DAMPE space mission and recent results

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Gran Sasso Science Institute (GSSI)
& INFN Laboratori Nazionali del Gran Sasso

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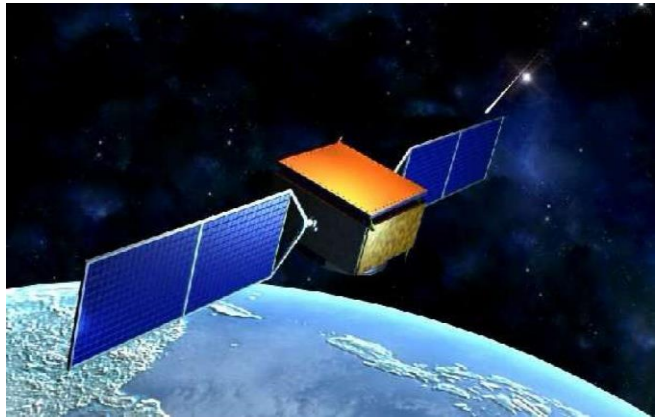
Overview

- Introduction of the collaboration and scientific goals of DAMPE
- DAMPE structure and functionality parameters
- Recent results concerning spectra of electron, proton and helium
- Brief introduction on our analysis on proton + helium spectrum



The Collaboration

- **CHINA**
  - Purple Mountain Observatory, CAS, Nanjing
  - University of Science and Technology of China, Hefei
  - Institute of High Energy Physics, CAS, Beijing
  - National Space Science Center, CAS, Beijing
  - Institute of Modern Physics, CAS, Lanzhou
- **ITALY**
  - INFN Perugia and University of Perugia
  - INFN Bari and University of Bari
  - INFN Lecce and University of Salento
  - INFN LNGS and Gran Sasso Science Institute
- **SWITZERLAND**
  - University of Geneva

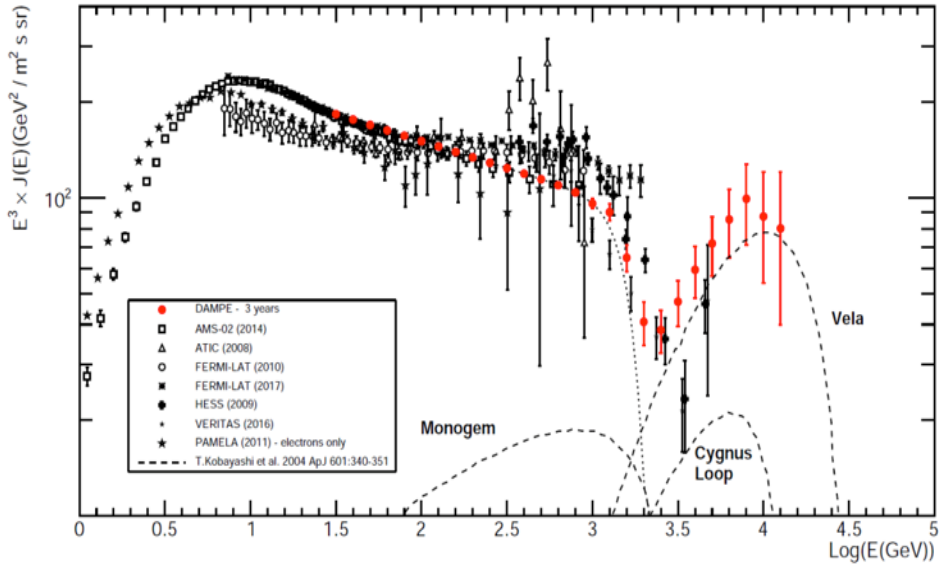
Launched on December 17th 2015, DAMPE has been collecting CR data for more than 4 years!

