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Session J13 Cosmic Ray Science Interest Group



Status and Plan of the **ISS-CREAM** Experiment

Nicolas PICOT-CLEMENTE

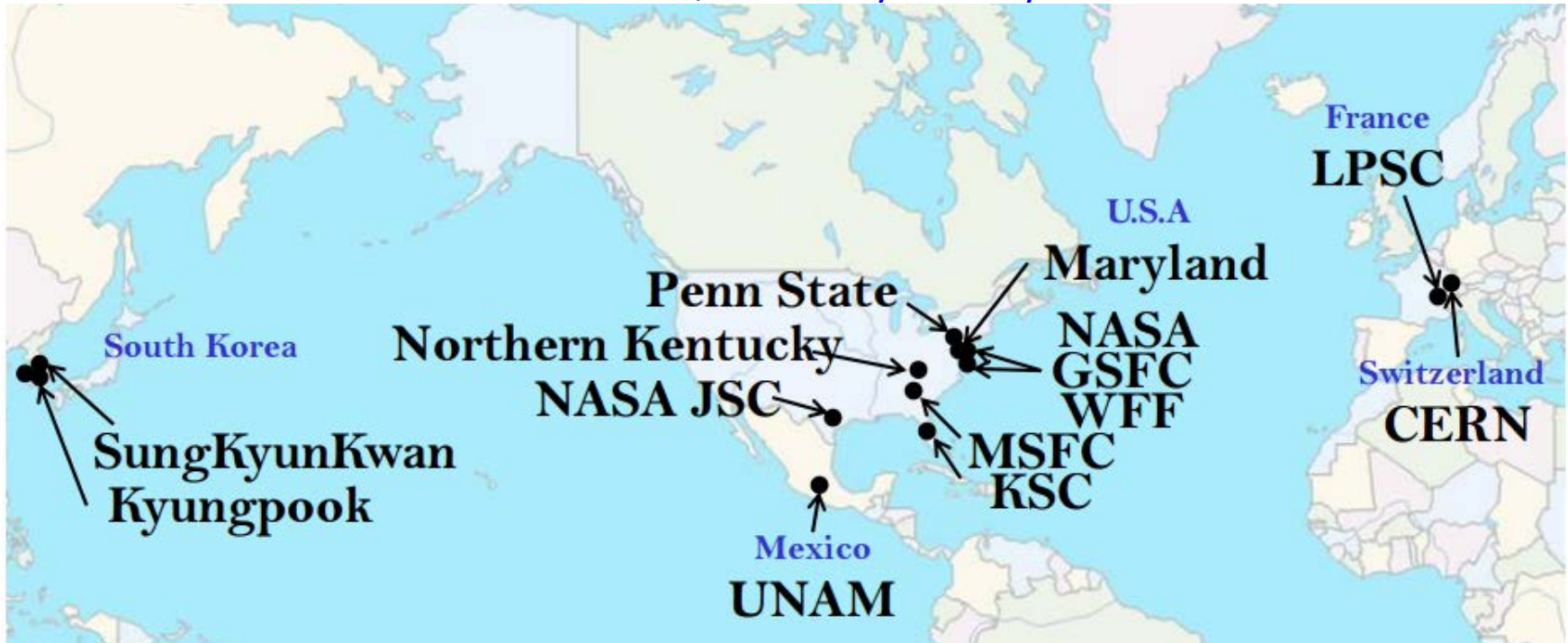
Institute for Physical Science and Technology

University of Maryland

For the ISS-CREAM collaboration

The ISS-CREAM Team

PI: Eun-Suk Seo, University of Maryland



Y. Amare, D. Angelaszek,, M. Copley, C. Ebongue,, I. Faddis, B. Fields, M. Gupta, J.H. Han, I. J. Howley, H.G. Huh, D.Y. Kim, K.C. Kim, M.H. Kim, K. Kwashnak, M.H. Lee, J. Liang, L. Lutz, A. Malinin, J. Meade, O. Ofoha, N. Picot-Clemente, E.S. Seo, J. R. Smith, P. Walpole, R.P. Weinmann, J. Wu, Y.S. Yoon
University of Maryland

T. Anderson, S. Coutu, S. Im
Penn State University

J.A. Jeon, J. Lee, H.Y. Lee, H. Lim, H.A. Park, I.H. Park
SungKyunKwan University, Korea

Y.S. Hwang, H.J. Hyun, H.B. Jeon, H. J. Kim, J. Lee, J.M. Park, H. Park
Kyungpook National University, Korea

