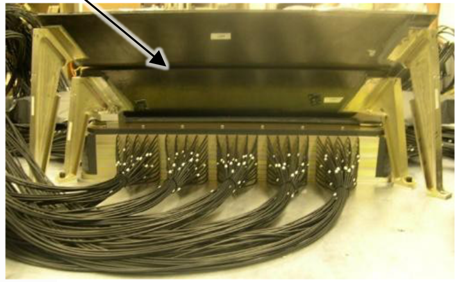
- Charge measurements
- 2.12 cm^2 pixels
- 79 cm x 79 cm active detector area

Top & **B**ottom **C**ounting **D**etectors

- Segmented for e/p separation
- Independent trigger
- Scintillator viewed by photodiode array



Carbon Targets (0.5 λ_{int}) induce hadronic interactions



CALorimeter (20 layers W + Scintillating Fibers, 1.0 λ_{int})

- Provides tracking: 2 views, 10 layers/view, 50 ribbons/layer
- Provides energy and trigger

Boronated **S**cintillator **D**etector

- Monolithic slab of boronated scintillator
- Alternative energy measurement

Adapted from E.S. Seo

ISS operations from 8/22/2017 to 2/12/2019

ISS-CREAM: Analysis Status

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- Early CAL-based analysis efforts resulted in fluxes orders of magnitude below expected values
  - Instrument performed reasonably otherwise. See K. Sakai Poster 1051
  - Fluxes calculated using BSD-determined energy are reasonable
  - Simulated CAL- and BSD-based "fluxes" reconstruct identically.
- Exhaustive search for inefficiencies
  - Track-independent machine learning cosmic ray identification algorithm did not identify additional showering events. See M. Yu Poster 476.
  - Investigated triggers, CAL, SCD, T/BCD, live time, reconstruction of dataset…
- Missing events may be due to ambiguity in absolute energy spectrum of calorimeter
  - Different electronics used on-orbit compared to beam calibrations.
    - Alteration extended dynamic range; difference inferred with assumptions about DAC full ranges
  - Sherlock Holmes: "When you have eliminated the impossible, **whatever** remains, however improbable, must be the truth."
- Energy rescaling of CAL compared to expectations from beam tests and inferred electronics changes
  - Absolute scale calibration from BSD comparison with MC expectations suggests scaling of 6-8
  - Details in Poster 866 by Yu Chen: On-Orbit Energy Calibration of the Calorimeter on the ISS-CREAM Instrument Using the Boronated Scintillator Detector

