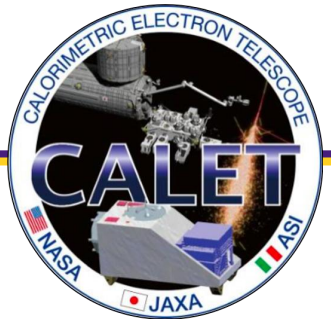
CALET in the USA

Nicholas Cannady
CALET-US Collaboration

CALET 10th Anniversary Symposium
Waseda University – Tokyo, Japan
November 15, 2025

Participating CALET-US Institutions



LSU
LOUISIANA STATE UNIVERSITY

CALET-US Lead Institution
- Local PI: Michela Negro
- US CALET Data Center (USCDC)
- HPC Facilities
- Postdoctoral Researchers
- PhD Students

WashU

Collaborating University
- Local PI: Wolfgang Zober
- US CALET Data Center (USCDC)
- Research Faculty
- Postdoctoral Researchers
- PhD Students

NASA
Goddard
Space Flight Center

Collaborating NASA Center
- Local PI: John F. Krizmanic
- HPC Facilities
- CS Researchers
- Postdoctoral Researchers

University of Colorado
Boulder

Guest Collaborators for Space Weather
- Tenured Faculty
- PhD Students

High-Performance Computing (HPC)

LSU HPC for CALET

- SuperMike-II cluster
  - 146 Tflop total
  - 440 nodes with 16 Intel Xeon cores each
- SuperMike-III cluster
  - 1.3 Pflop total
  - 171 nodes with 64 Intel Xeon cores each

CALET has repeatedly won competitive allocations on HPC resources at LSU

- 6 proposals submitted and awarded over a span of 10 years
- Over 10,000,000 CPU-hours used for shared EPICS simulations of e-, p, He, and more

NCCS ADAPT at GSFC

GSFC HPC for CALET

CALET has a persistent allocation on the NCCS ADAPT cluster at GSFC

- 21 VM nodes with 24 AMD cores each
- 50 TB local storage
- Simulation and processing of event-by-event TeV electron/proton datasets

CALET-US Research Overview

Cosmic-Ray Electrons

- Lead: Nicholas Cannady
- Participants: GSFC, LSU
- Topics:
  - Event-by-event analysis of TeV-energy candidates
  - Supervised and unsupervised machine learning approaches for electron identification

Ultra-Heavy Nuclei

- Lead: Wolfgang Zober
- Participants: WUSTL, GSFC
- Topics:
  - Abundances relative to $_{26}$Fe of nuclei up to $_{44}$Ru
  - Geomagnetic field effects

Operations Support

- Lead: Nicholas Cannady
- Participants: GSFC, LSU
- Topics:
  - Data quality monitoring
  - Large-scale simulations
  - Data archival
  - Field-of-view studies

Gamma-Ray Astrophysics

- Lead: Michela Negro
- Participants: LSU, WUSTL, GSFC
- Topics:
  - Galactic center excess
  - Prominent sources
  - Transient follow-up for GRBs and gravitational wave events

Space Weather

- Lead: Alessandro Bruno
- Participants: GSFC, LSU, CU Boulder
- Topics:
  - Relativistic electron precipitation
  - Heliospheric transients
  - Geomagnetic storms and radiation belt dynamics