S. Nutter
Northern Kentucky University

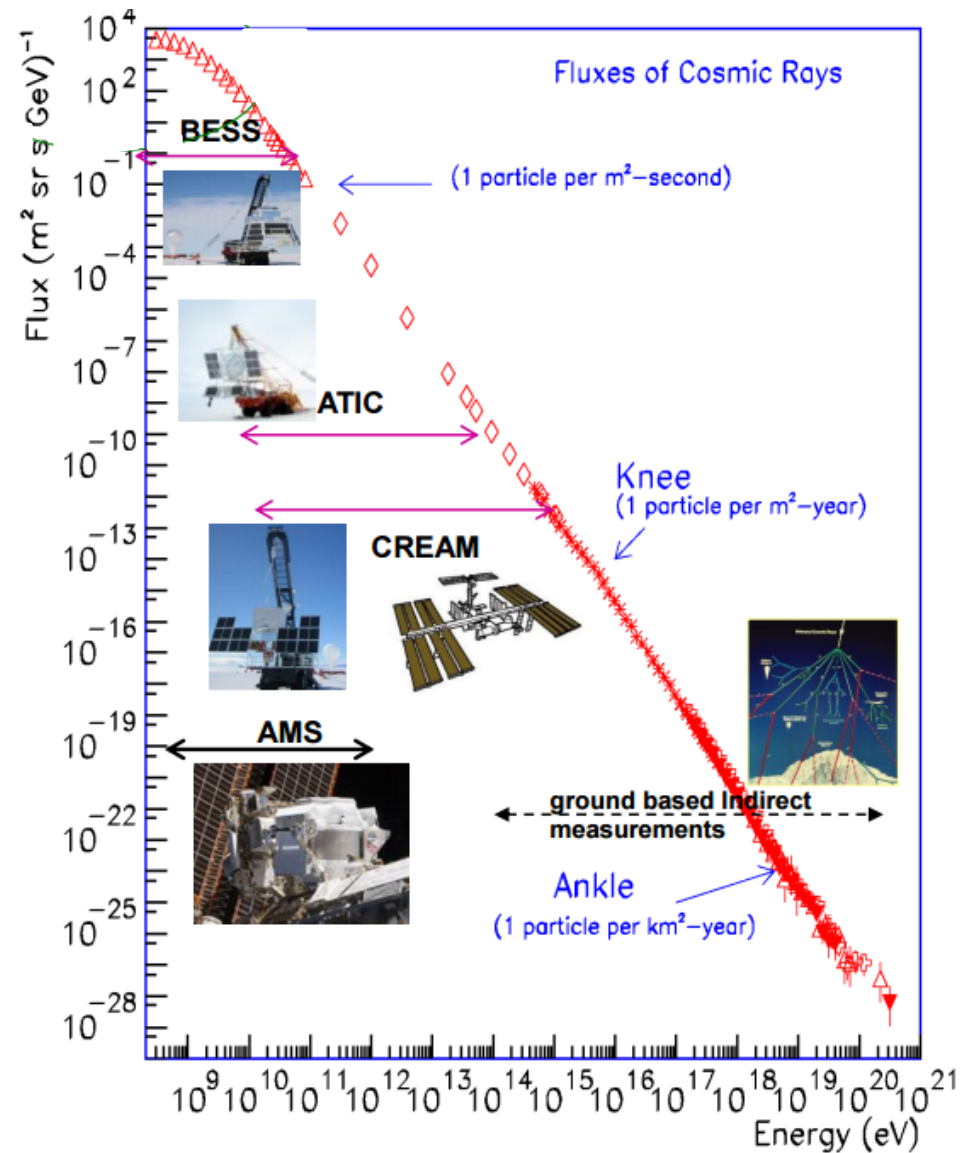
J.T. Link, J.W. Mitchell
NASA/Goddard Space Flight Center

M. Buénerd, L. Derome, L. Eraud
Laboratoire de Physique Subatomique et de Cosmologie, Grenoble, France

A. Menchaca-Rocha
Instituto de Fisica, Universidad Nacional Autonoma de Mexico, Mexico

Science Goals

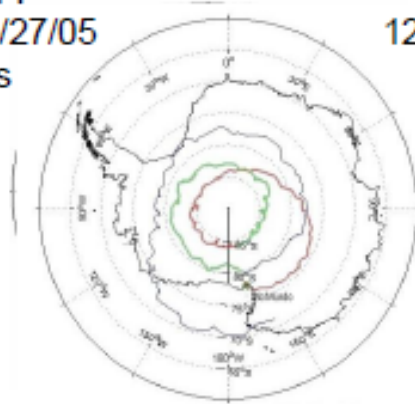
- ❑ ISS-CREAM is an instrument designed to **measure** and **identify** the elemental composition of incident cosmic-ray nuclei from 10^{11} to 10^{15} eV.
- ❑ Primary goal: Extend direct measurements of cosmic-ray energy spectra from proton to iron to the highest energies.
- ❑ Secondary goal: Bring precise measurements of electron flux at high energies.
- ❑ Science Objectives to address:
 - What are the acceleration mechanism and Galactic sources of high energy cosmic rays?
 - How do propagation affect cosmic-ray energy spectra?
 - What is the origin of the knee?