The scientific goals

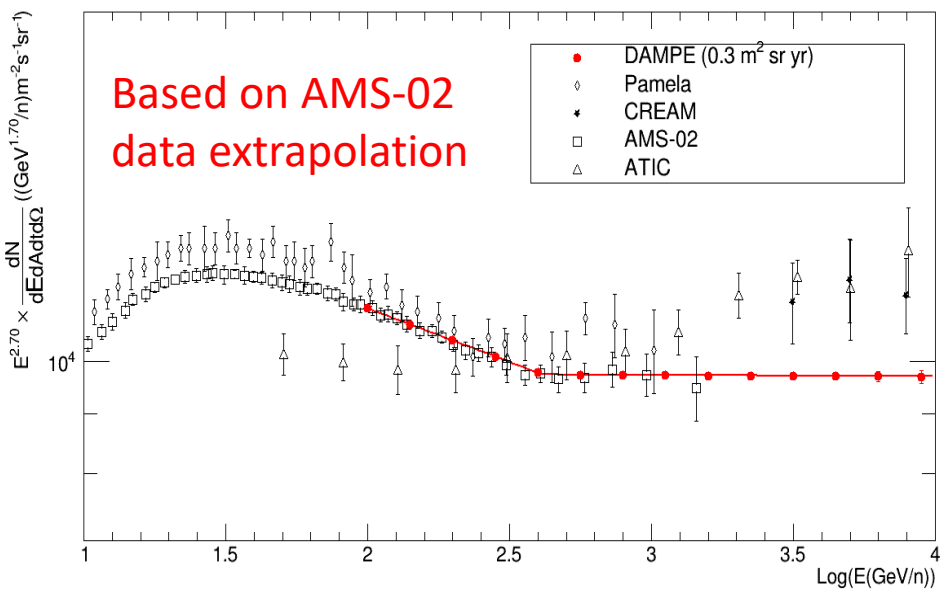
High energy particle detection in space

- Study of the cosmic-ray electron spectra
- Study of cosmic-ray protons and nuclei: spectrum and composition
- High energy gamma ray astronomy
- Search for dark matter signatures in lepton spectra

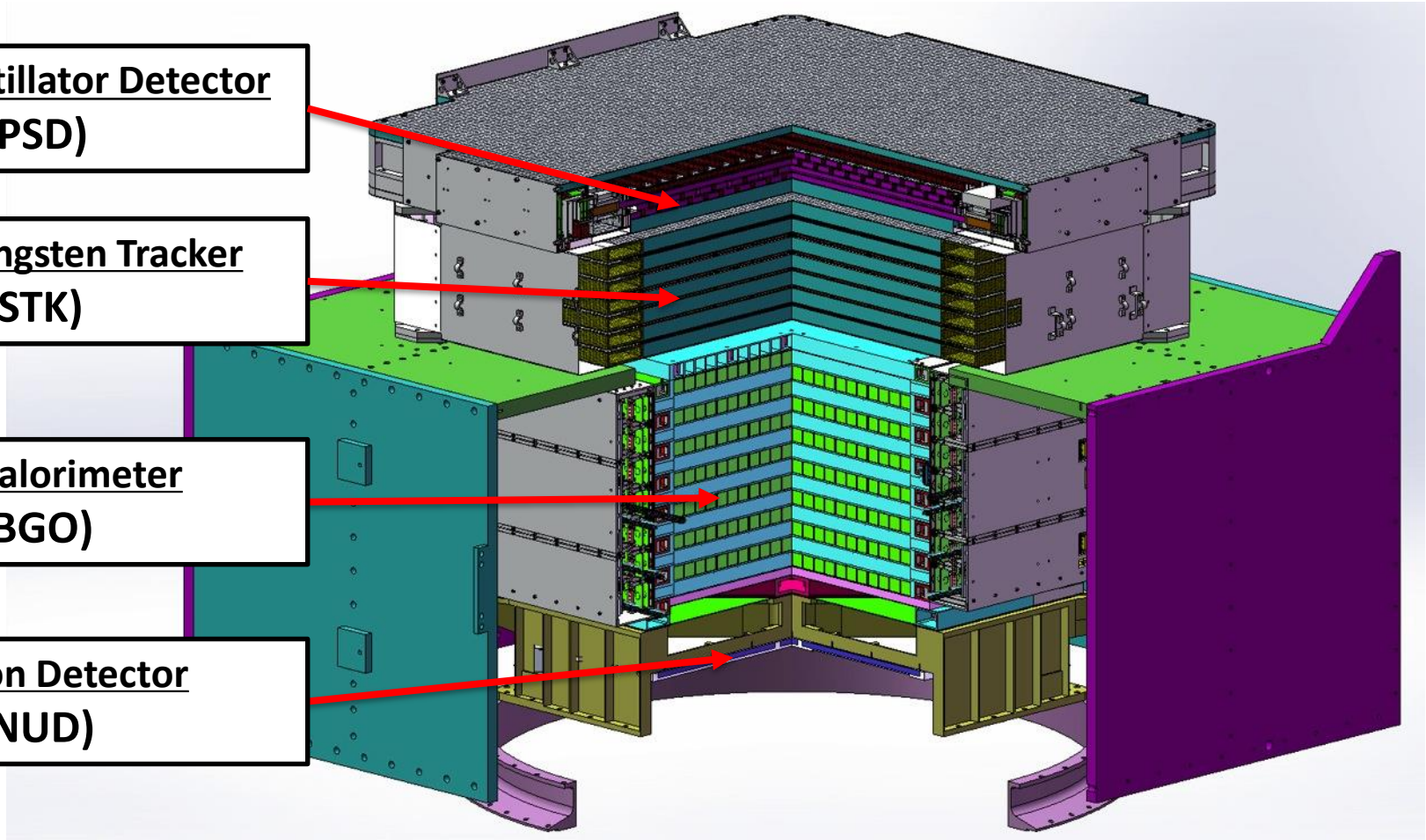
DAMPE expected electron+positron spectrum



