# CALETによる11GeV-4.8TeVの全電子スペクトル観測

## All-Electron Energy Spectrum from 11GeV to 4.8TeV with CALET


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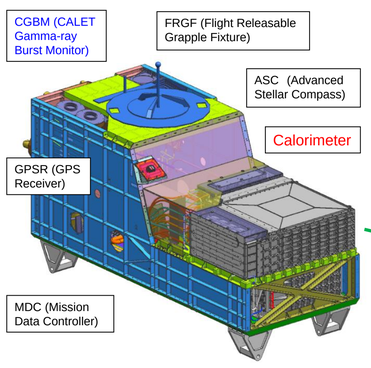
**Abstract: Extended results on the cosmic-ray electron + positron spectrum from 11 GeV to 4.8 TeV are presented based on observations with the Calorimetric Electron Telescope (CALET) on the International Space Station utilizing the data up to November 2017. The analysis uses the full detector acceptance at high energies, approximately doubling the statistics compared to the previous result.**


## 1. Introduction

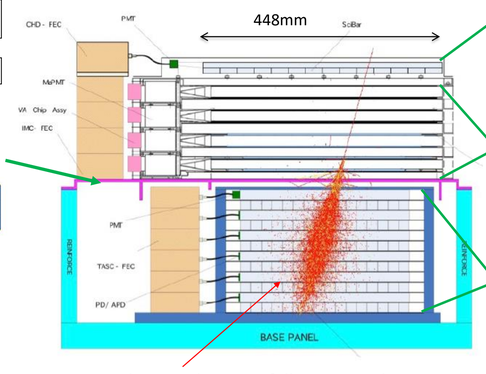
The CALET Collaboration managing the CALorimetric Electron Telescope (CALET) a space-based instrument optimized for the measurement of the all-electron spectrum, published its first result in the energy range from 10 GeV to 3 TeV [PRL 119 (2017) 181101]. Subsequently, the DArk Matter Particle Explorer (DAMPE) collaboration published their all-electron spectrum in the energy range from 25 GeV to 4.6 TeV [Nature 552 (2017) 63]. The latter publication was followed by many papers speculating about the origin of a peak-like structure near 1.4 TeV in the DAMPE data. It is important for CALET to update our results to better compare with DAMPE's spectrum.

## 2. CALET Instrument




- **Mass: 612.8 kg**
- **JEM Standard Payload Size:**
  **1850mm(L) × 800mm(W) × 1000mm(H)**
- **Power Consumption: 507 W（max）**
- **Telemetry:**
  **Medium 600 kbps (6.5GB/day) / Low 50 kbps**

Fully active thick calorimeter ($30X_0$) optimized for electron spectrum measurements well into the TeV region




**Charge Detector** **CHD**
**plastic scintillator hodoscope,** absolute charge measurement (including charge zero)

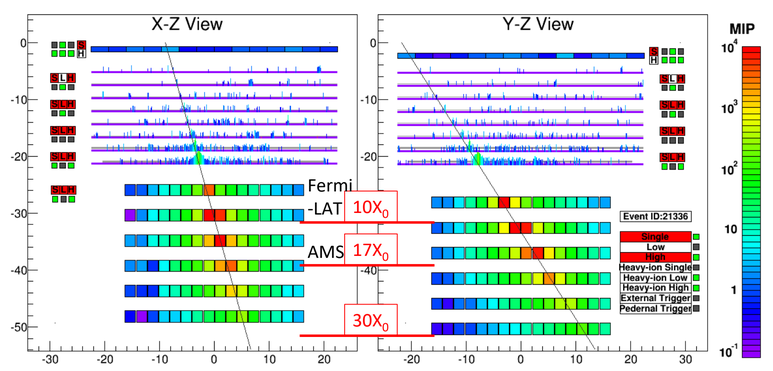
**Imaging Calorimeter** **IMC**
**SciFi + tungsten plate ($3X_0$),** reconstruction of shower axis and initial shower development

**Total Absorption Calorimeter** **TASC**
**PWO hodoscope (27X0),** energy measurements and particle identification

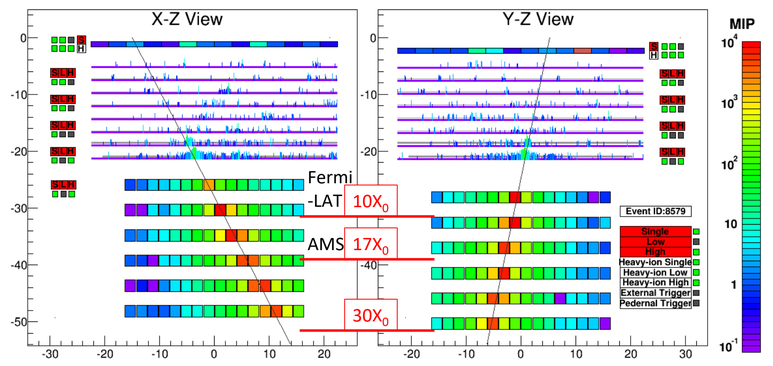
1TeV electron shower is fully contained in TASC
(95% of primary electron energy is actually measured by TASC)

## 3. CALET Capability of All-Electron Measurements

**3TeV Electron Candidate**




**Corresponding Proton Background**




CALET is a dedicated detector for all-electron spectrum measurements.