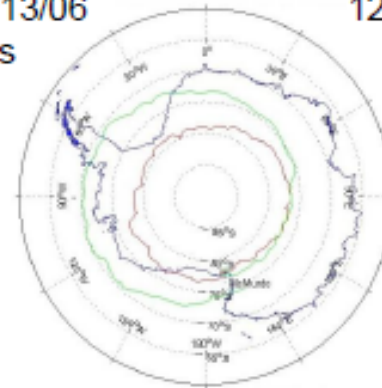
CREAM Balloon Flight Heritage

Six Balloon Flights in Antarctica in 6 years: ~ 161 days Cumulative Exposure

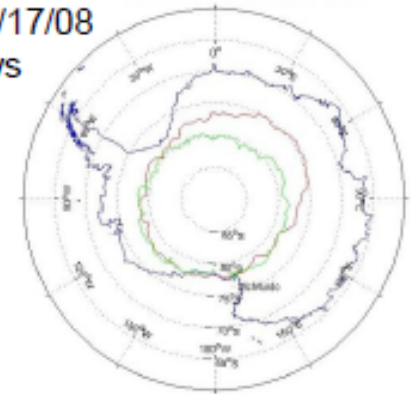
CREAM-I
12/16/04 – 1/27/05
42 days



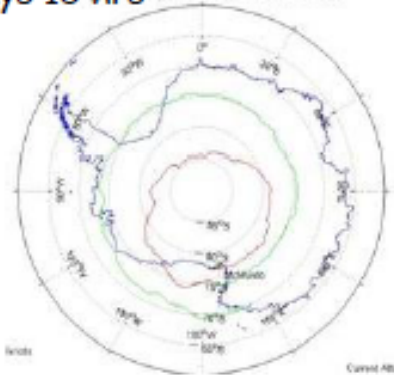
CREAM-II
12/16/05-1/13/06
28 days



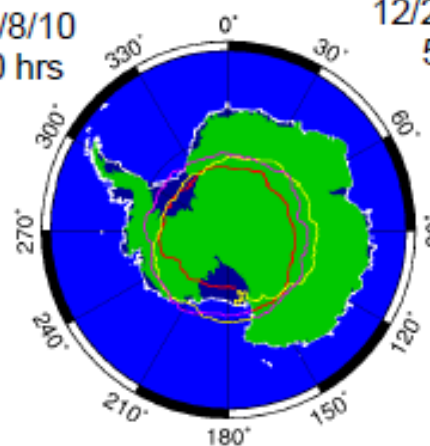
CREAM-III
12/19/07-1/17/08
29 days



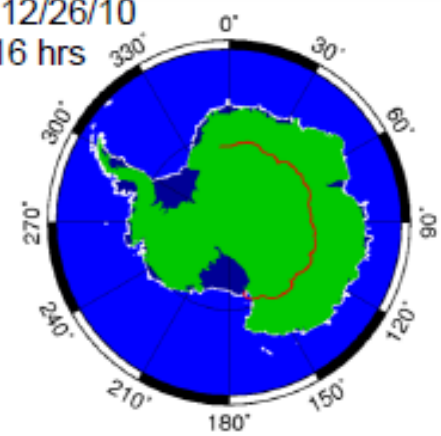
CREAM-IV
12/19/08 - 1/7/09
19 days 13 hrs