DAMPE expected proton spectrum



The detector structure



PSD: Charge measurement; Identify electron and γ-ray;
STK: Tungsten converter (pair production); Precise tracking (silicon strips);
BGO: Energy measurement; e/p separation;
NUD: Hadron rejection;

The detector parameters

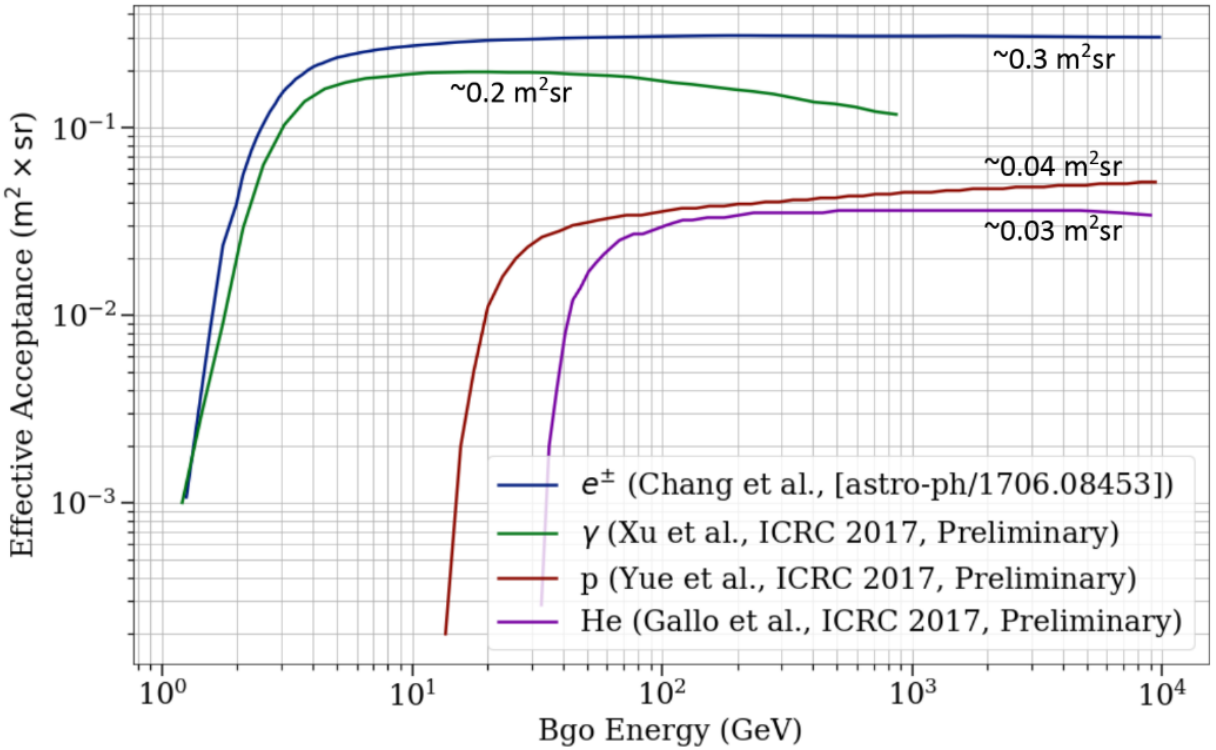
DAMPE main parameters

Parameter	Value
Energy range of γ-rays/electrons	5 GeV−10 TeV
Energy resolution[a] of γ-rays/electrons	$\leq$ 1.5% at 800 GeV
Energy range of protons/heavy nuclei	50 GeV−100 TeV
Energy resolution[a] of protons	$\leq$ 40% at 800 GeV
Effective area at normal incidence (γ-rays)	1100 cm^2 at 100 GeV
Geometric factor for electrons	0.3 m^2 sr above 30 GeV
Photon angular resolution[b]	$\leq 0.2^\circ$ at 100 GeV
Field of View (FoV)	~1.0 sr