CALET Electrons at TeV Energies

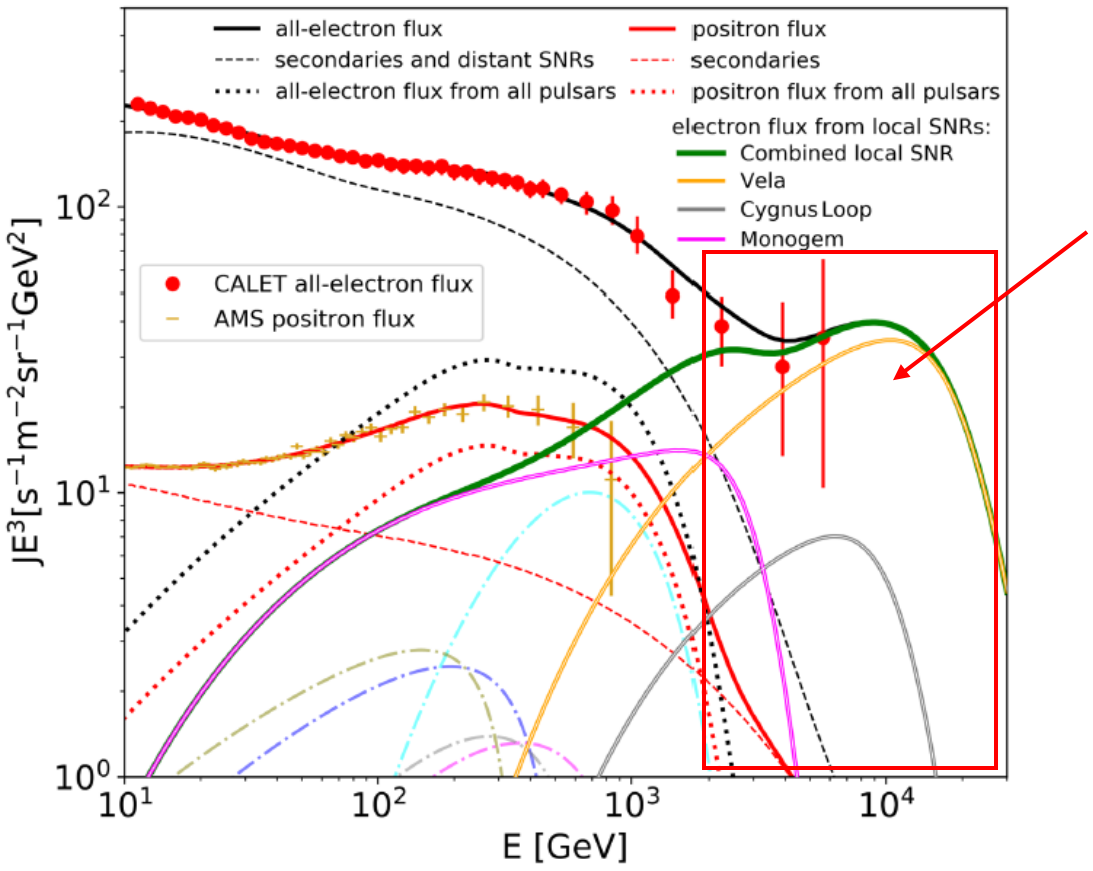
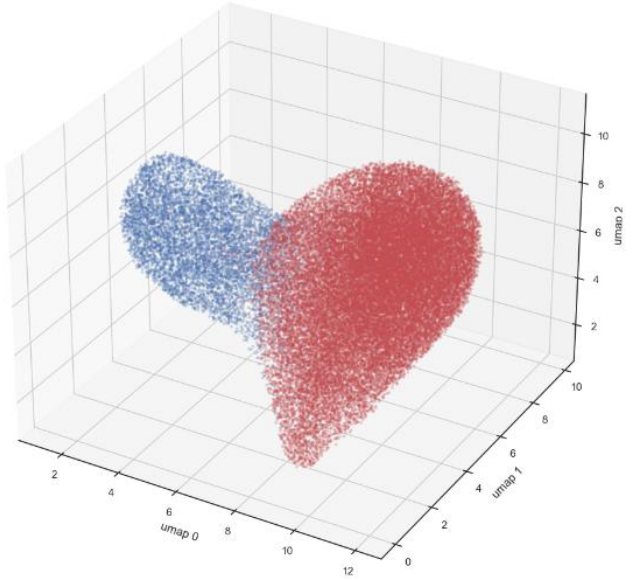


FIG. 4. Possible spectral fit over the whole region of CALET observations, including pulsars and nearby SNR sources as individual sources, with the Vela SNR dominating in the TeV region. See details in text.