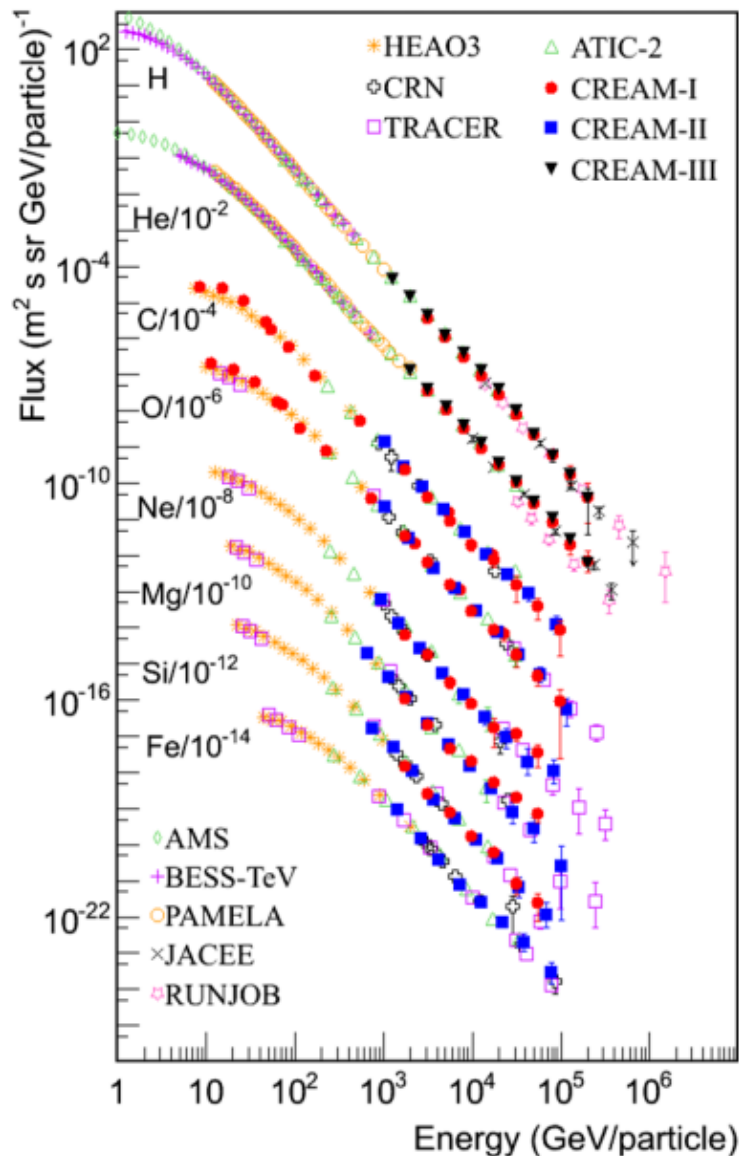
CREAM-V
12/1/09 – 1/8/10
37 days 10 hrs



CREAM-VI
12/21/10 – 12/26/10
5 days 16 hrs



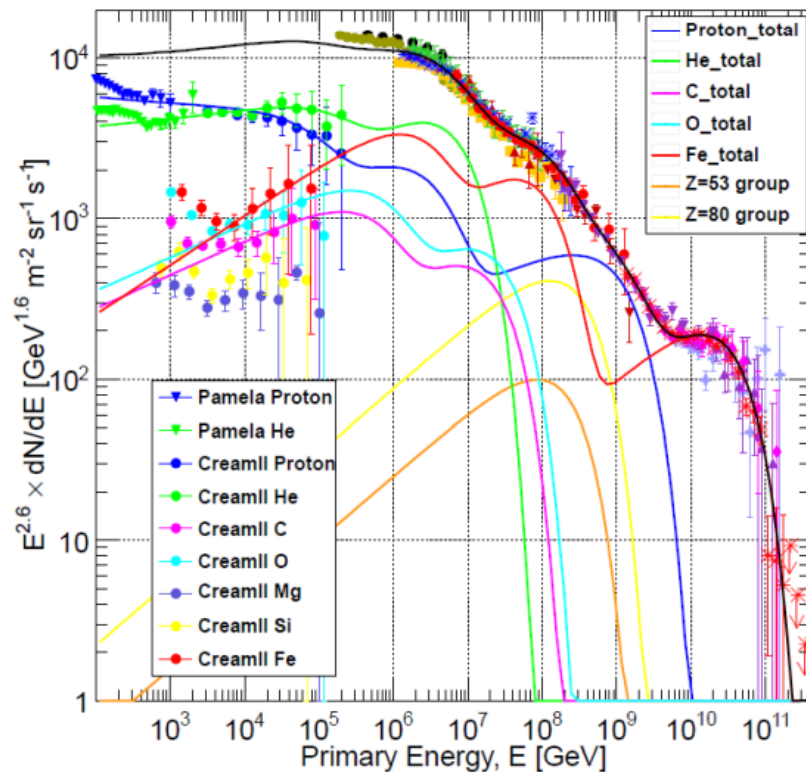
CREAM Elemental Spectra over 4 energy decades!



➔ Important information to help solve the knee puzzle.

Acceleration limit:

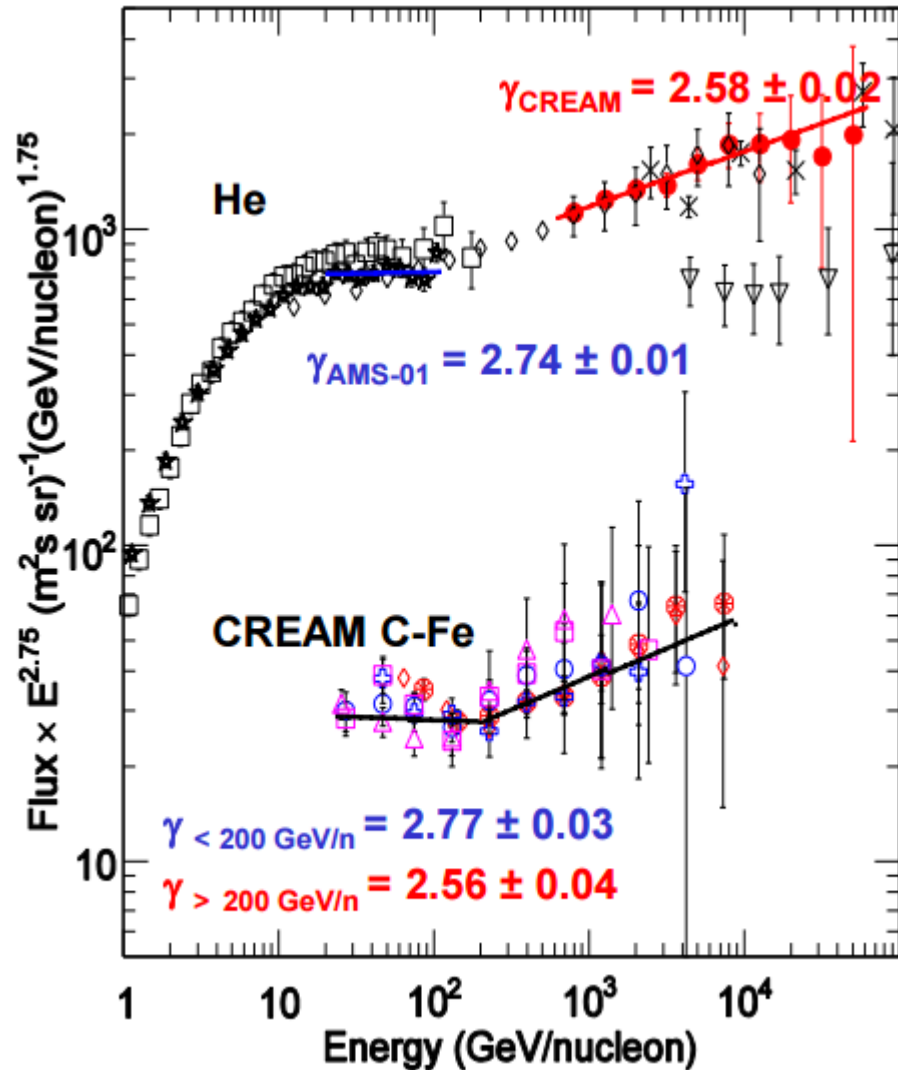
$$E_{\text{max}_z} = Z_e \times R = Z \times E_{\text{max}_p}, \text{ where rigidity } R = Pc/Z_e$$



