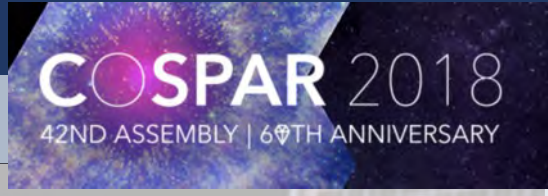

Cosmic-Ray Electron Flux from 1 GeV to 10 GeV with Low-Energy Trigger in the CALET Experiment

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for the CALET Collaboration

CALET Collaboration



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12) KEK, Japan
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14) Nagoya University, Japan
15) NASA/GSFC, USA
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17) National Institute of Polar Research, Japan
18) Nihon University, Japan
19) Osaka City University, Japan
20) Riken, Japan
21) Ritsumeikan University, Japan
22) Shibaura Institute of Technology, Japan
23) Shinshu University, Japan
24) St. Marianna University School of Medicine, Japan
25) University of Denver, USA
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27) University of Padova and INFN, Italy
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29) University of Rome Tor Vergata and INFN, Italy
30) University of Siena and INFN, Italy
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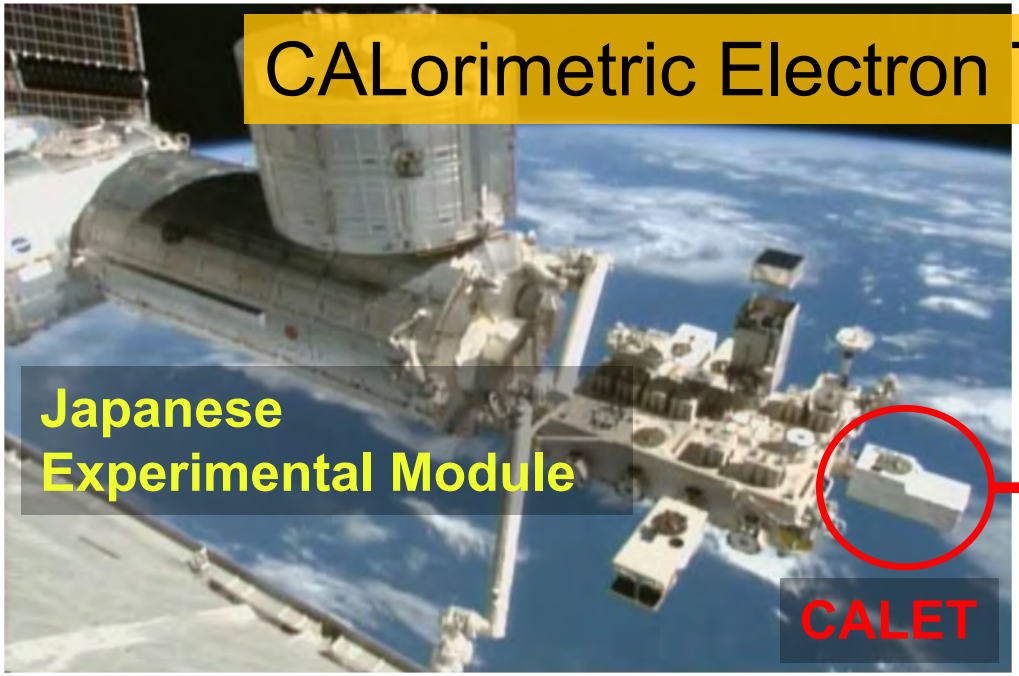
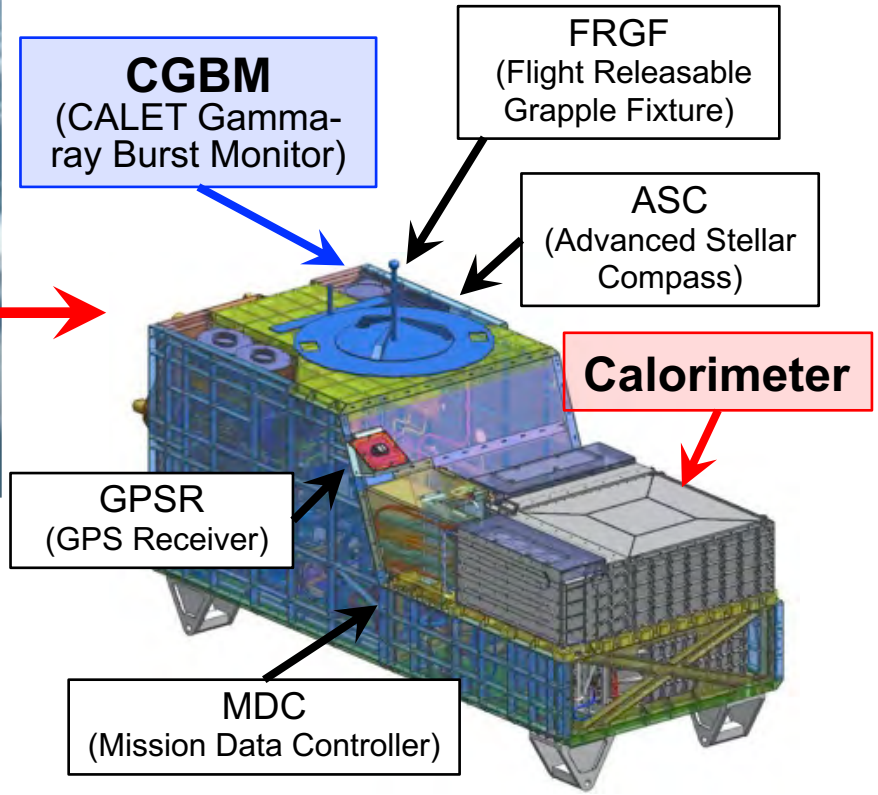
32) Waseda University, Japan
33) Washington University-St. Louis, USA
34) Yokohama National University, Japan
35) Yukawa Institute for Theoretical Physics, Kyoto University, Japan

CALET on the ISS



CALorimetric Electron Telescope (CALET)



Launch: Aug. 19, 2015

Observations: Oct. 13, 2015

Observation Targets:

Electron ($e^- + e^+$): 1GeV – 20 TeV

p--Fe: 10 GeV – 1000 TeV

Ultra heavy ions (26<Z<=40): > 600 MeV/n

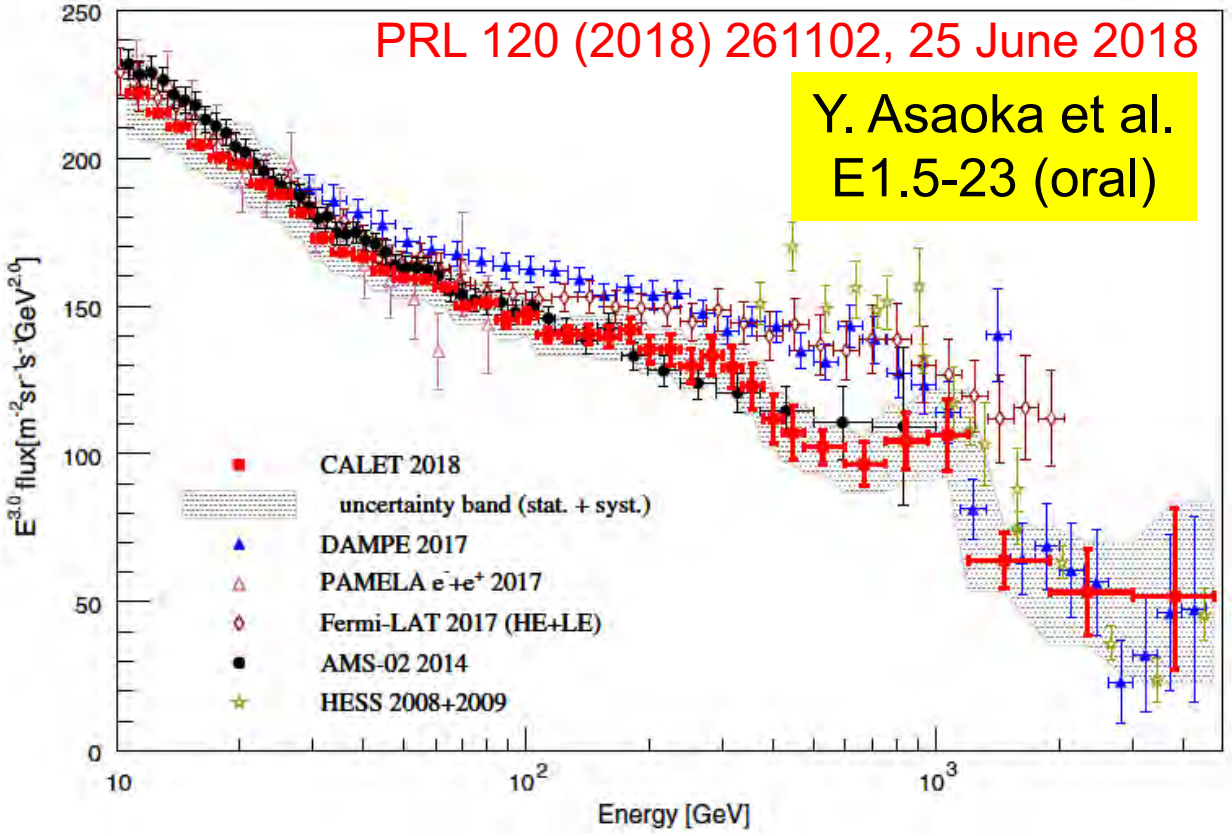
Gamma-rays (Diffuse + Point sources): 1 GeV – 1 TeV

Measurement of the CR $e^- + e^+$ with High-Energy Trigger

High-energy shower trigger (HE-Trigger):

- Energy thresholds are set to detect shower events with energies over 10 GeV.
- HE-trigger is always active.