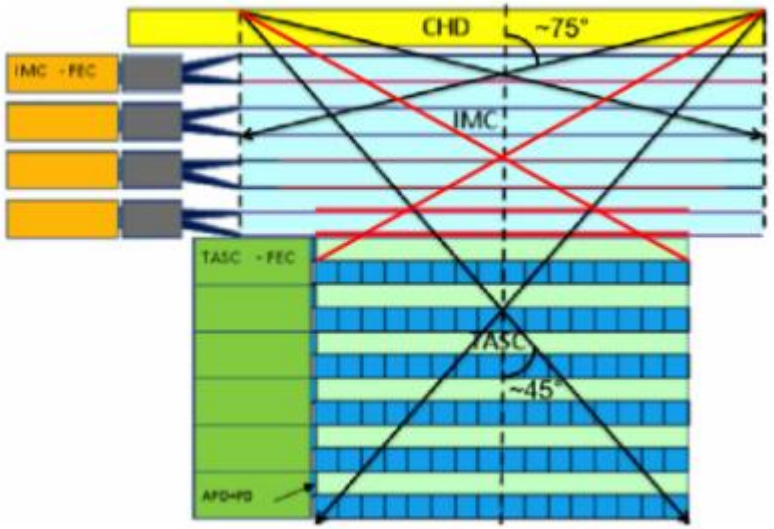
In the multi-TeV region, CALET may reveal the signature of a nearby source (the Vela SNR) for the first time.

The CALET-US team works directly with CALET-JP colleagues in an **event-by-event analysis** of candidate events.



At LSU and GSFC, the team also focuses on potential novel approaches for electron-proton separation.

Ultra-Heavy Nuclear Abundances with CALET



CALET results are very consistent with HEAO-3, ACE-CRIS, and SuperTIGER.