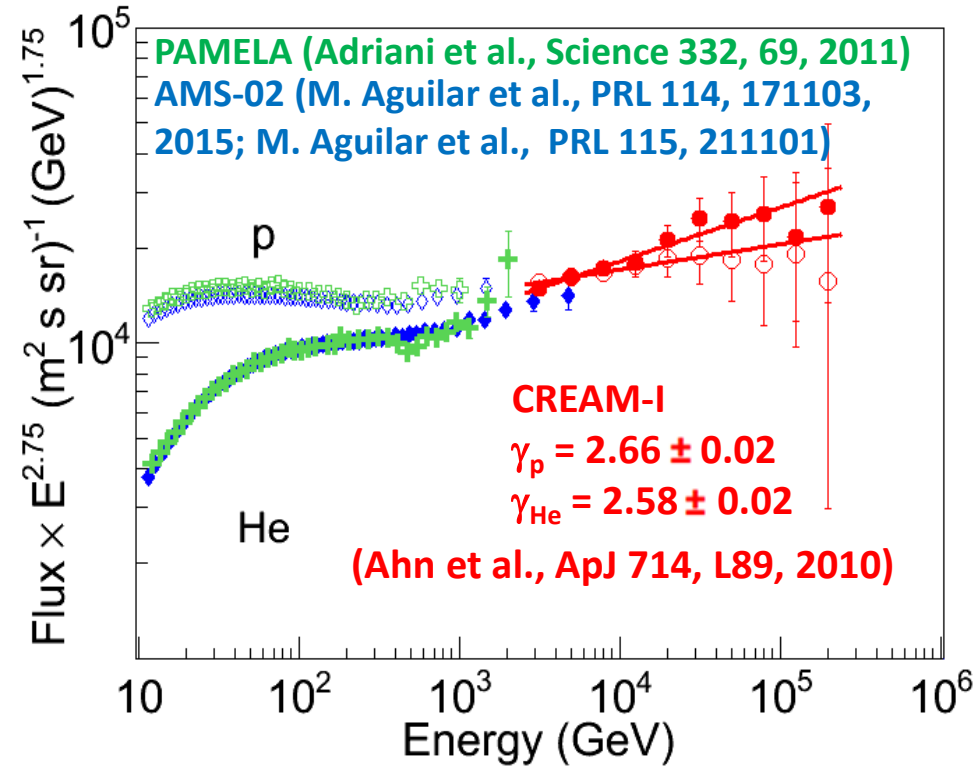
(T. K. Gaisser, T. Stanev and S. Tilav, Front. Phys. 8(6), 748, 2013)

(Yoon et al. ApJ 728, 122, 2011; Ahn et al., ApJ 715, 1400, 2010; Ahn et al. ApJ 707, 593, 2009)

CREAM Spectra Harder than Previous Measurements

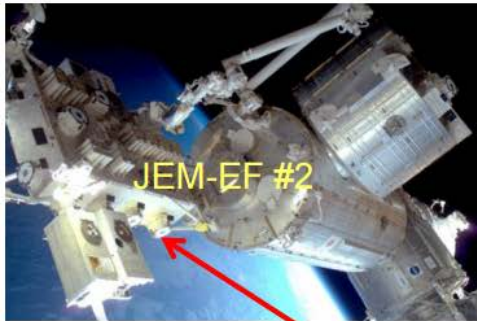


(Yoon et al. ApJ 728, 122, 2011)

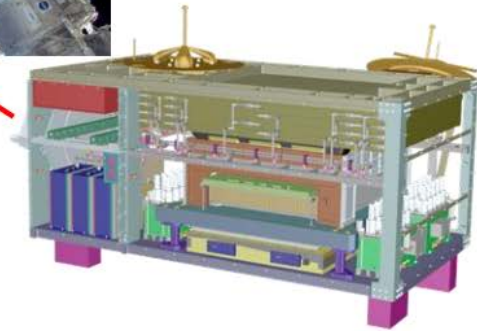


Important information to constrain acceleration and propagation models.