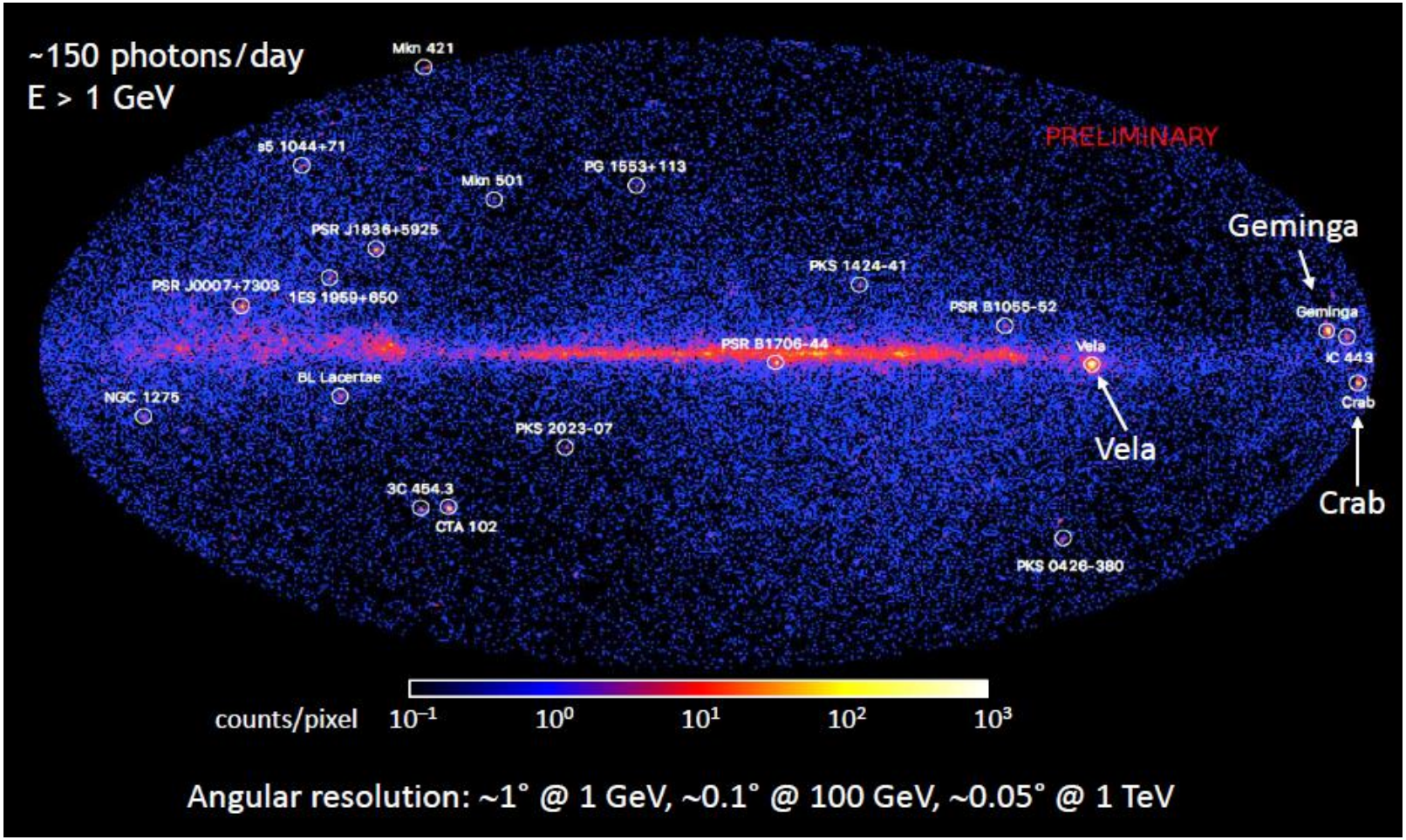
Comparison with AMS-02 and Fermi LAT

	DAMPE	AMS-02	Fermi LAT
e/γ Energy res.@100 GeV (%)	**1.2**	3	10
e/γ Angular res.@100 GeV (deg)	0.2	0.3	0.1
e/p discrimination	10^5-10^6	10^5 - 10^6	10^3
Calorimeter thickness (X_0)	**32**	17	8.6
Geometrical accep. (m^2sr)	**0.3**	0.09	1