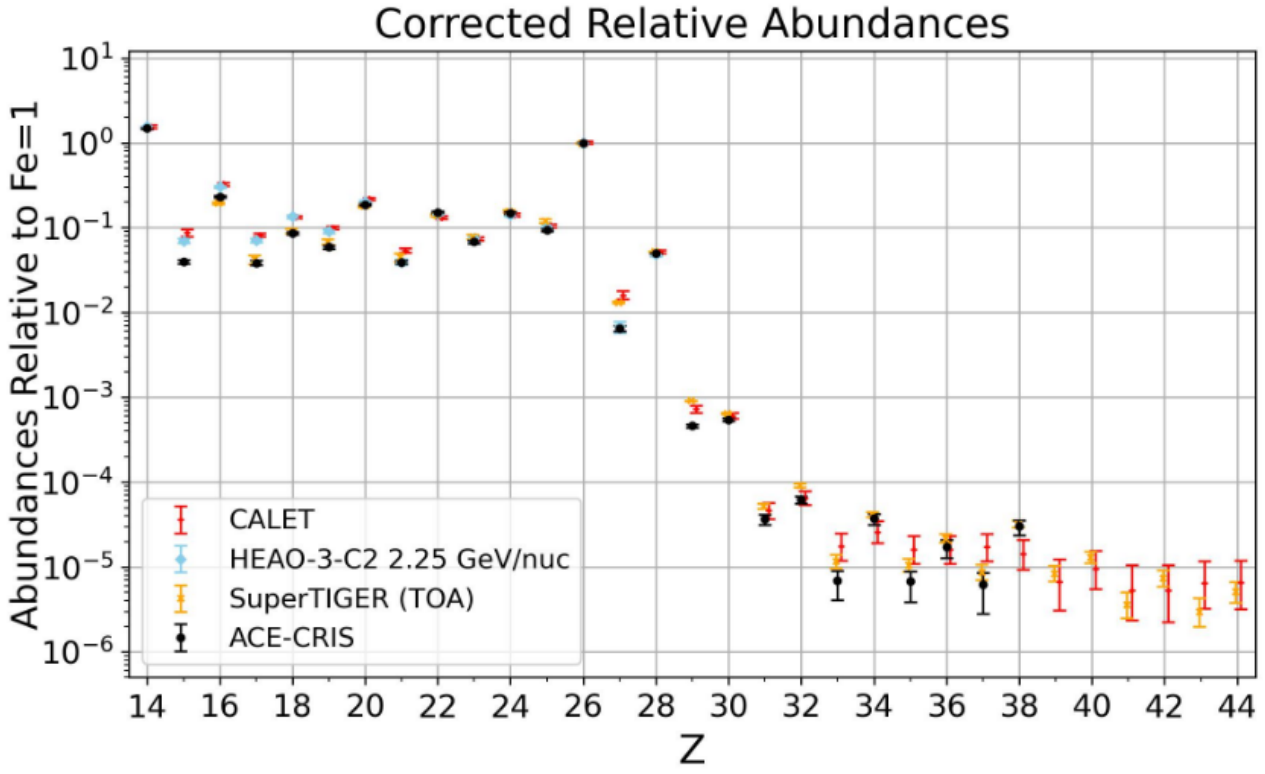
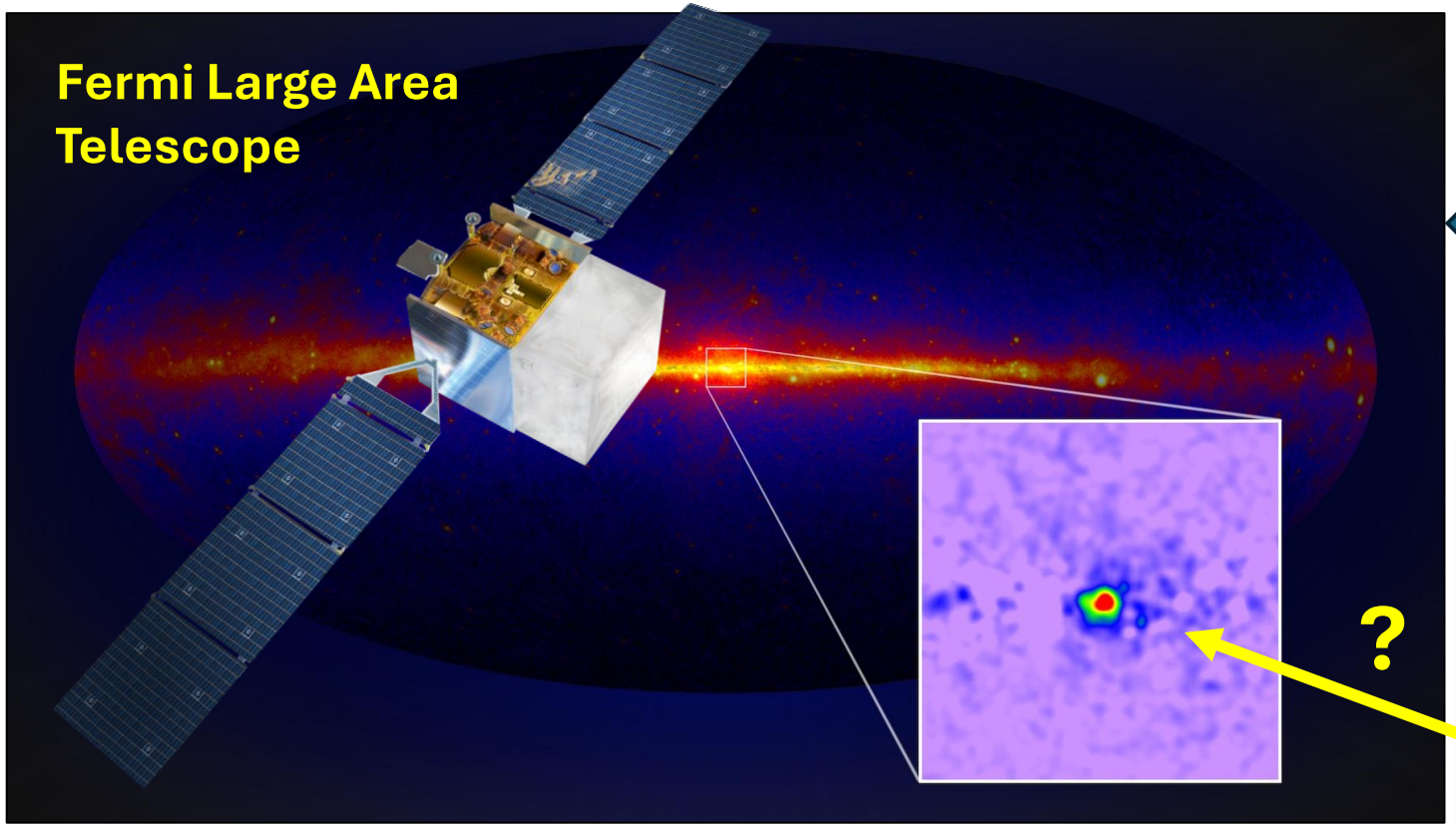