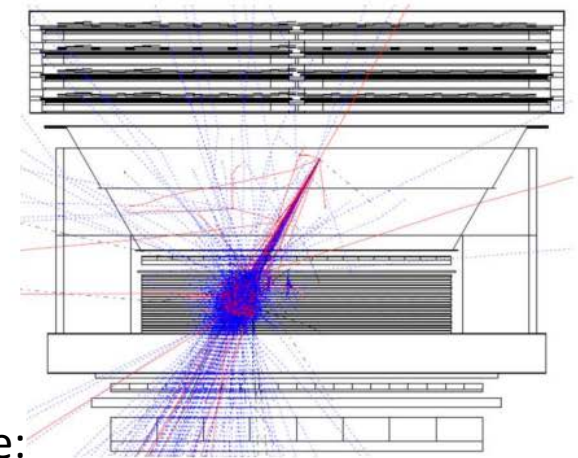
ISS-CREAM: CREAM for the ISS



To be installed on the ISS by
SpaceX-12 in 2017

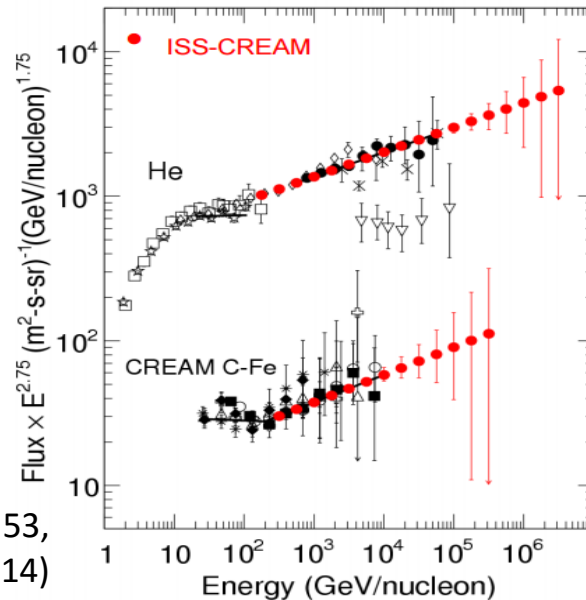


Mass: 1392 kg
Power: ~550 W
Nominal data rate:
~350 kbps

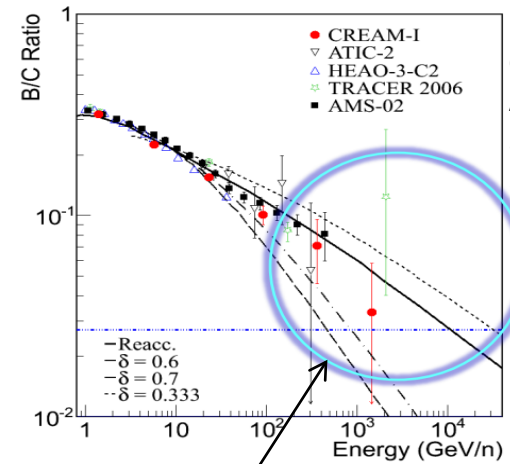


The CREAM payload has been redesigned for implementation on the ISS (NASA's share of JEM-EF).

Expected sensitivity after
3 years on the ISS →



(Seo et al., Adv. Space Res. 53,
1451-1455, 2014)



(Ahn et al., CREAM
Collaboration,
Astropart. Phys.,
30/3, 133-141,
2008)

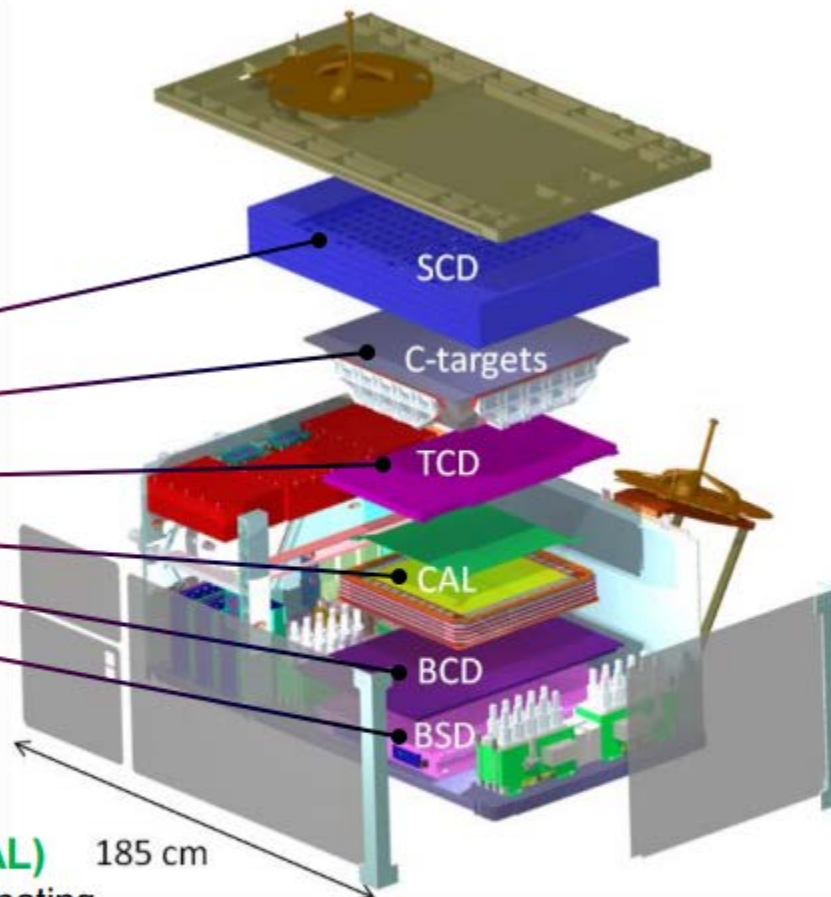
ISS-CREAM to fill data in
this region

The ISS-CREAM Instrument

(Seo et al., Adv. Space Res. 53, 1451-1455, 2014)

Silicon Charge Detector (SCD)

- Precise charge measurements with charge resolution of $\sim 0.2e$.
- 4 layers of 79 cm x 79 cm active area (2.12 cm^2 pixels).



Top/Bottom Counting Detector (T/BCD)

- Plastic scintillator instrumented with an array of 20×20 photodiodes for e/p separation.
- Independent trigger.

Calorimeter (CAL) 185 cm

- 20 layers of alternating tungsten plates and scintillating fibers.
- Determines energy.
- Provides tracking and trigger.

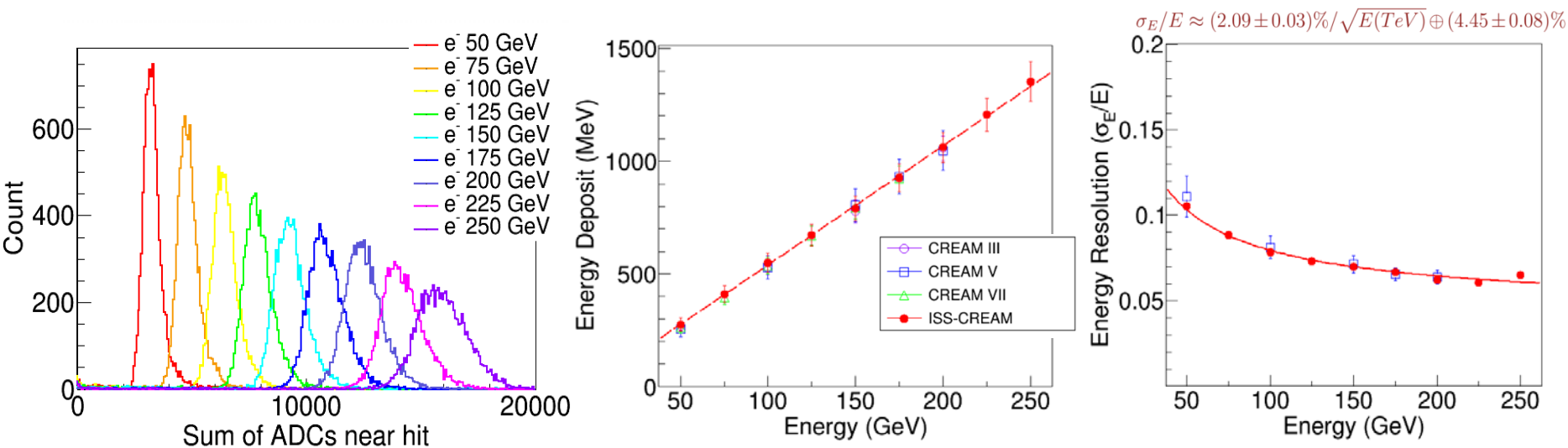
Boronated Scintillator Detector (BSD)