DAMPE effective acceptance for different CR particles



The gamma ray sky



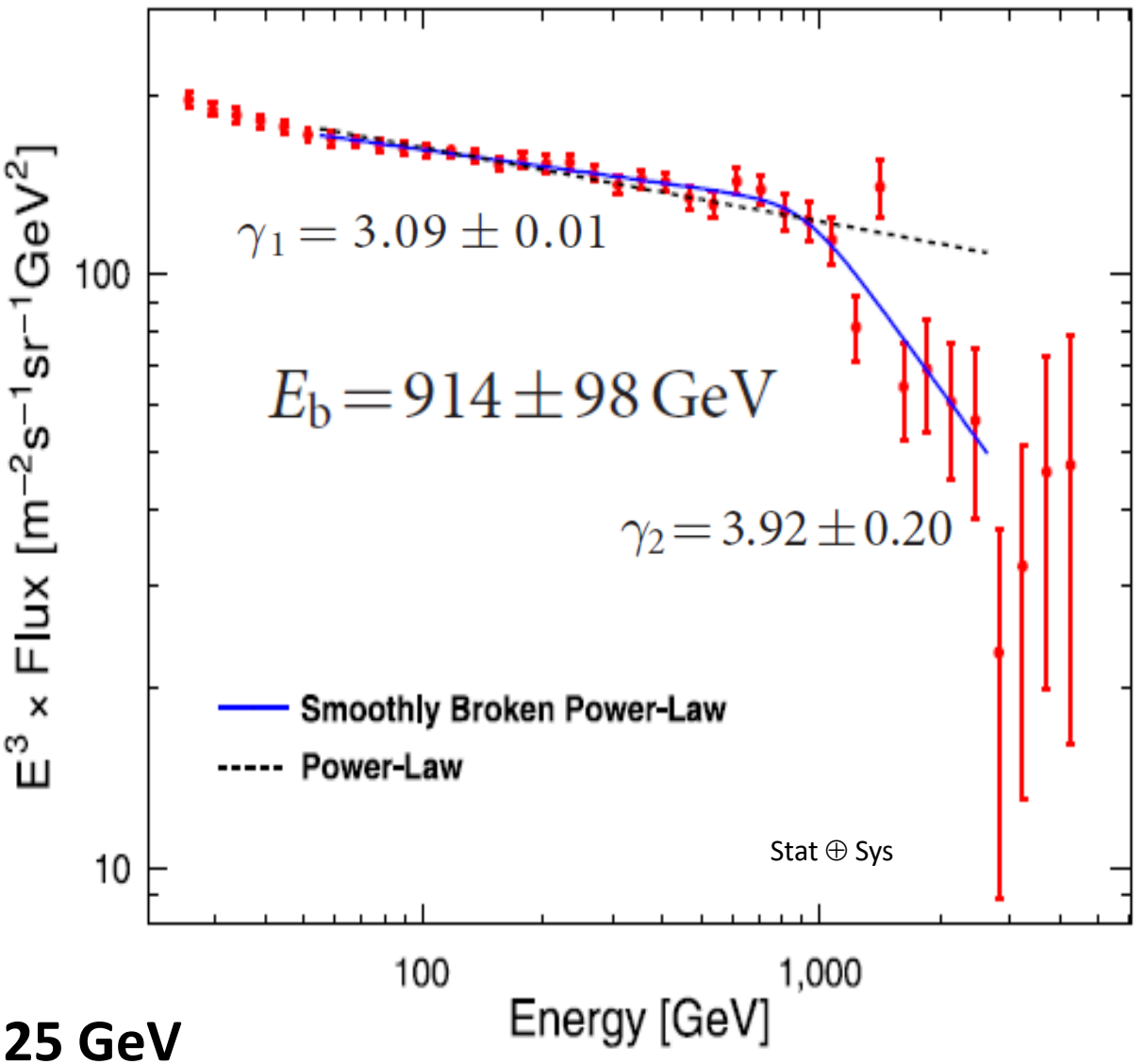
The DAMPE (e^++e^-) spectrum

LETTER nature International weekly journal of science :10.1038/nature24475