Figure 10. Corrected CALET relative abundances from Table 2 and plotted alongside results from several other experiments. For lower Z, CALET is able to be compared to HEAO-3-C2 (J. J. Engelmann et al. 1990), the SuperTIGER top of instrument (N. E. Walsh et al. 2022), and ACE-CRIS (M. H. Israel et al. 2018; W. R. Binns et al. 2022) abundances. The data used from ACE-CRIS and HEAO-3-C2 are the propagated source abundances.

Analysis by the WUSTL and GSFC teams – with long experience in the TIGER and SuperTIGER missions – achieved a measurement of abundances up to $_{44}$Ru.

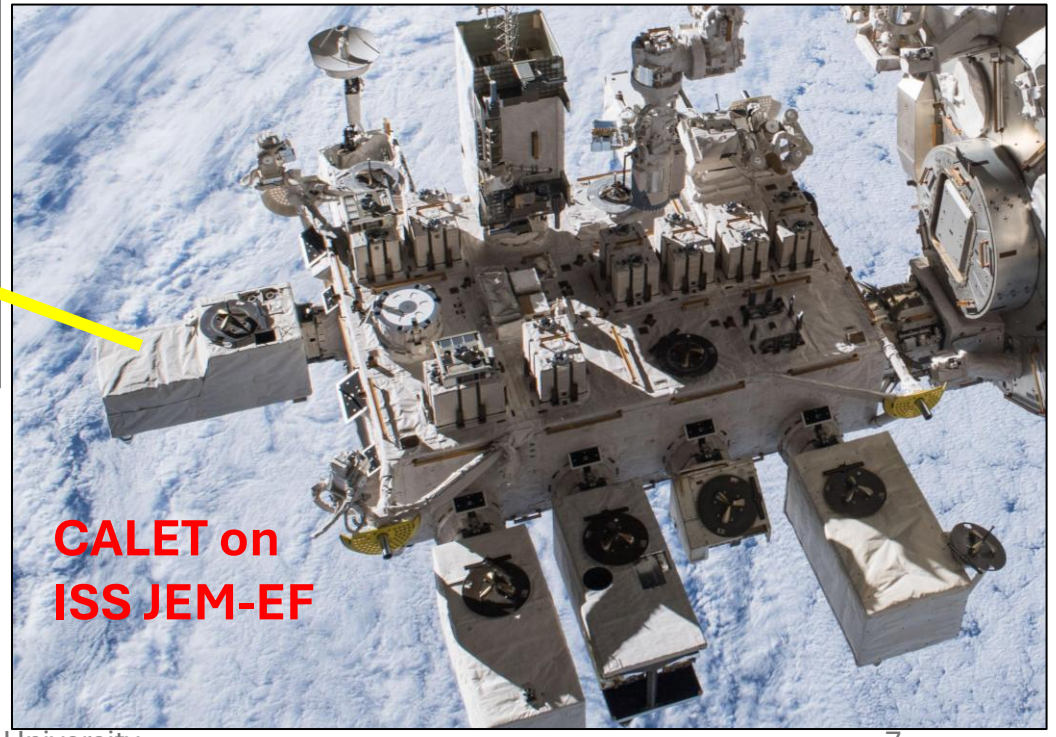
This measurement uses a special trigger mode which only requires signals in the CHD and IMC.