- Additional e/p separation by detection of thermal neutrons.

Performance of the Calorimeter with Electron Beam

The ISS-CREAM CAL is identical to CREAM.

A beam test was performed in August 2015 at CERN to characterize the performances of the detector.

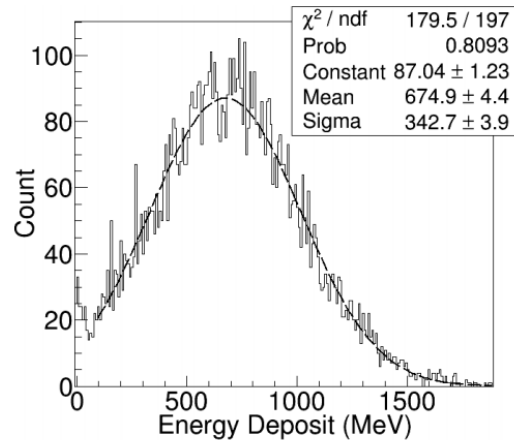


(Ahn et al., to be submitted)

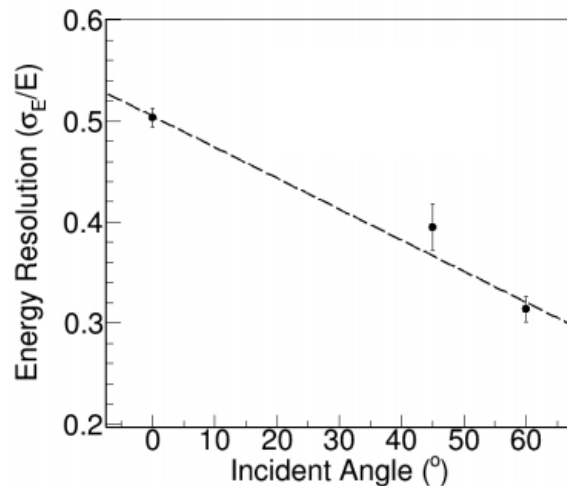
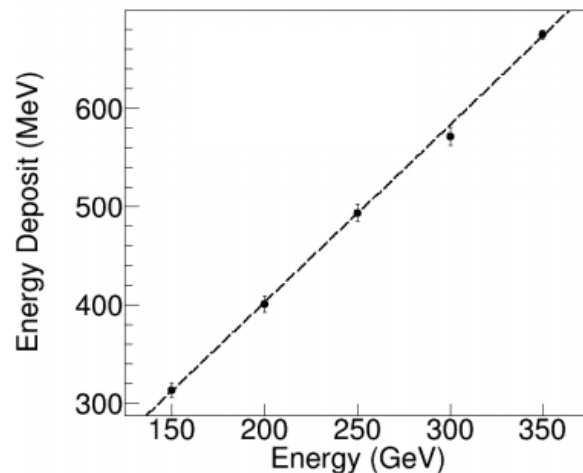
ISS-CREAM data are **consistent** with **previous CREAM** calorimeter measurements.
Very good linear energy response of the detector with electrons.

Performance of the Calorimeter with Pion Beam

Signal of 150 GeV Pions



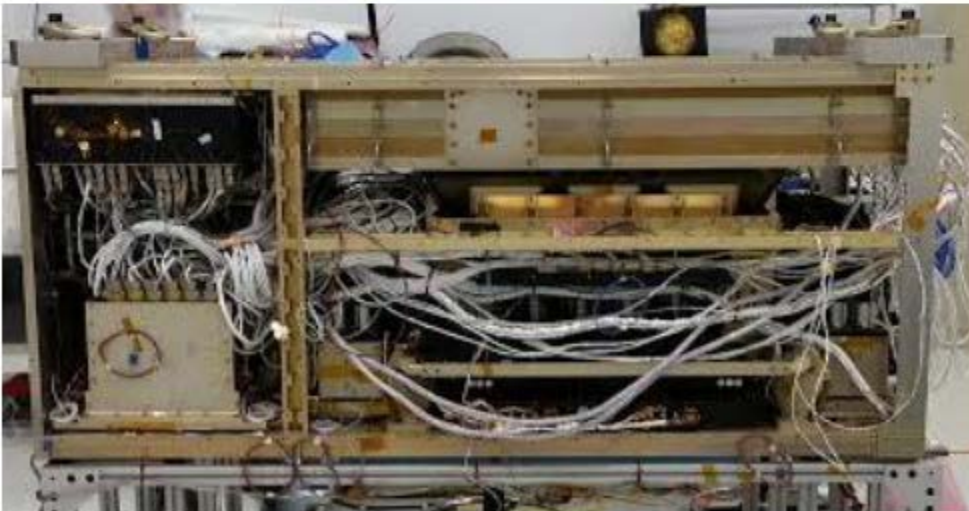
(Ahn et al., to be submitted)