Direct detection of a break in the teraelectronvolt cosmic-ray spectrum of electrons and positrons

DAMPE Collaboration*

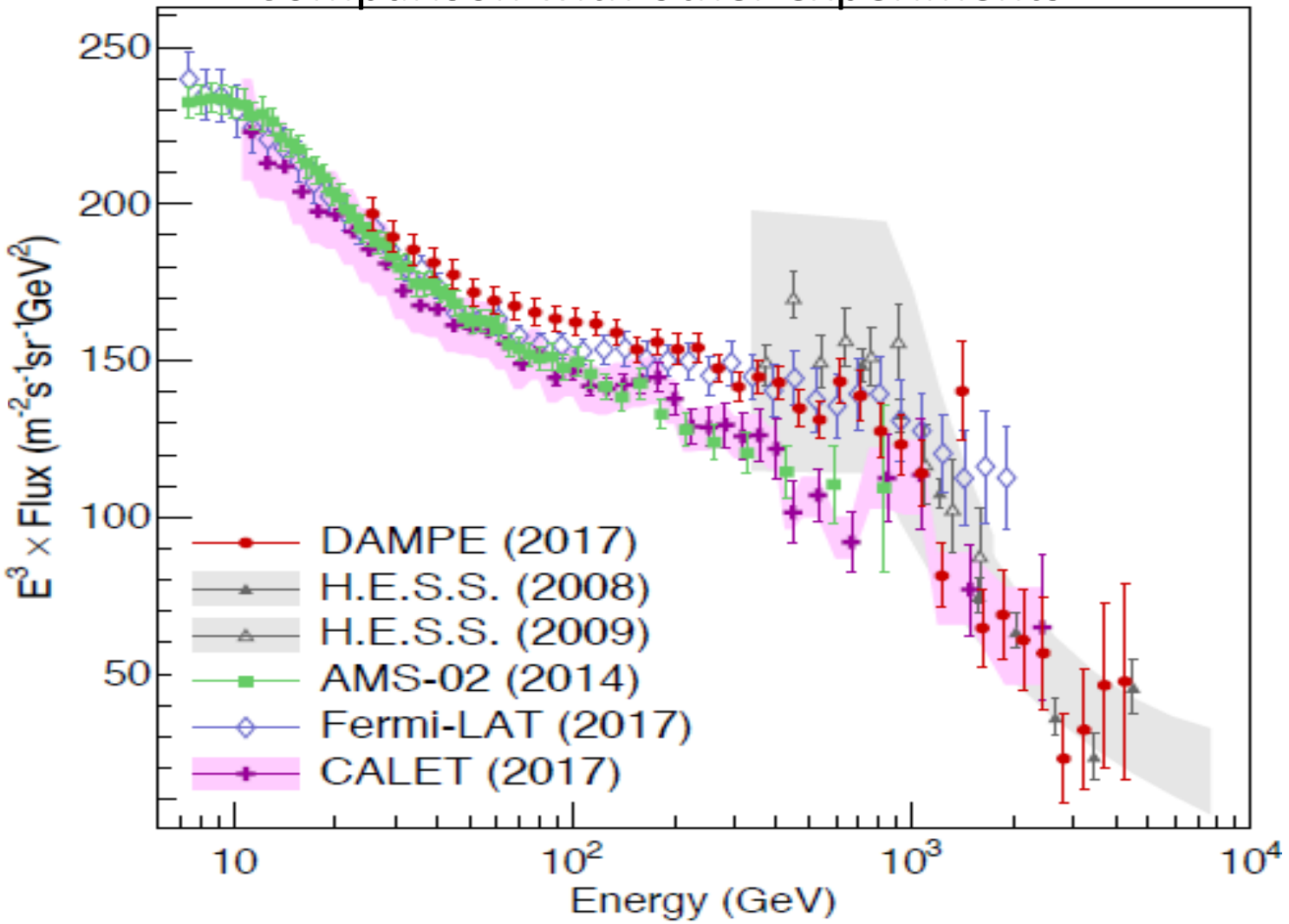
First Direct Evidence for a spectral break in the all-electron spectrum at 0.9 TeV