Gamma-ray Analysis with CALET



GeV-energy excess detected with Fermi-LAT
Dark Matter?
Unresolved sources?

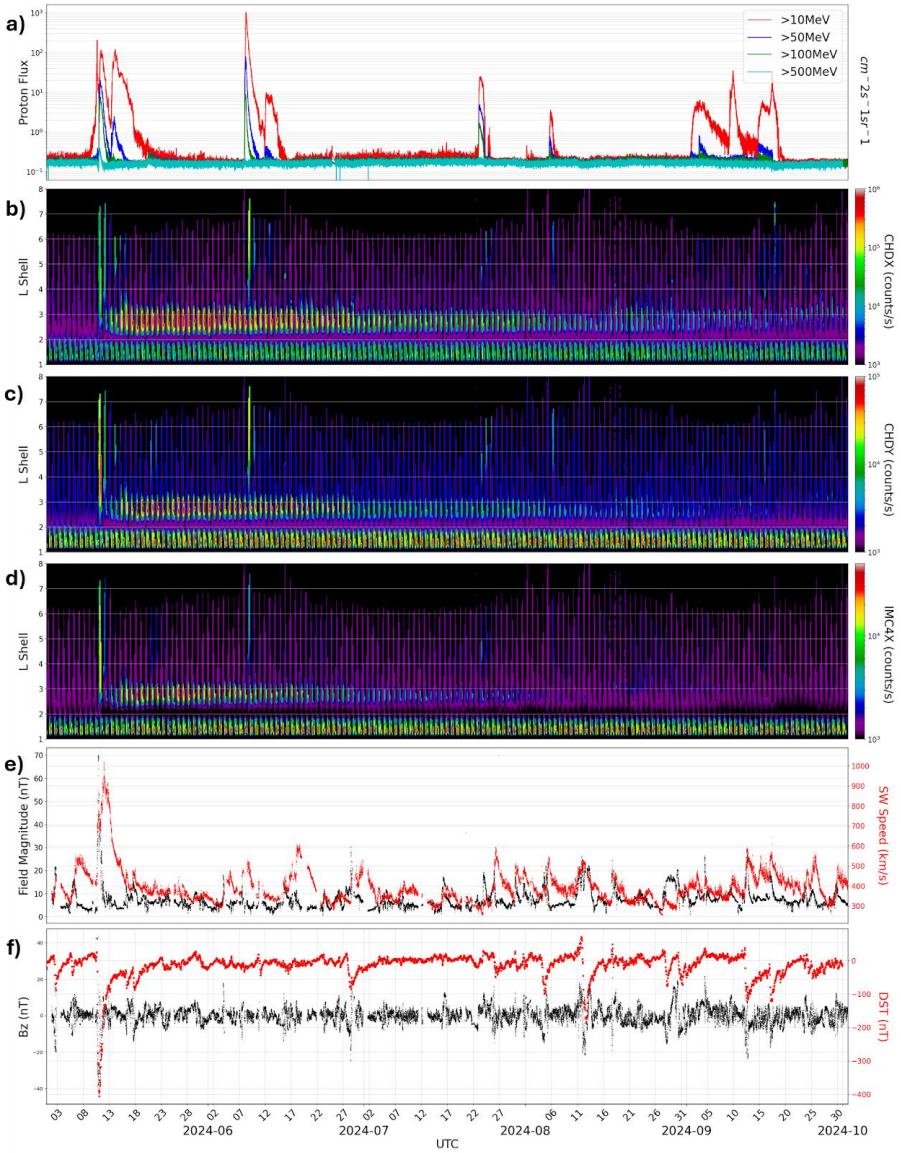
?