CR $e^- + e^+$ spectrum from 11 GeV to 4.8 TeV



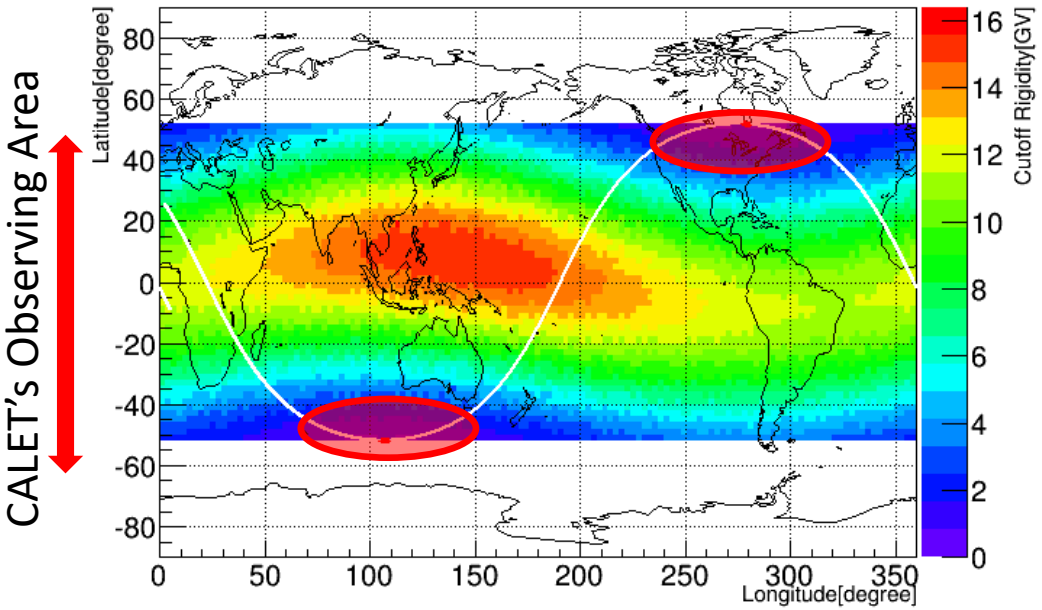
Measurement of the CR $e^- + e^+$ with Low-Energy Trigger

Low-energy shower trigger (LE-Trigger):

- Energy thresholds are set to detect shower events with energies over 1.0 GeV.
- Measurement of low energy electrons (1GeV ~ 10GeV) with LE-trigger is active only at high latitude where maximum cutoff rigidity is 5.0GV.

→In 1 cycle, LE mode works 2 times for 90 s

Cutoff Rigidity Map and ISS Orbit



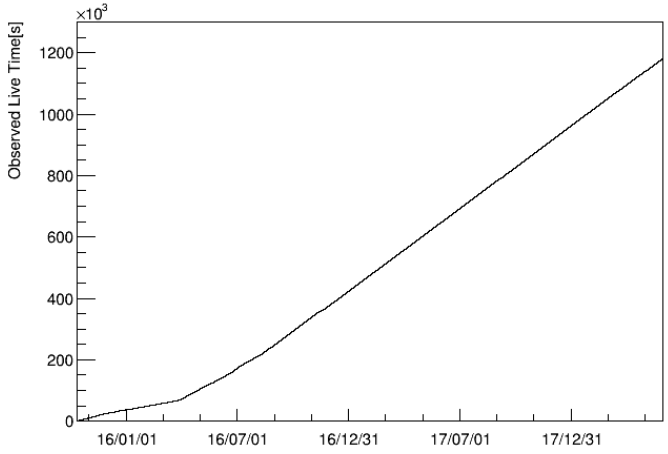
http://www.ngdc.noaa.gov/IAGA/vmod/igrf.html

Oct. 13, 2015 ~ May 31, 2018

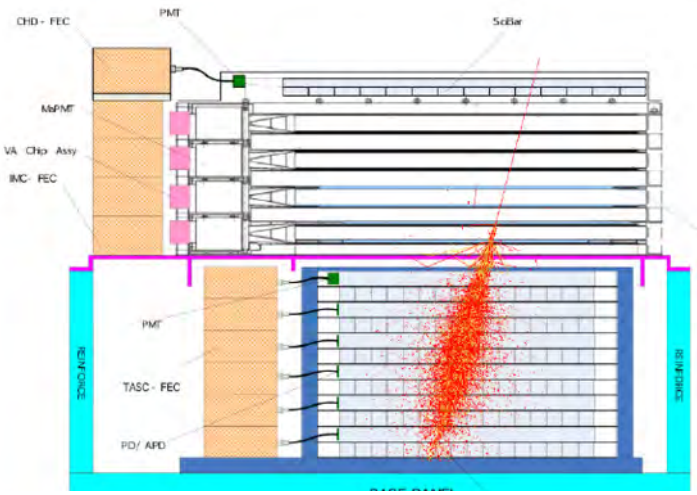
Total Live Time: 1,182,625 [sec]

Total events (<50GeV): 35,760,251[events]

Integrated Live Time



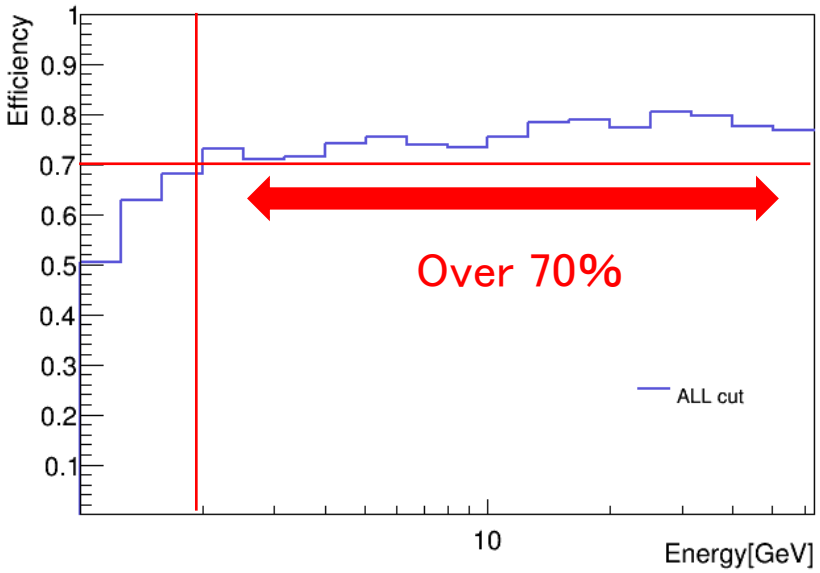
Analysis Procedure for Low-Energy $e^- + e^+$



CHD (Charge Detector)

IMC (Imaging Calorimeter)

TASC (Total Absorption Calorimeter)



Energy dependence of low energy e−+e+ efficiency

Event selections for low energy $e^- + e^+$

① Energy threshold: IMC7–8 and TASC top layer

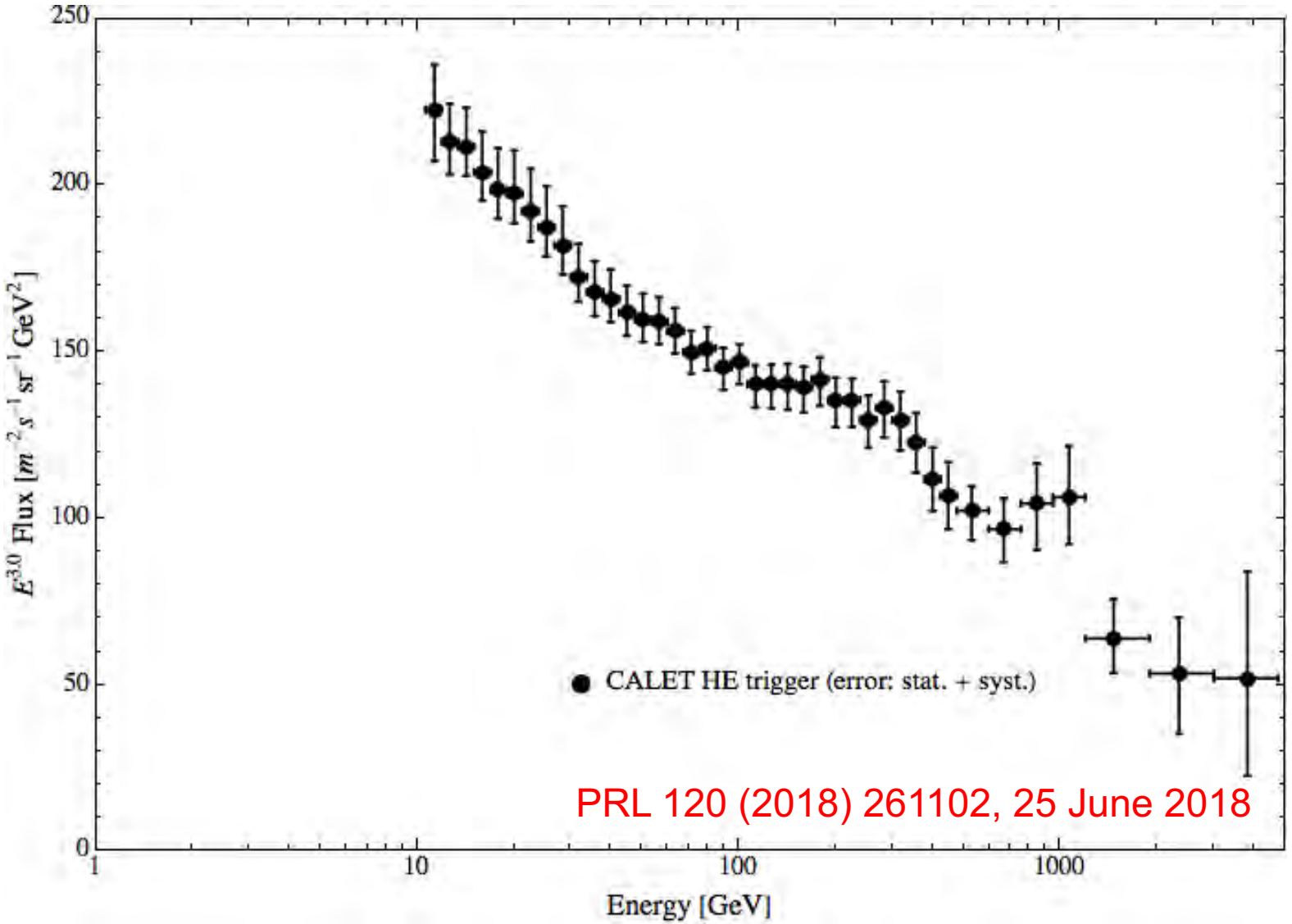
② Tracking: IMC
- Kalman filter track reconstruction with IMC

③ Charge determination: CHD
- CHD energy deposit to remove Z>=2

④ e/p separation: IMC bottom layer and TASC top layer
- Energy deposit and Shower concentration of IMC bottom layer
- R_E of TASC top layer