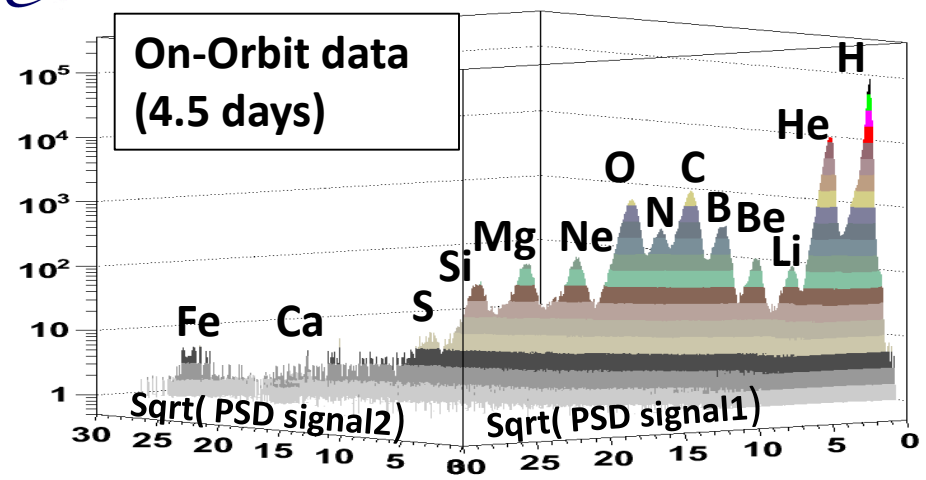
- 530 days
- 2.8 billions CR events
- 1.5 million CREs above 25 GeV