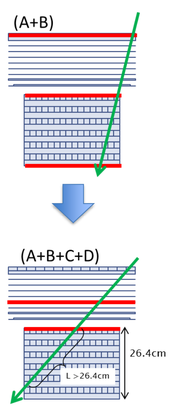
1. **Reliable tracking**
   well-developed shower core
2. **Fine energy resolution**
   full containment of TeV showers
3. **High-efficiency electron ID**
   $30X_0$ thickness

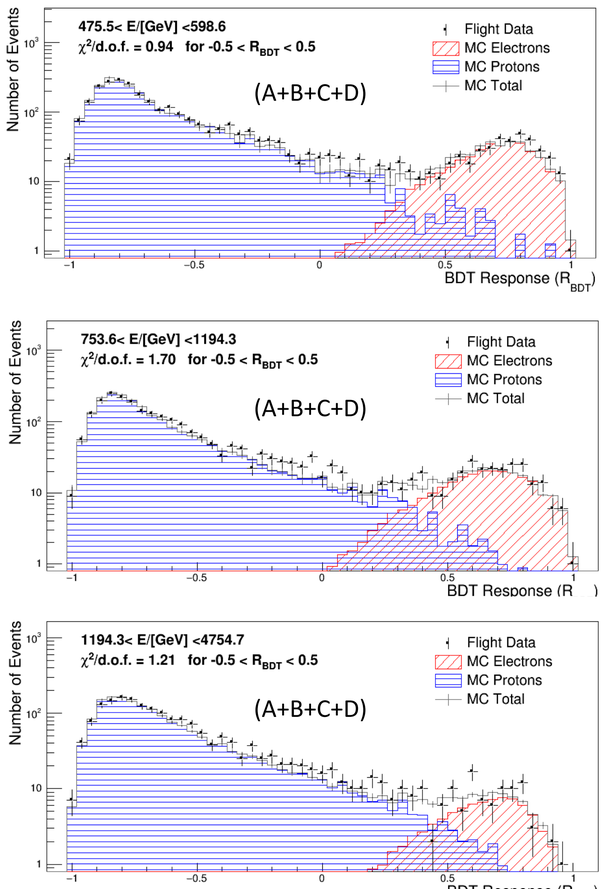
CALET is best suited for observation of possible fine structures in the all-electron spectrum up to the trans-TeV region.

## 4. Full-Acceptance Analysis

**Analyzed Flight Data:**

- 780 days (October 13, 2015 to November 30, 2017)
- Full CALET acceptance at the high energy region
  (Acceptance A+B+C+D; 1040cm²sr).
  In the low energy region fully contained events are used (A+B; 550cm²sr)