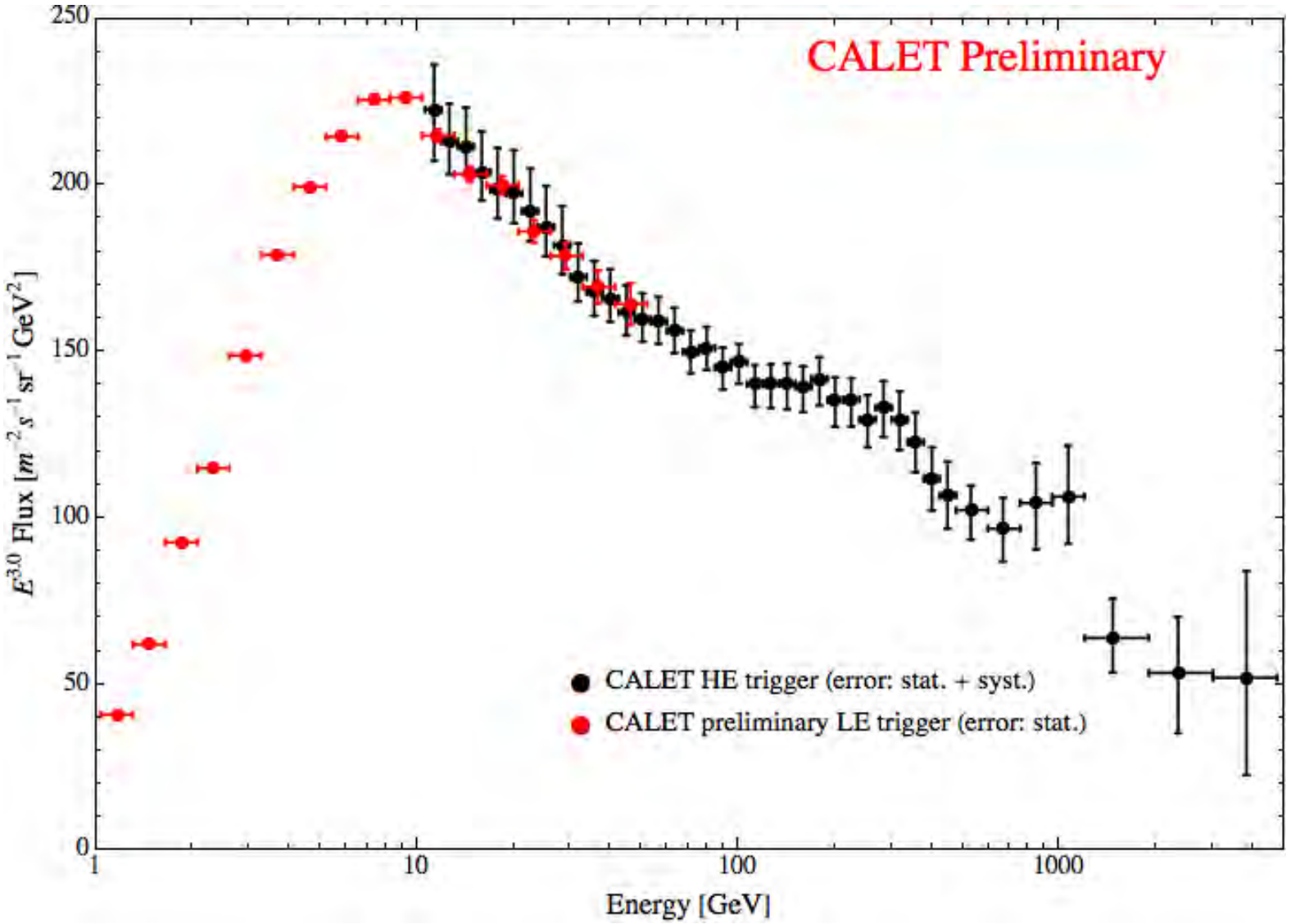
⑤ Energy determination: IMC and top 3 layers of TASC X, Y
- Energy deposit of top 3 layers of TASC X, Y and IMC

CR $e^- + e^+$ obtained with HE trigger and LE trigger

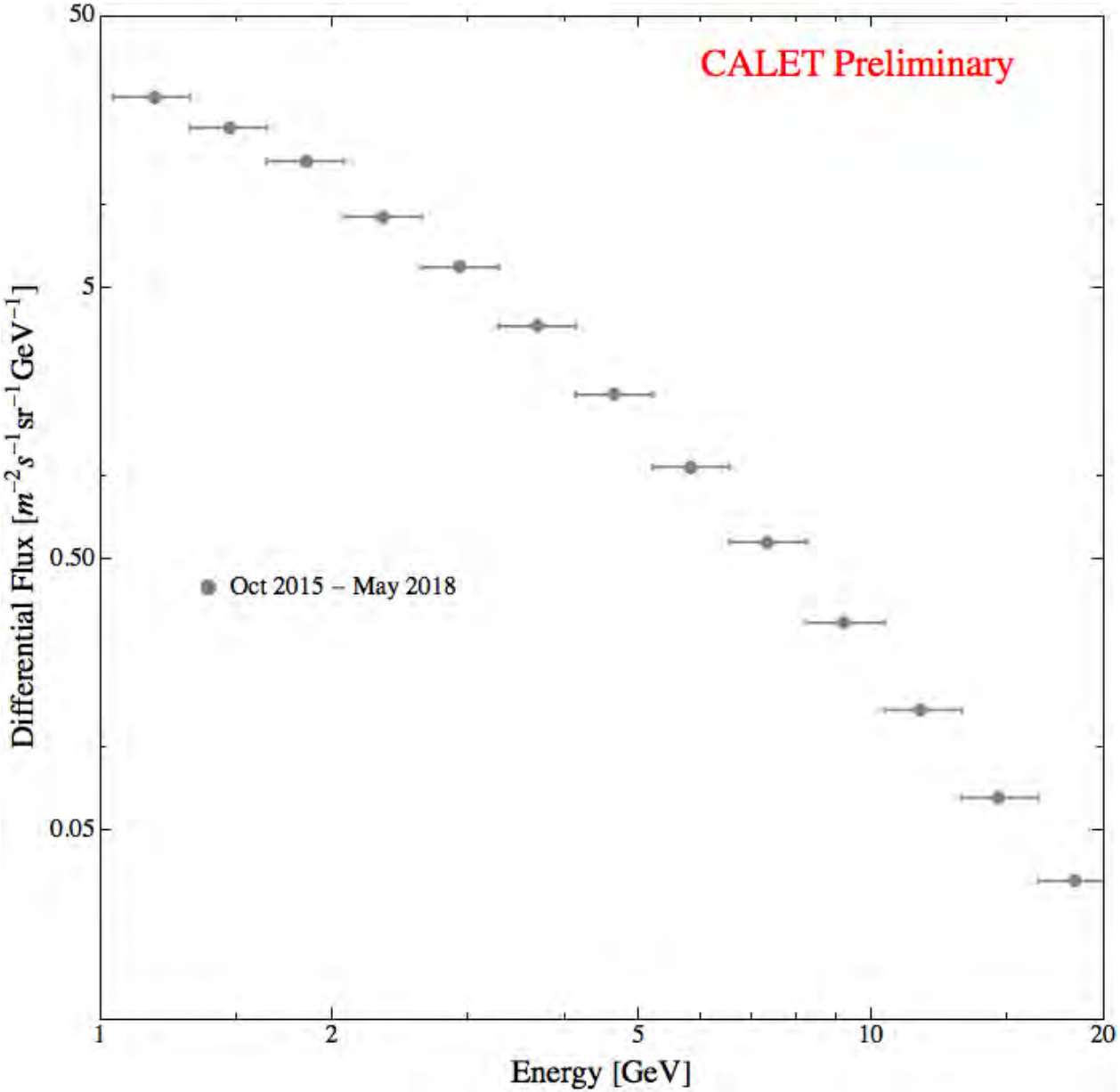


PRL 120 (2018) 261102, 25 June 2018

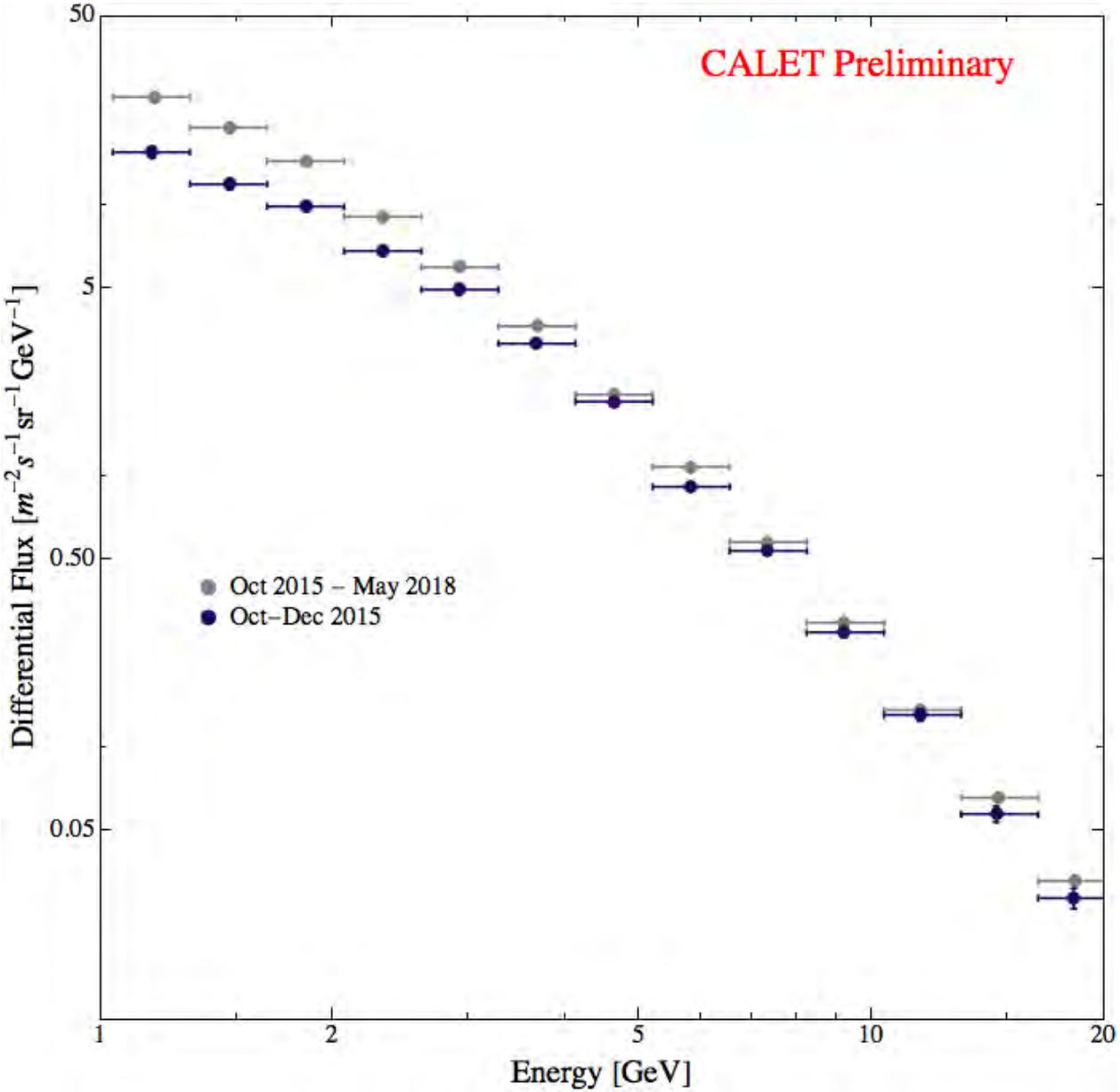
CR $e^- + e^+$ obtained with HE trigger and LE trigger