ISS-CREAM: Preliminary results

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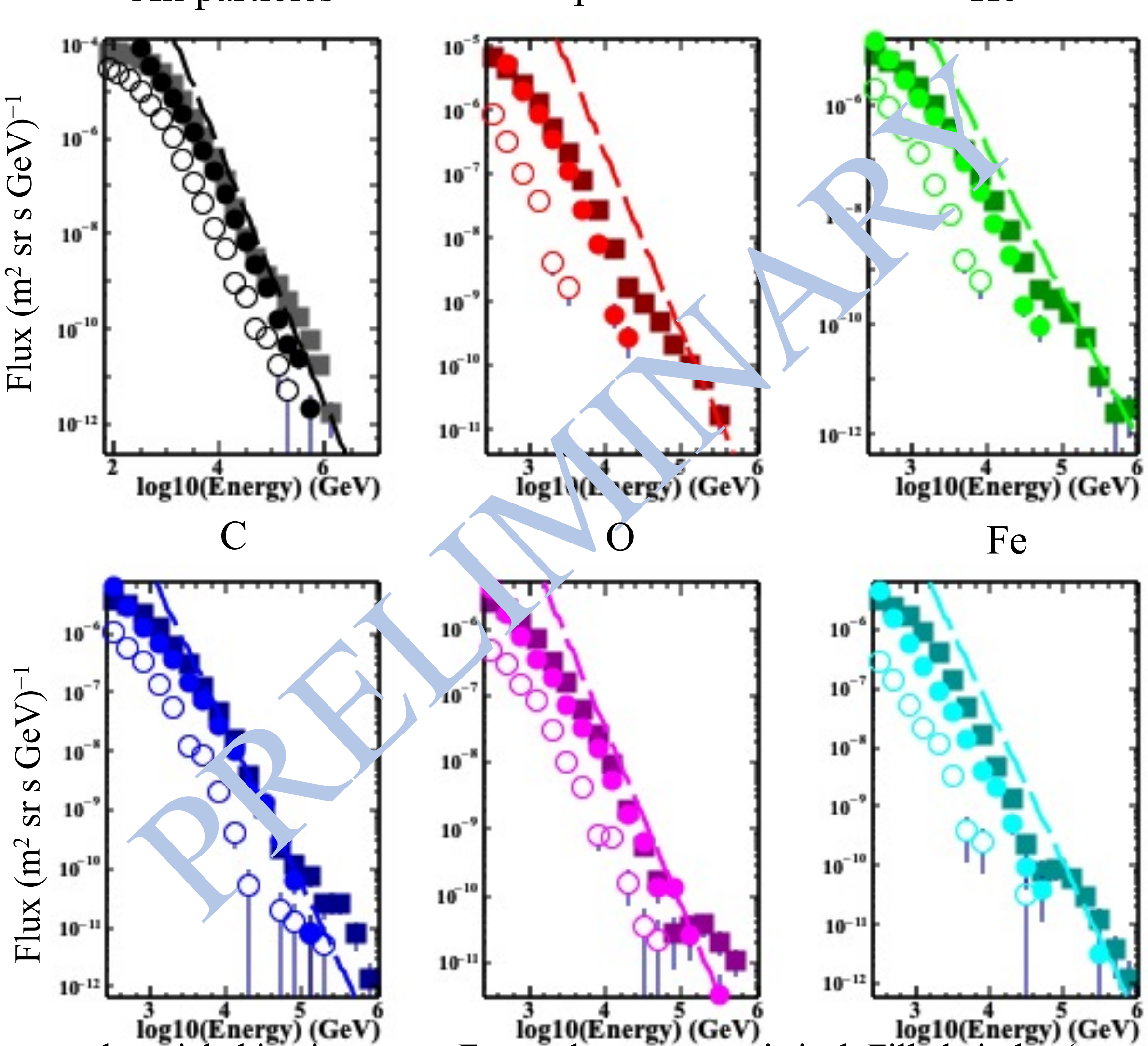
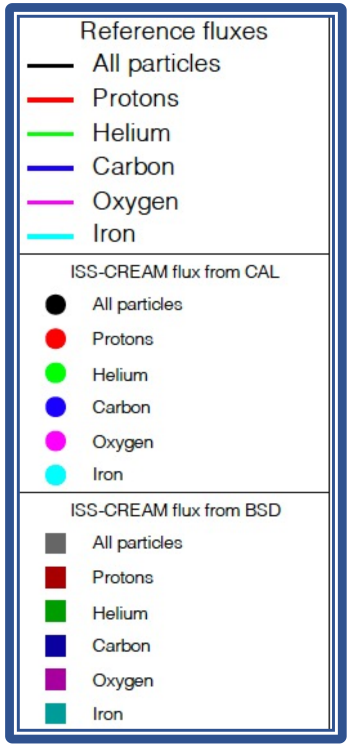
- Flux vs particle total kinetic energy for selected charges using conservative x6 scaling of CAL energies.
  - BSD calibration suggested factor of 6-8 solves many problems
    - More agreement between MC and on-orbit data
    - Reasonable fluxes/number of particle detections
      - Instrument threshold raised
    - Agreement between fluxes calculated with BSD and with CAL
- Future work:
  - Refine BSD calibration of CAL energy scale.
  - Refine proton selection cuts (tricky!).
  - Refine efficiency using on-orbit data compared to simulated data.
  - Estimate systematic errors.





Flux vs total particle kinetic energy. Errors shown are statistical. Filled circles (squares) are reconstructed from the x6 scaled CAL (BSD) energy deposit. Open circles are the flux using the original CAL energy scaling as described in the proceedings. Dashed lines are reference fluxes from Wiebel-Sooth, Biermann, and Meyer, *Astron & Astrophys,* v.330, p.389-398 (1998).