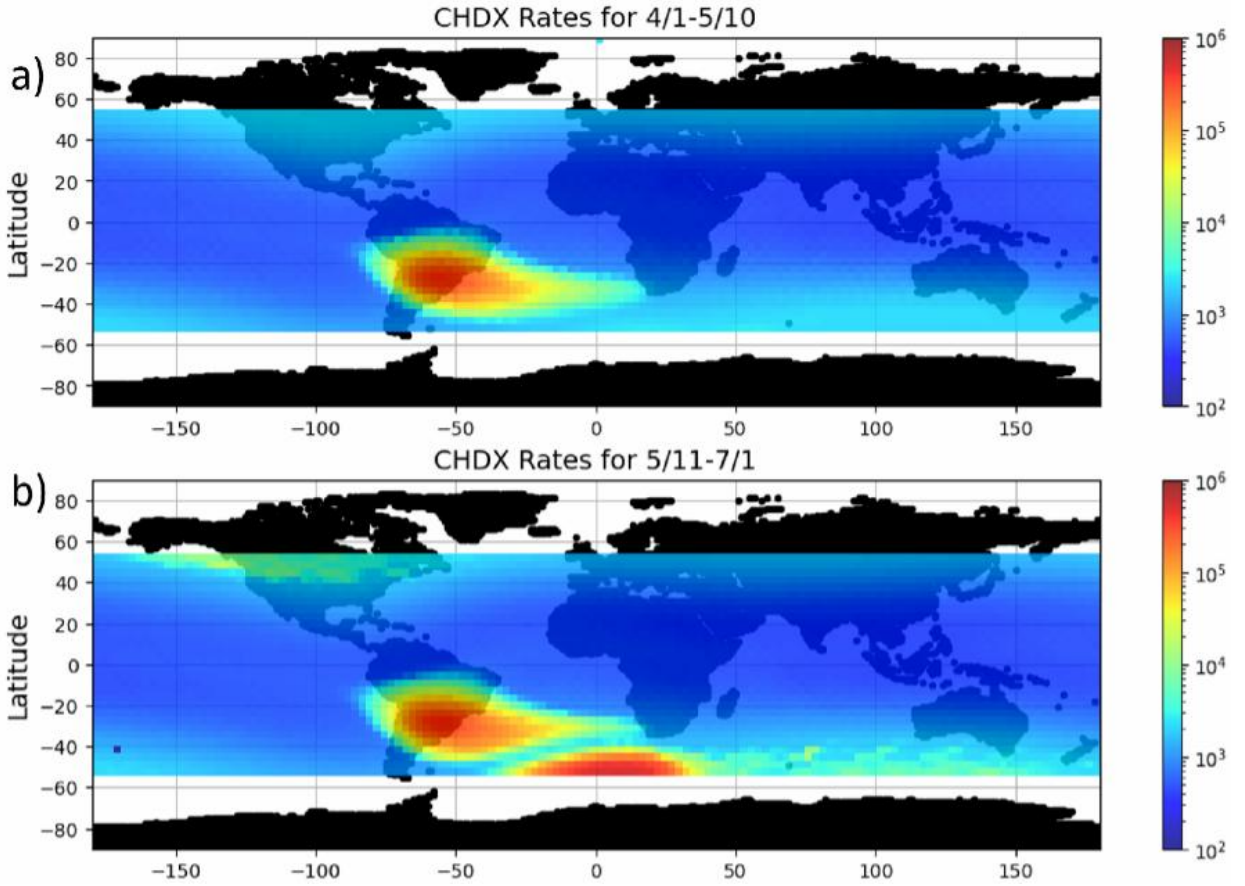
The CALET-US team is studying the potential for joint CALET + LAT analysis of the GC region

CALET could help resolve the mystery of its origin.

Space Weather – May 2024 Solar Event



CALET shows a new, long-lived MeV-energy electron storage ring in the geomagnetic field after the May 2024 activity.



Summary

Congratulations on 10 years of successful CALET operations to everyone involved in making it a reality!

- CALET has extended direct cosmic-ray measurements to new frontiers of energy and particle species
- Continuing productive cooperation between Japan, Italy, and US teams will yield even more valuable scientific results
- We are very pleased and excited to continue this fruitful collaboration through 2030 and beyond!

Thank you!