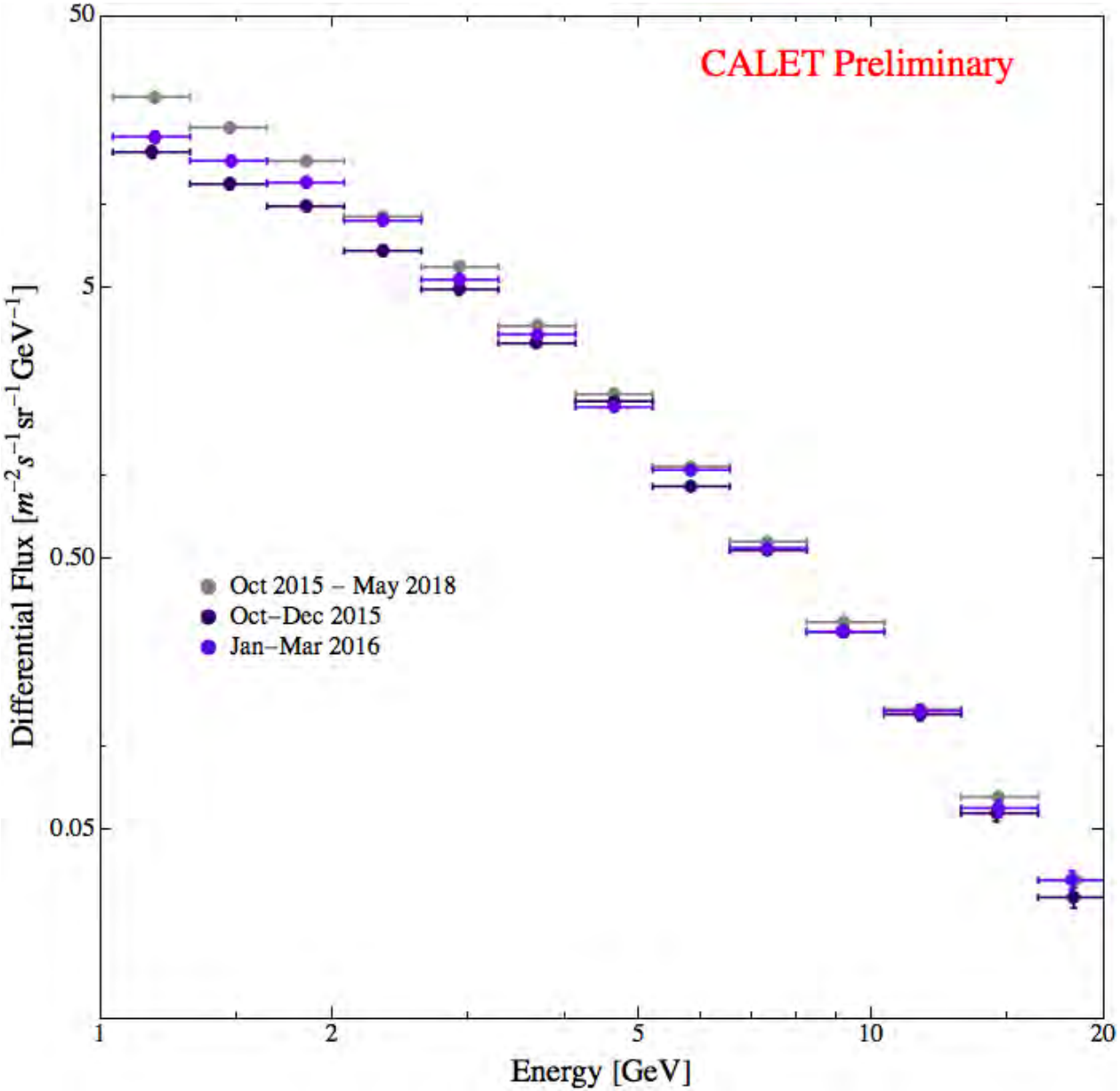
Low energy CR $e^- + e^+$ each 3 months



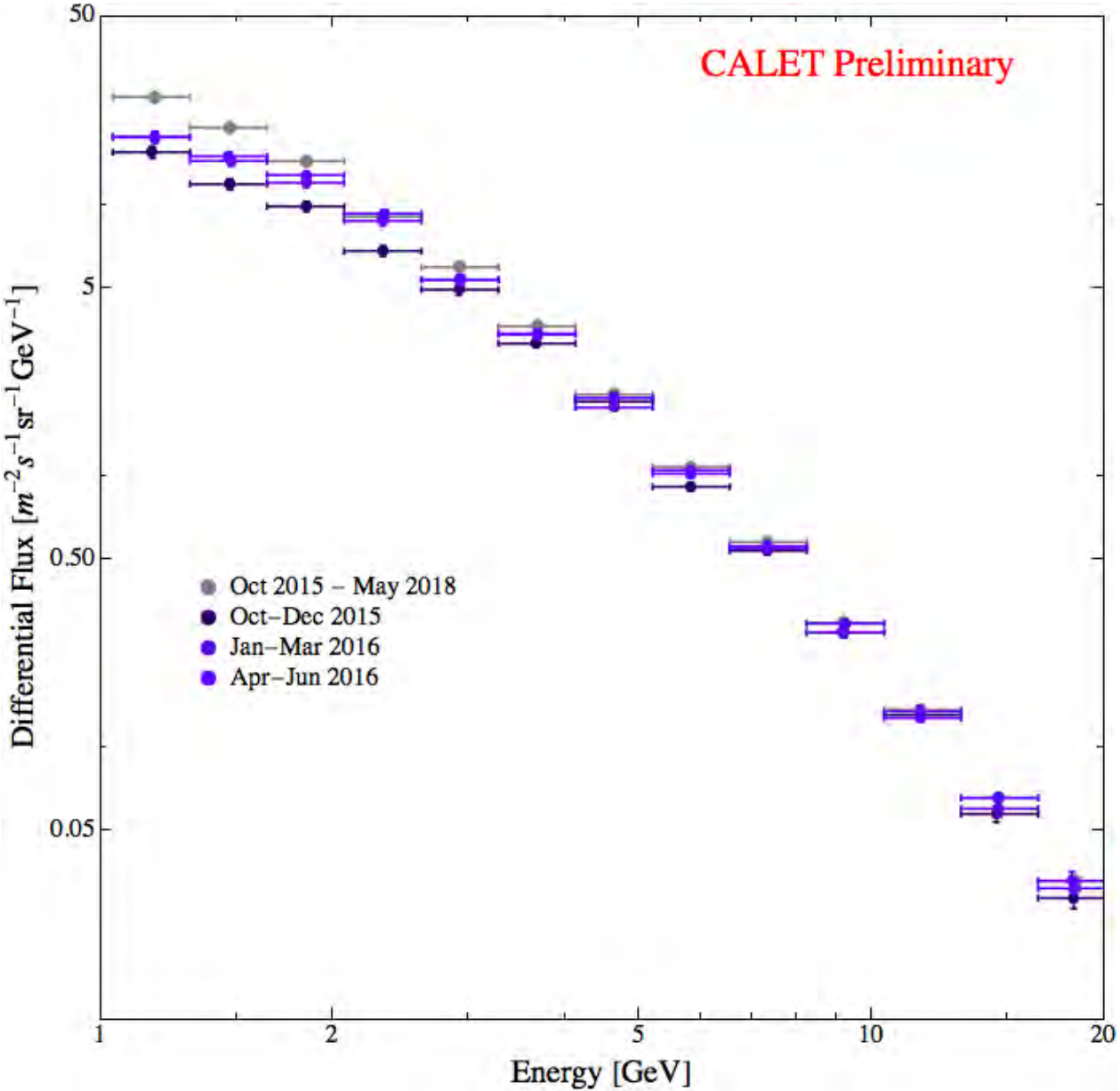
Low energy CR $e^- + e^+$ each 3 months



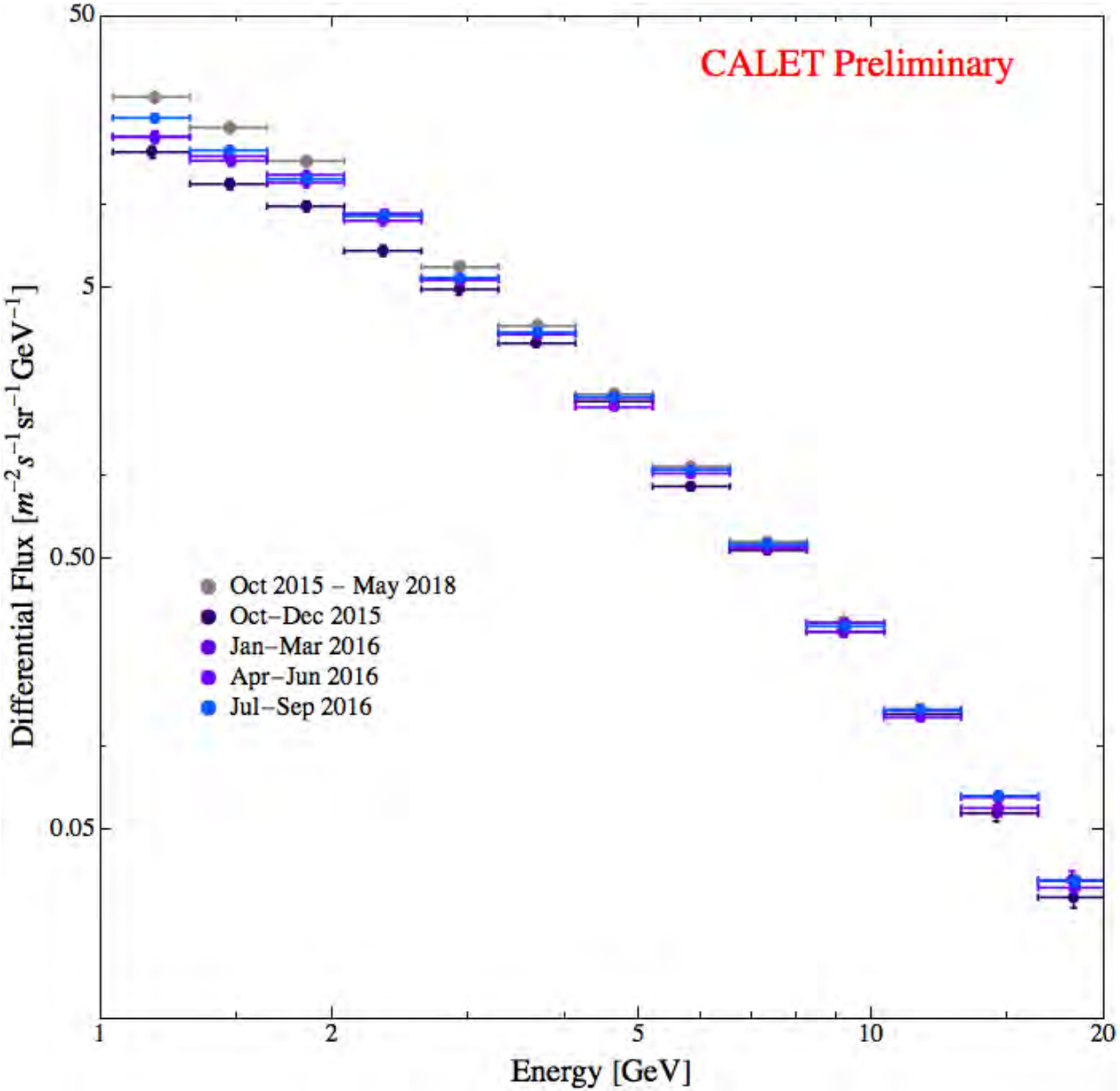
Low energy CR $e^- + e^+$ each 3 months



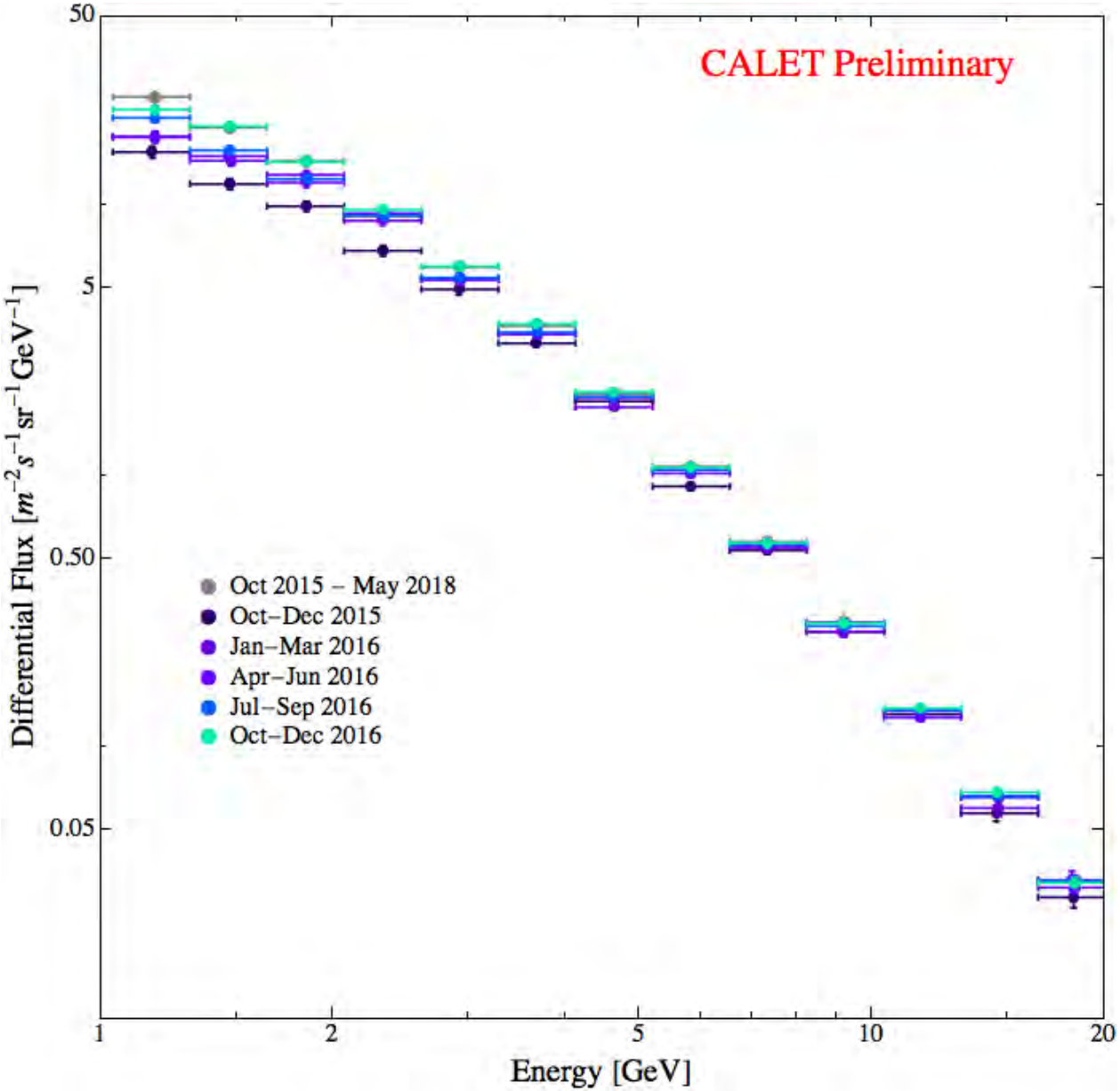
Low energy CR $e^- + e^+$ each 3 months



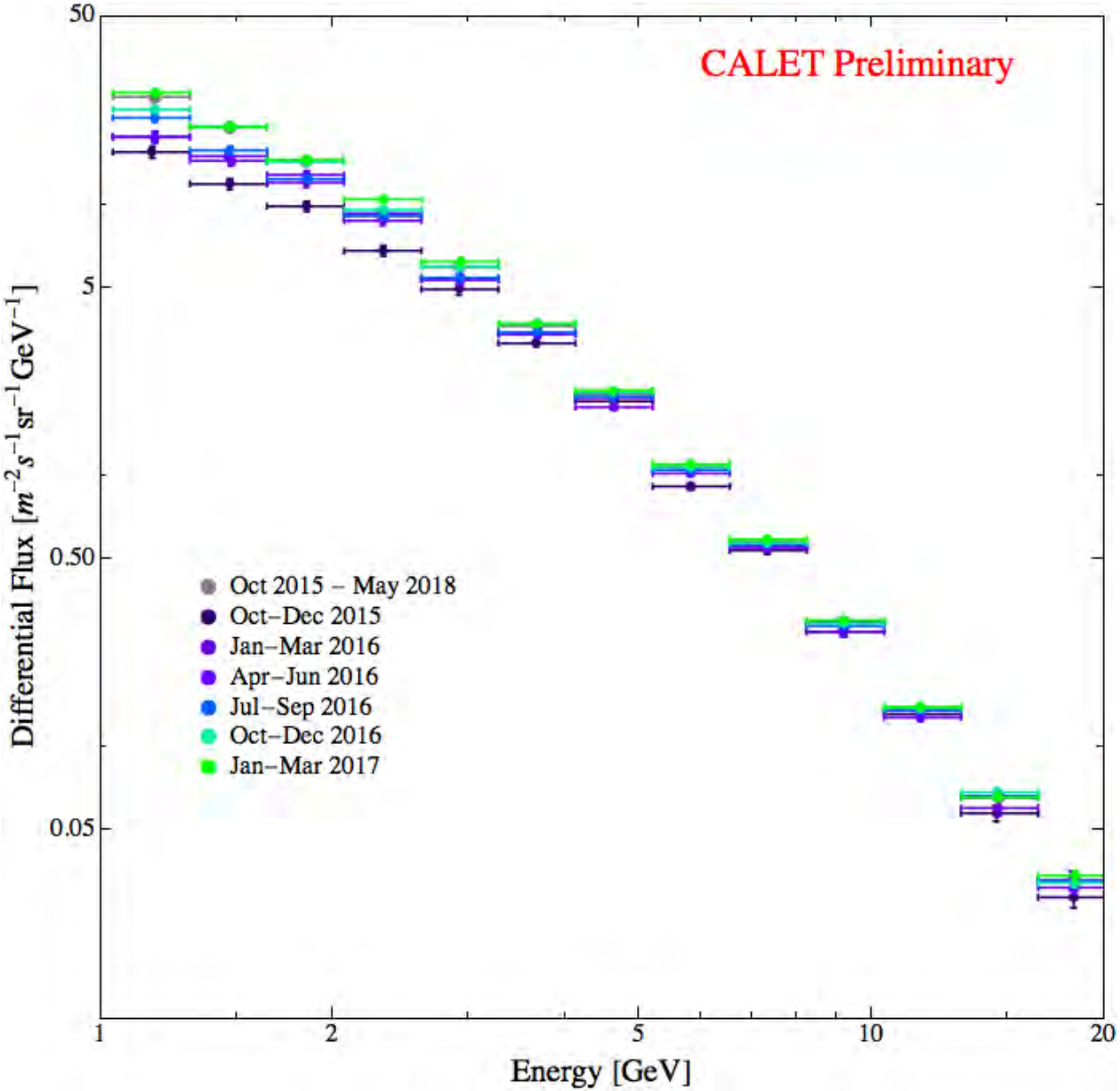
Low energy CR $e^- + e^+$ each 3 months