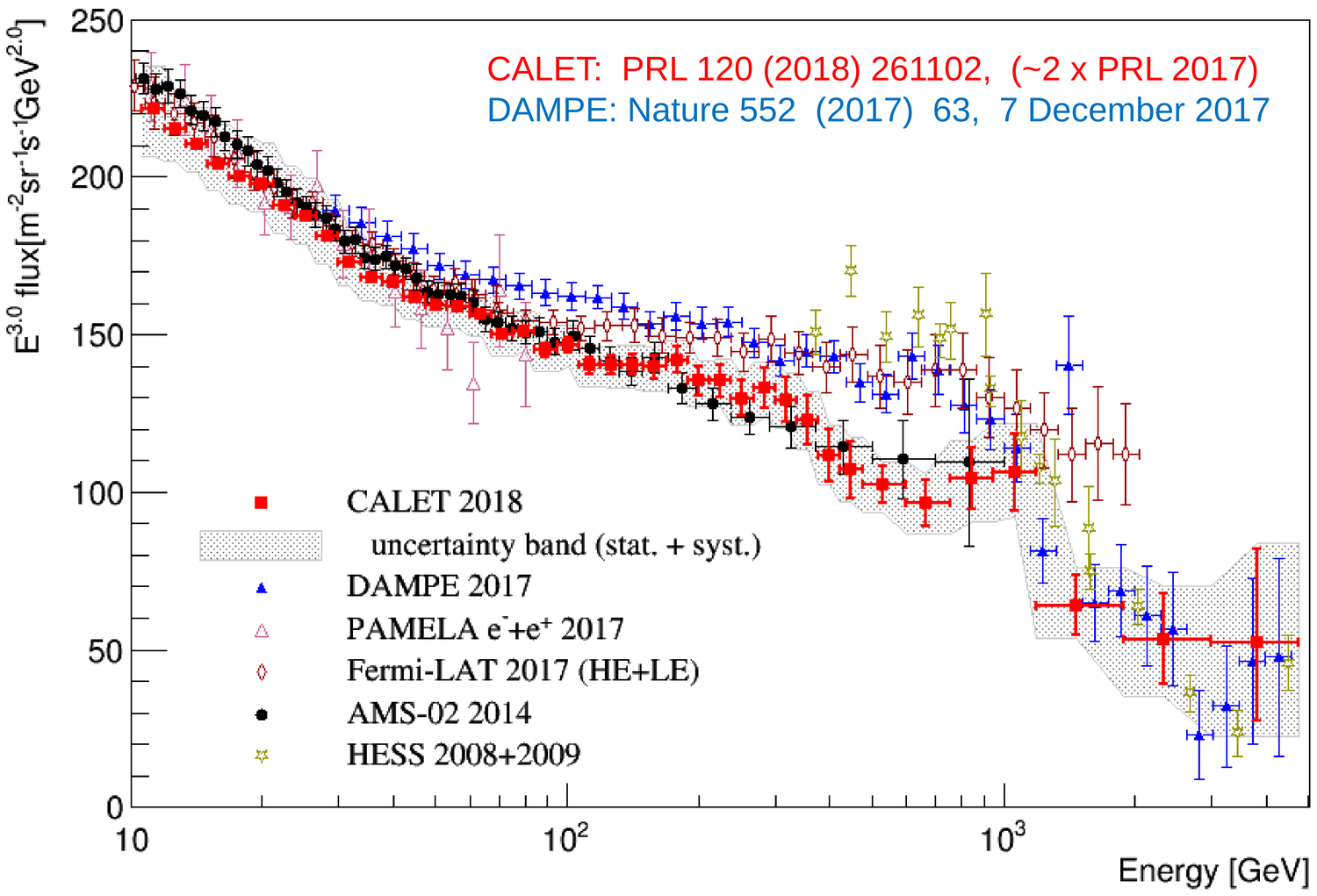




Electron Identification:

- Constant and high efficiency is the key point in our analysis.
- Simple two parameter (BDT) cut is used in the energy region E<475GeV (E>475GeV) while the small difference in resultant spectrum between two methods are taken into account in the systematic uncertainty.
- Contamination is ~5% up to 1TeV, and <15% in the 1—3 TeV region.

## 5. Extended CALET All-Electron Spectrum

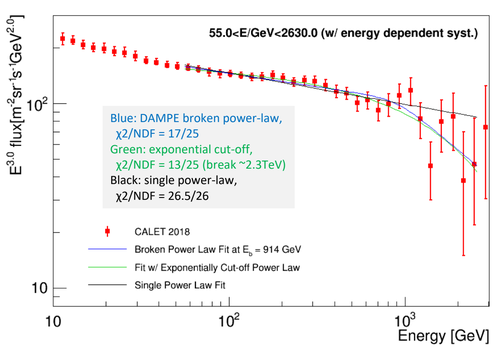
### and Comparison with Other Space/Ground Experiments

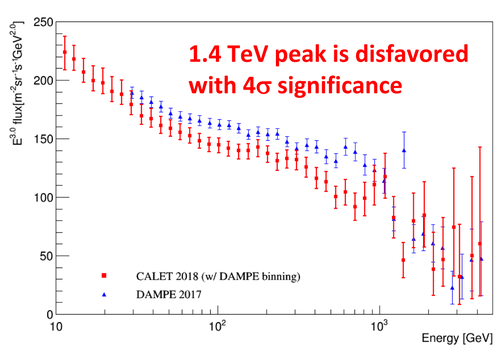


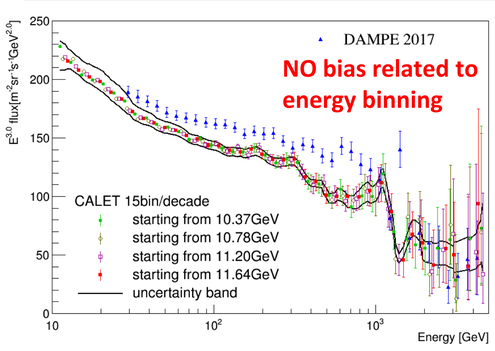

## 6. Discussion

1. CALET's spectrum is consistent with AMS-02 below 1 TeV.
2. There are two group of measurements:
   AMS-02+CALET vs Fermi-LAT+DAMPE, indicating the presence of unknown systematic errors.
3. CALET observes flux suppression consistent with DAMPE within errors above 1TeV.
4. No peak-like structure at 1.4 TeV in CALET data, irrespective of energy binning.

In the flux table given in the Supplemental Material of PRL 120 (2018) 261102, the systematic uncertainties are classified into several categories (i.e., BDT stability, trigger, absolute normalization, tracking, charge identification, electron identification, and MC model dependence) in order to allow for more sensitive interpretative studies using the CALET spectrum.




## 7. Conclusion and Prospects

- All electron spectrum has been extended in statistics and in the energy range from 11 GeV to 4.8TeV, as published in PRL again in June 2018 [PRL 120 (2018) 261102].
- Five years or more observations ⇒ 3 times more statistics, reduction of systematic errors.
  - The possibility of new discoveries dwells in fine structures of the all-electron spectrum.
  - Taking advantage of localness, the TeV all-electron spectrum approaches its origin.