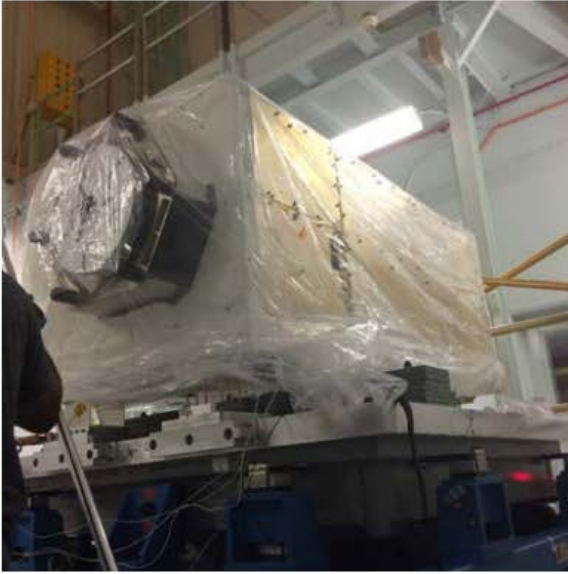
Energy resolution expected to be
~ 40% in average for isotropic
cosmic rays.

**Very good linear energy
response of CAL with pions.**

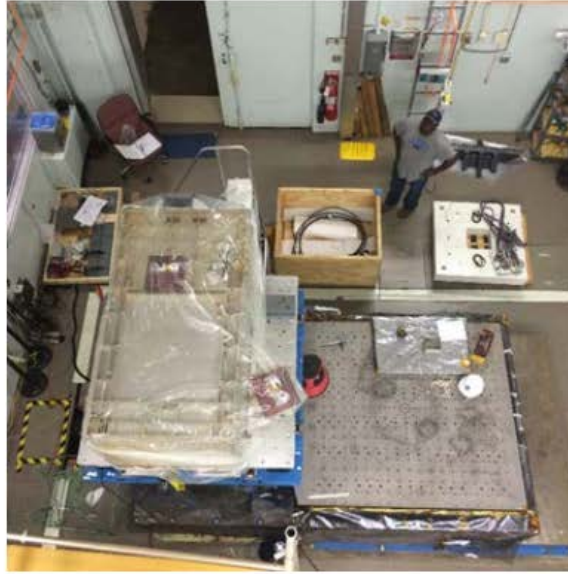
ISS-CREAM Integration at WFF



ISS-CREAM Vibe test and TVAC at GSFC



Vertical table



Vertical table - top view

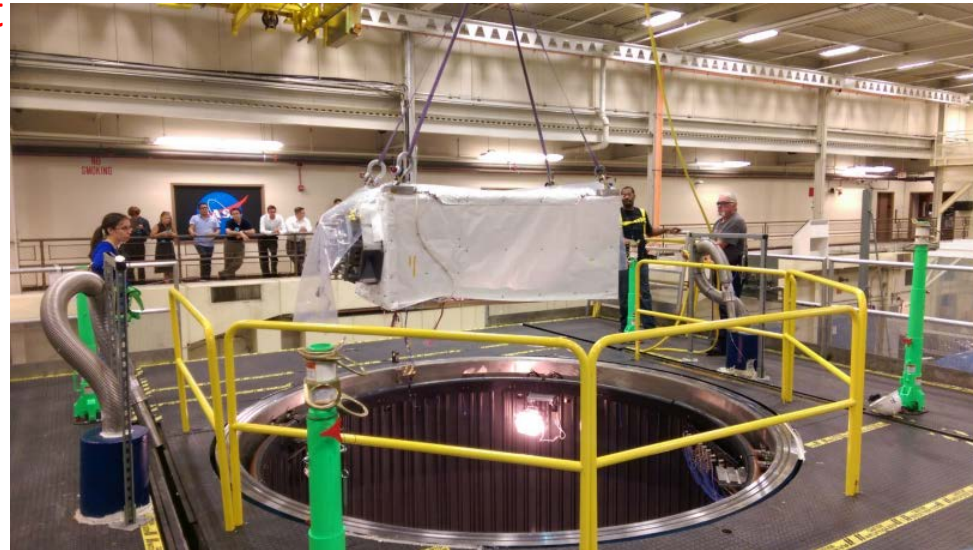


Acoustic chamber

TVAC test



N. Picot-Clément




ISS-CREAM Status & Plan

ISS-CREAM at KSC




Cosmic-Ray Observatory on the ISS

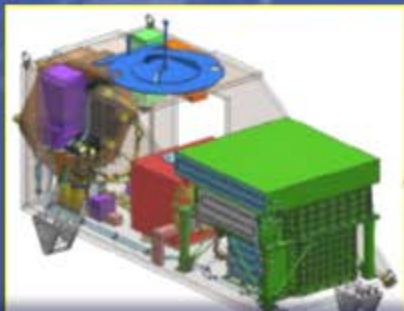
to solve the Mysteries of
Dark Matter &
Origin of Cosmic Rays



AMS-02 Launch
May 16, 2011



ISS-CREAM SpX-12
Launch 2017



CALET Launch
Aug. 19, 2015



JEM-EUSO
planned for
launch > 2020