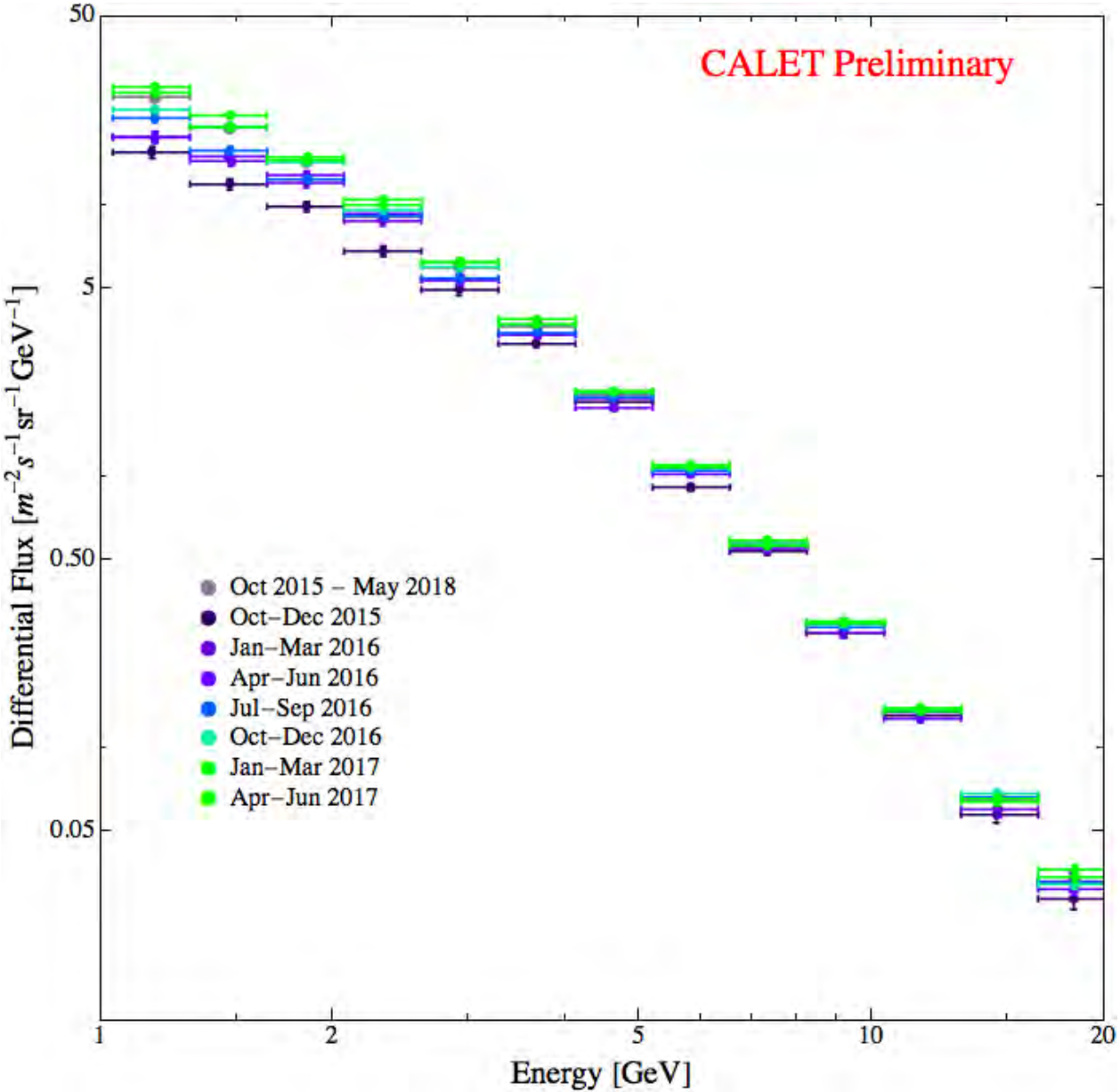
Low energy CR $e^- + e^+$ each 3 months



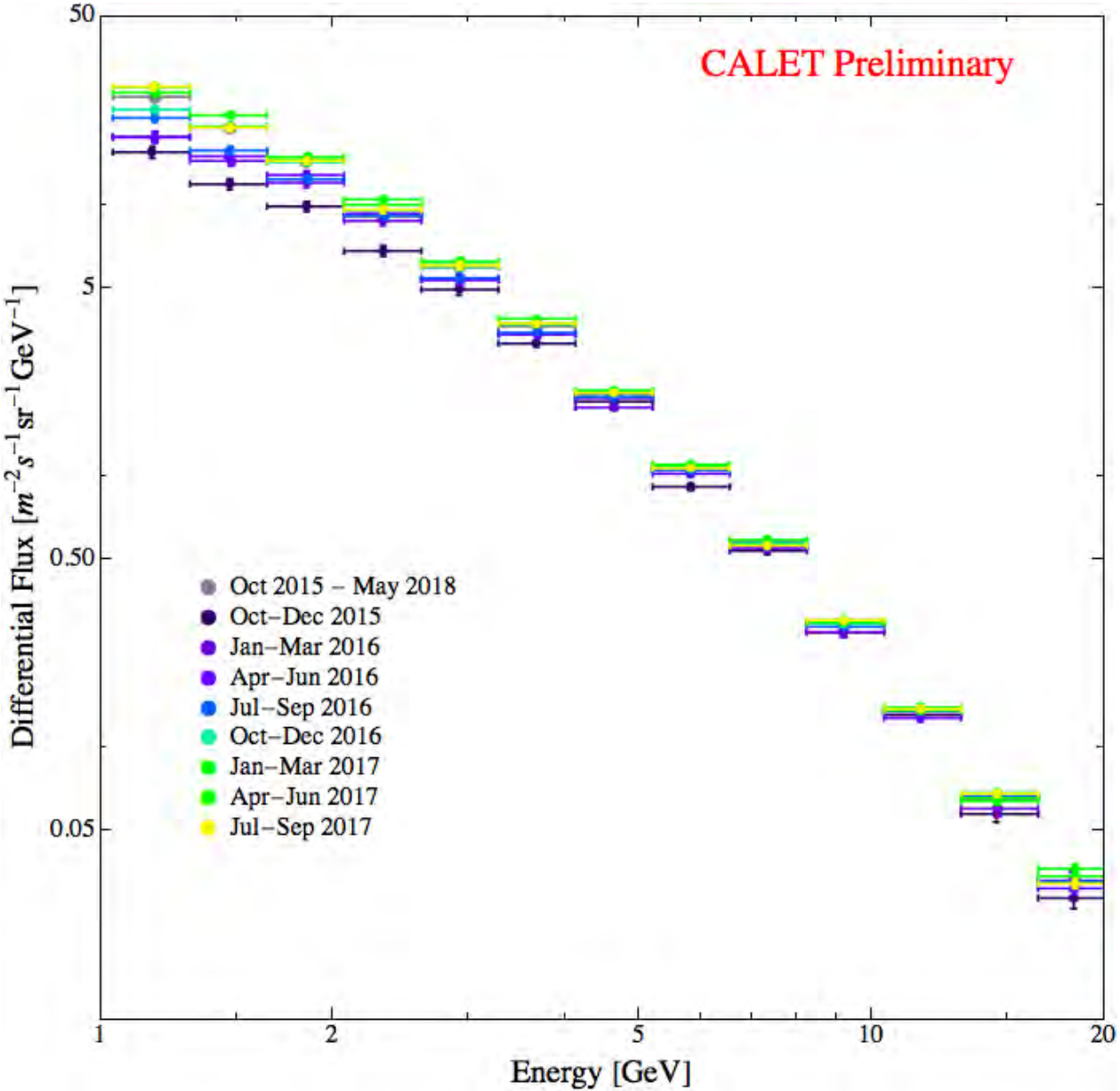
Low energy CR $e^- + e^+$ each 3 months



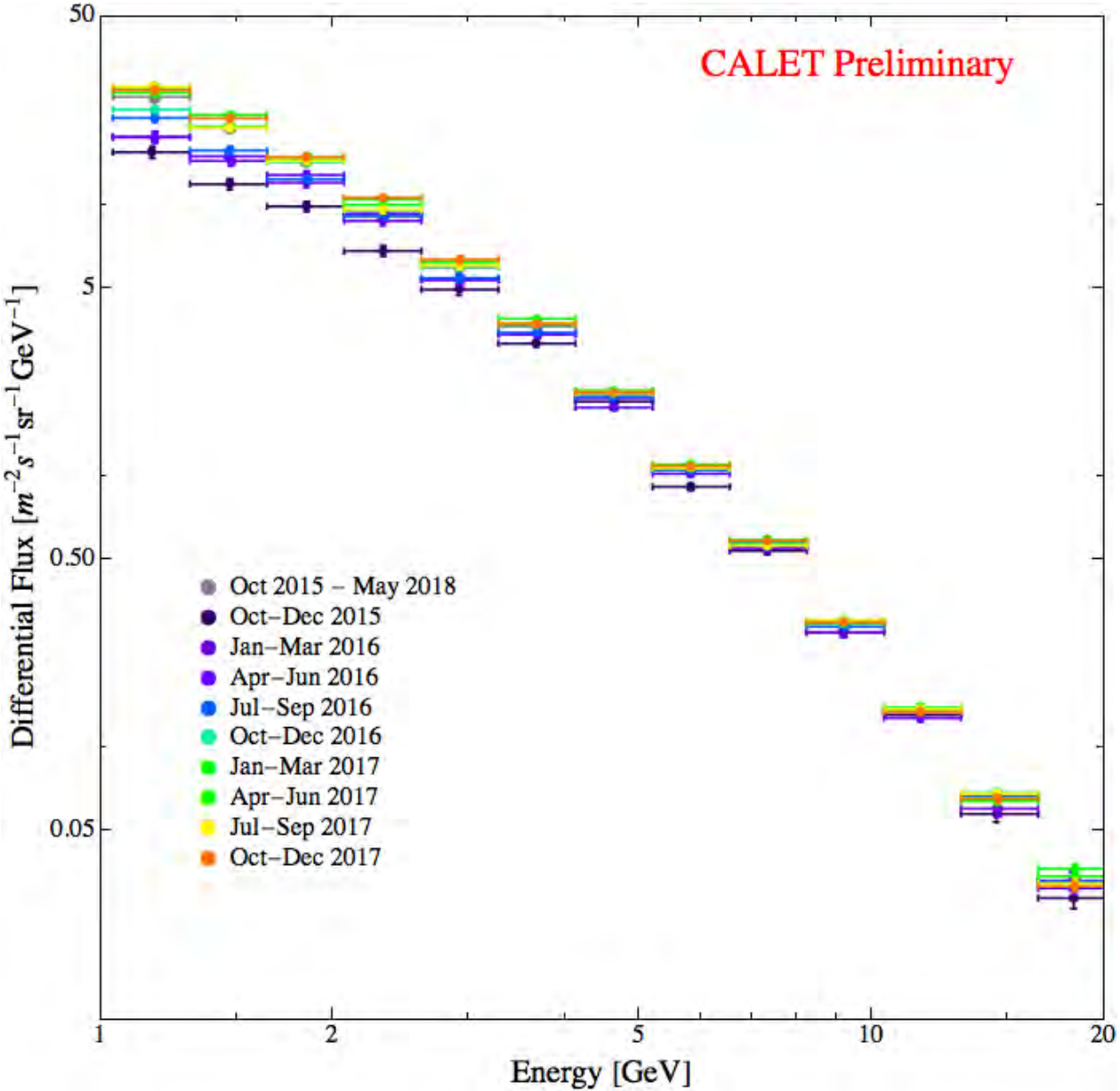
Low energy CR $e^- + e^+$ each 3 months



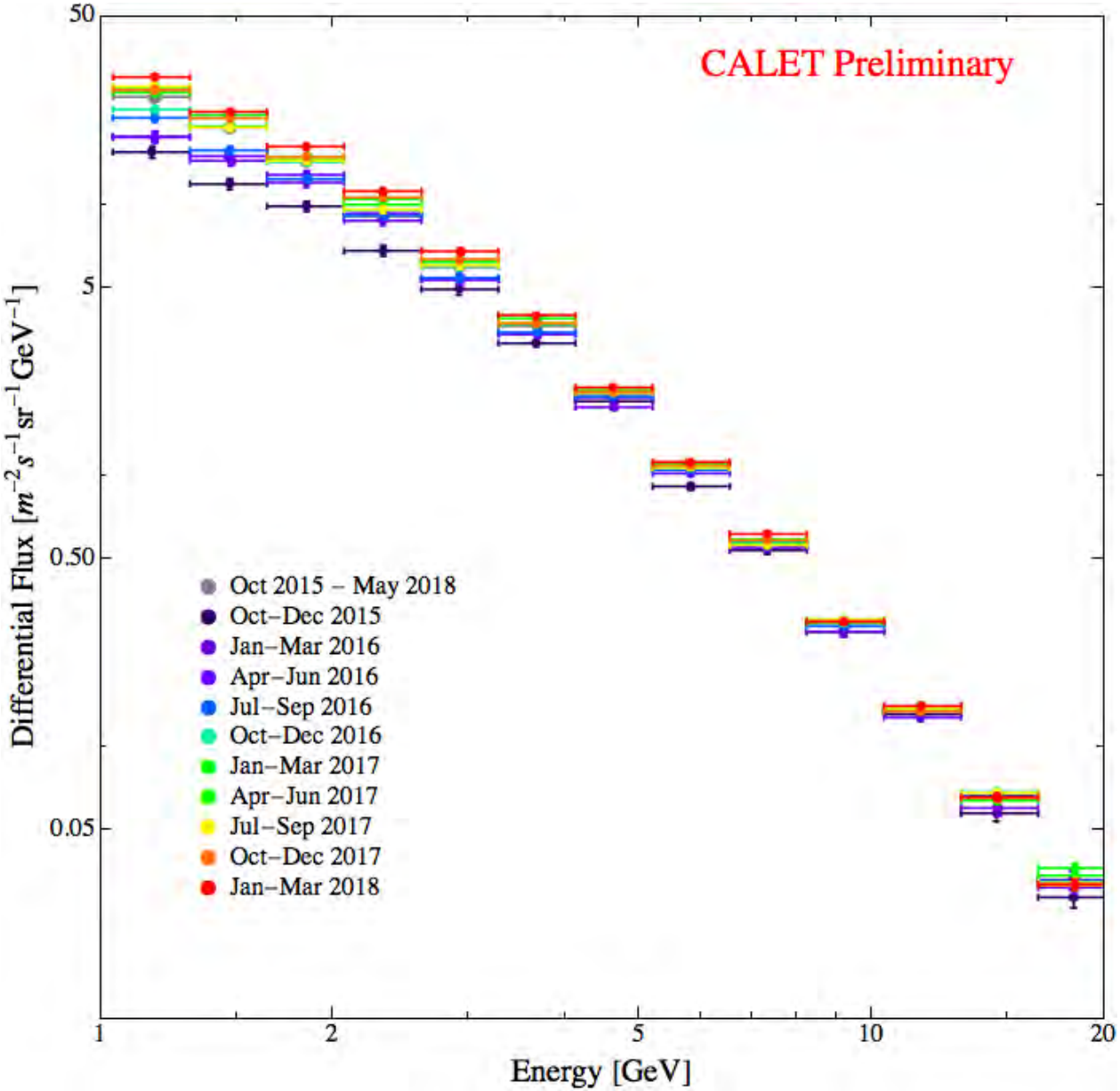
Low energy CR $e^- + e^+$ each 3 months



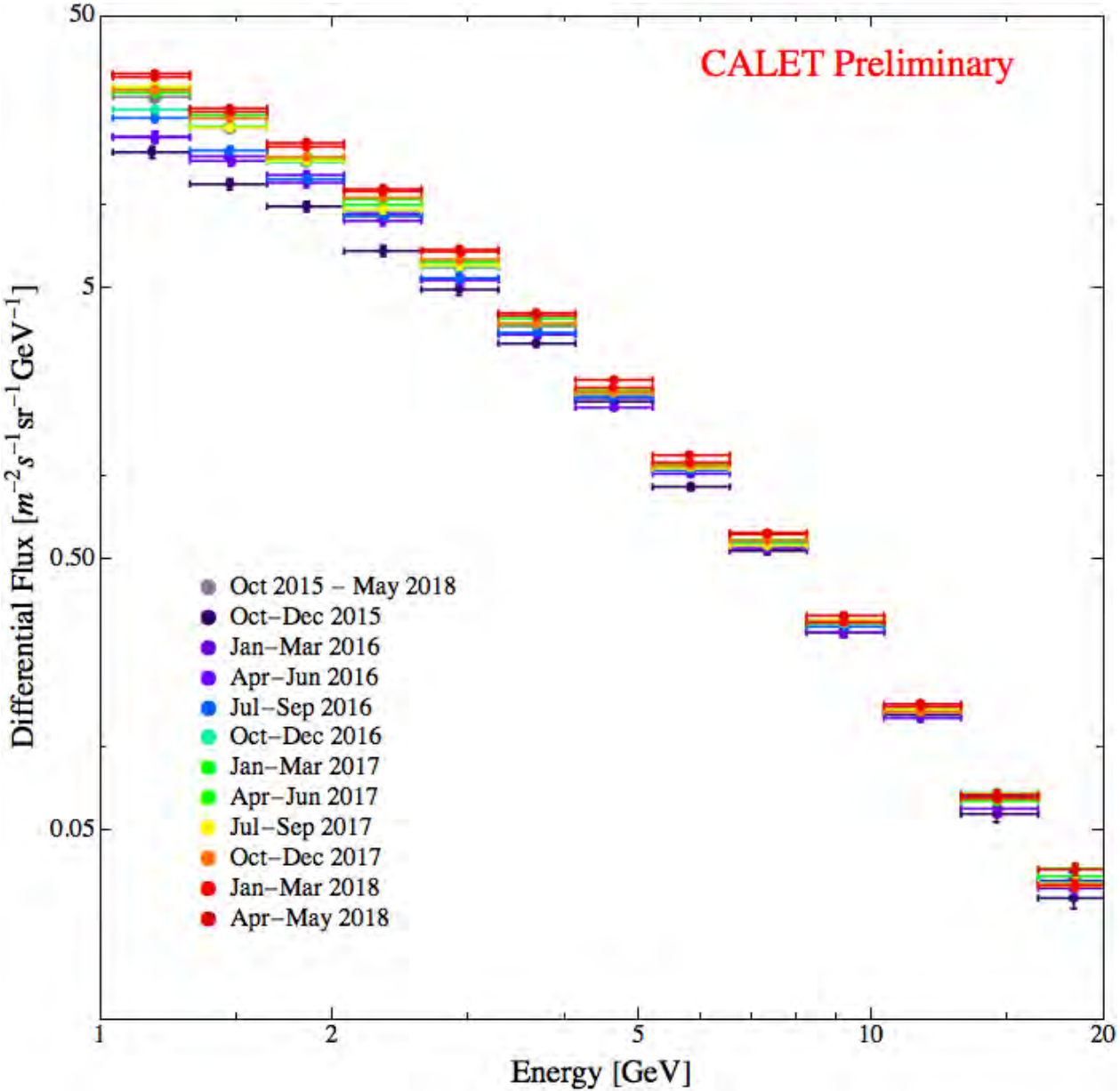
Low energy CR $e^- + e^+$ each 3 months



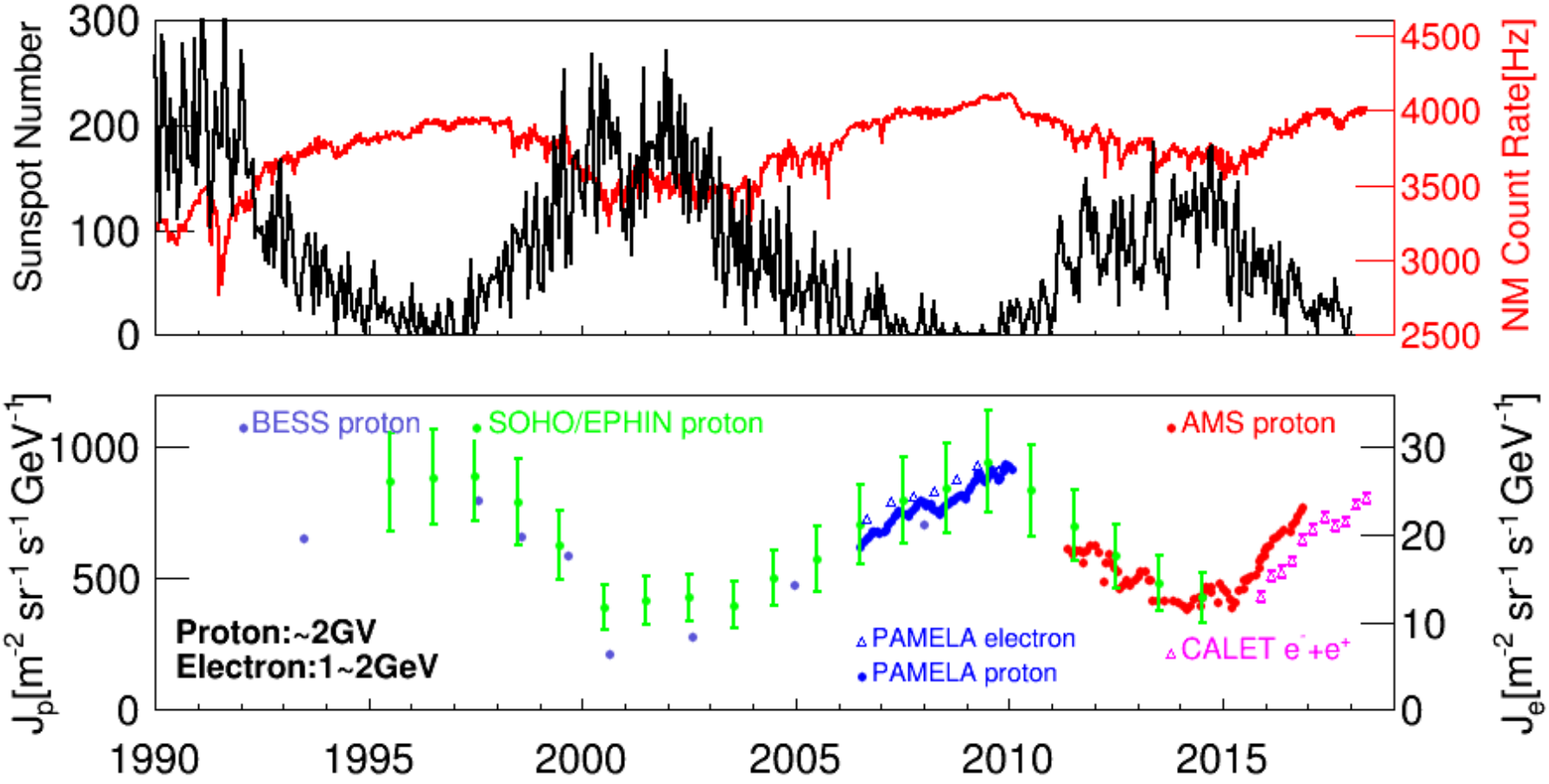
Low energy CR $e^- + e^+$ each 3 months



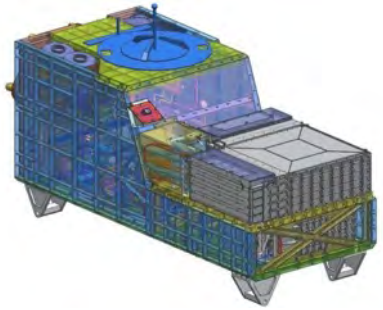
Low energy CR $e^- + e^+$ each 3 months



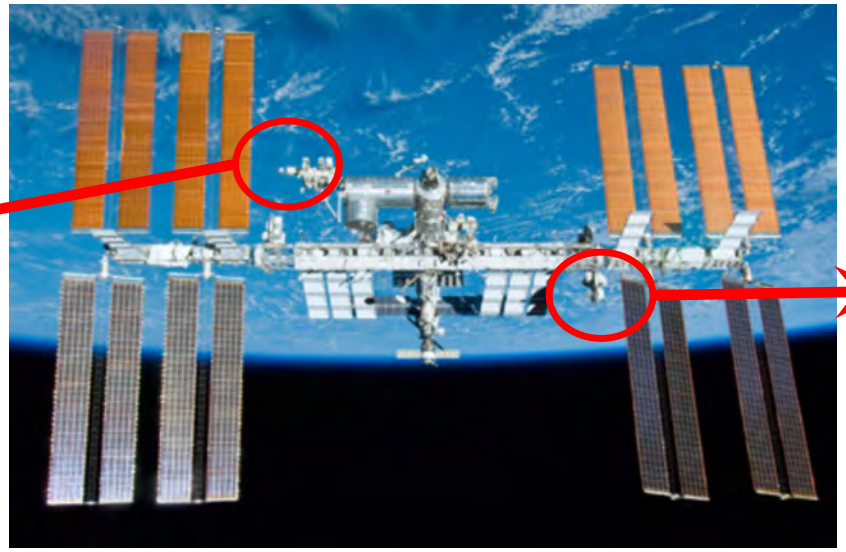
Solar Modulation of the Low-Energy GCR



Time Profile of the Monthly Flux of $e^- + e^+$

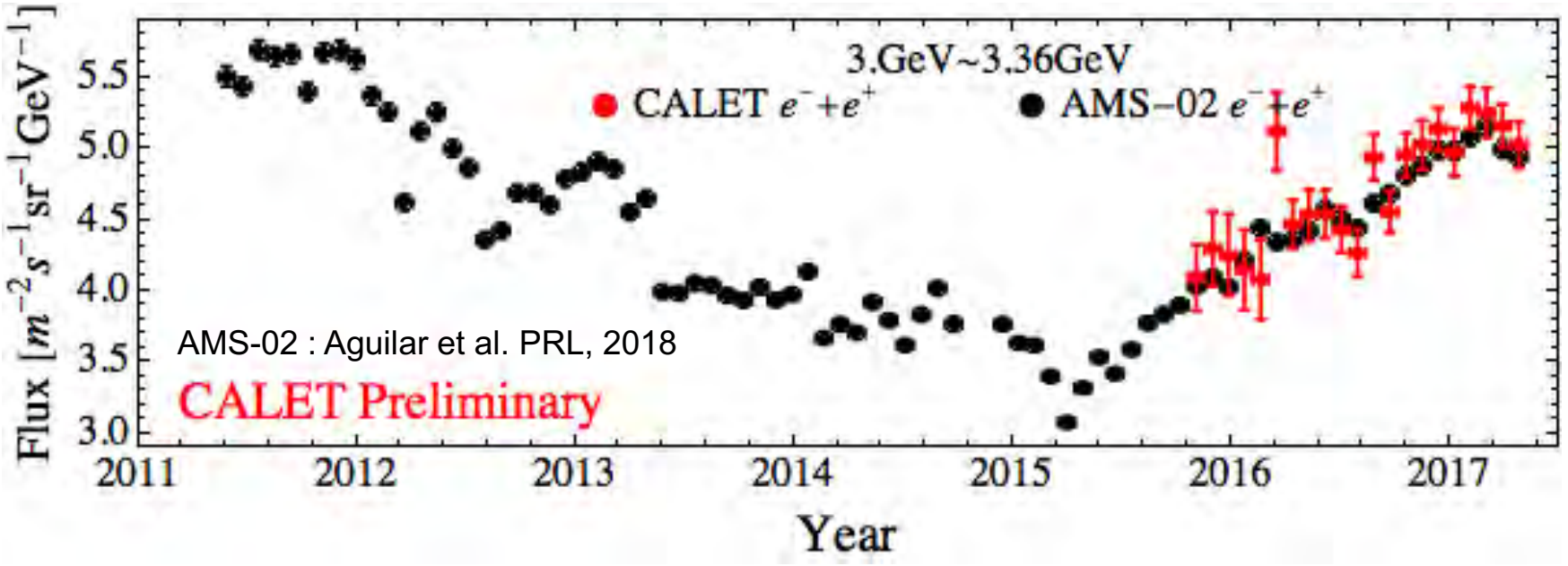


CALET Launch
Aug. 19, 2015

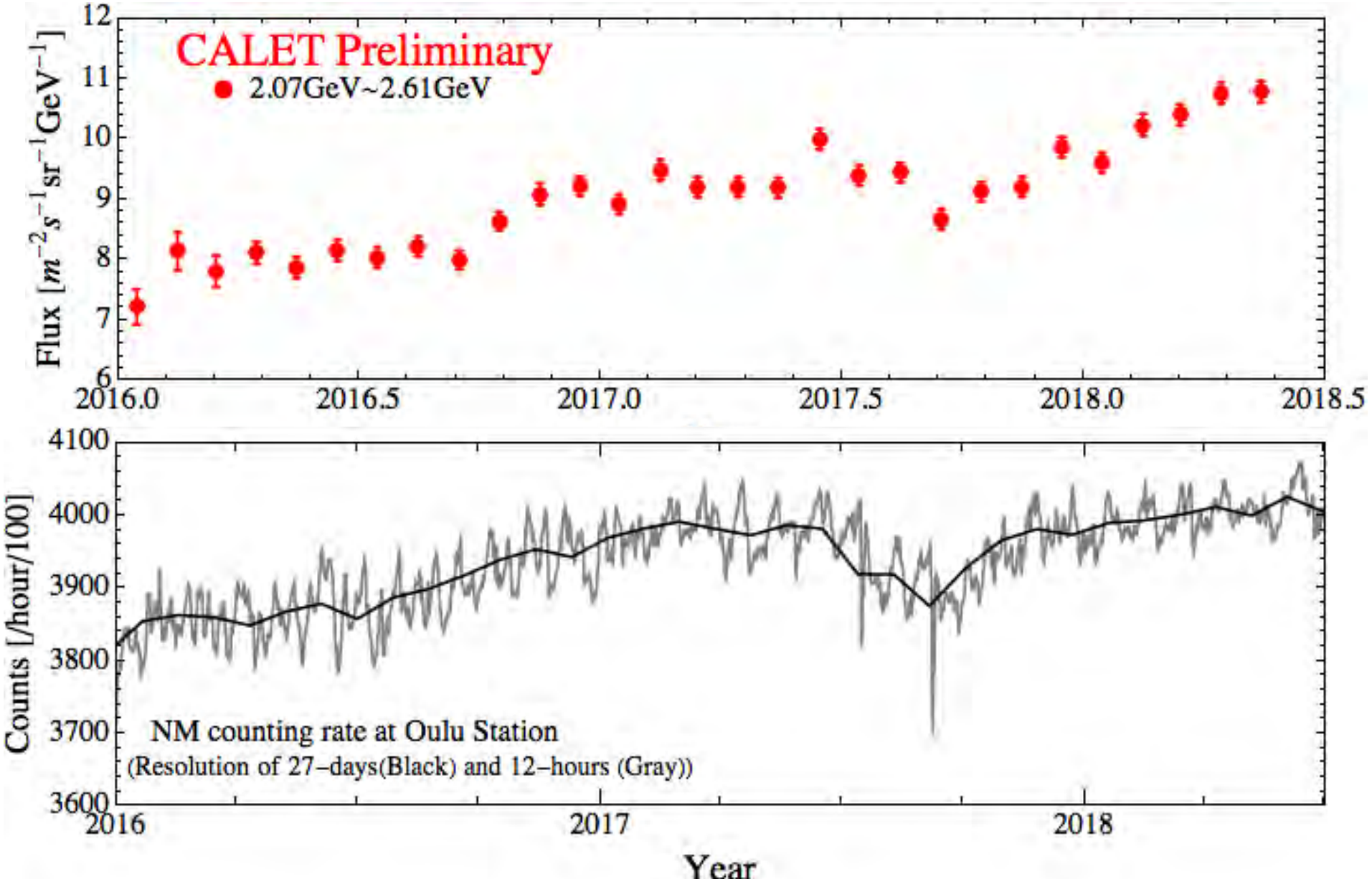


(NASA/JSC)

AMS-02 Launch
May 16, 2011



Time Profile of the Monthly Flux of $e^- + e^+$



Summary

- The ability of CALET low-energy trigger for measuring 1GeV-10GeV e^-+e^+ flux has been successfully demonstrated.
- Variations of preliminary energy spectra of low-energy e^-+e^+ measured by CALET show the solar modulation of the GCRs consistent with recent solar cycle levels.
- Time profile of the preliminary low-energy e^-+e^+ flux was generally consistent with that measured by AMS-02.
- Compared to neutron monitor's counting rate on the ground, we found no discrepancies in the feature of the time profile of the preliminary low-energy e^-+e^+ flux.
- We also found the charge-sign dependences of the solar modulation of e^- during the solar cycle 24, as expected from the drift motion of the GCRs in the heliosphere.
- Further studies will provide the daily variations of the low-energy e^-+e^+ flux such as Forbush decrease.