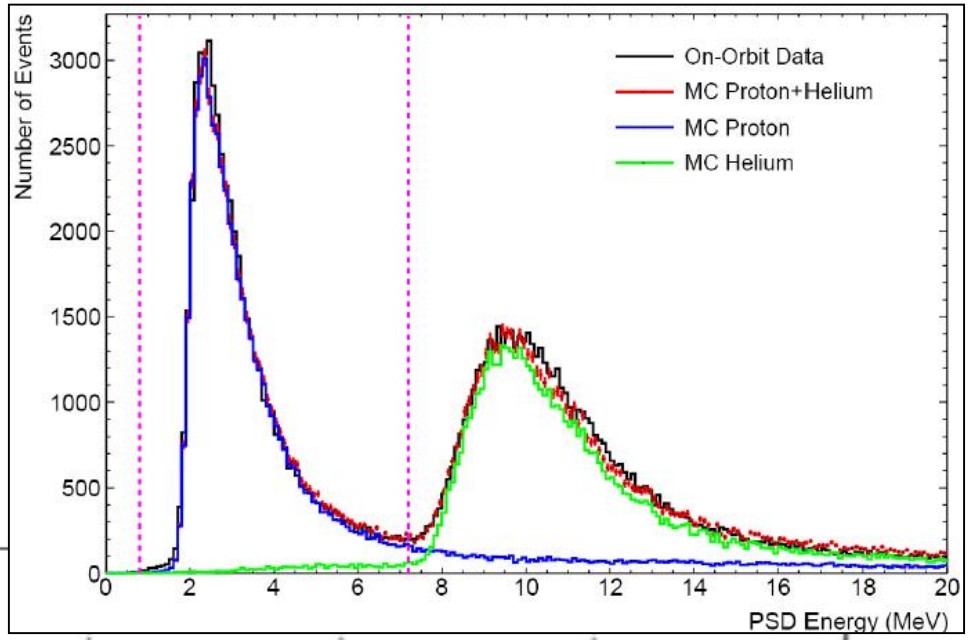
The all-electron spectrum

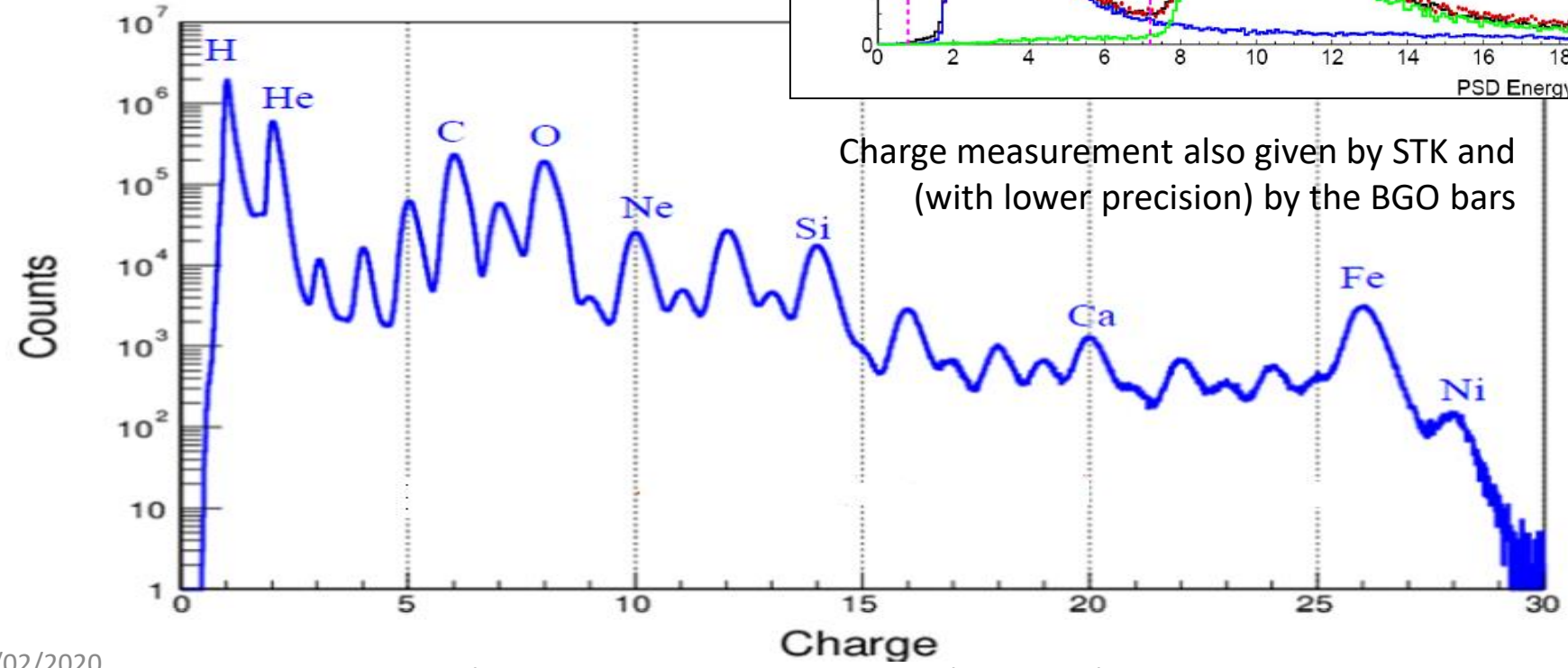
Comparison with other experiments



Nuclei ID with PSD

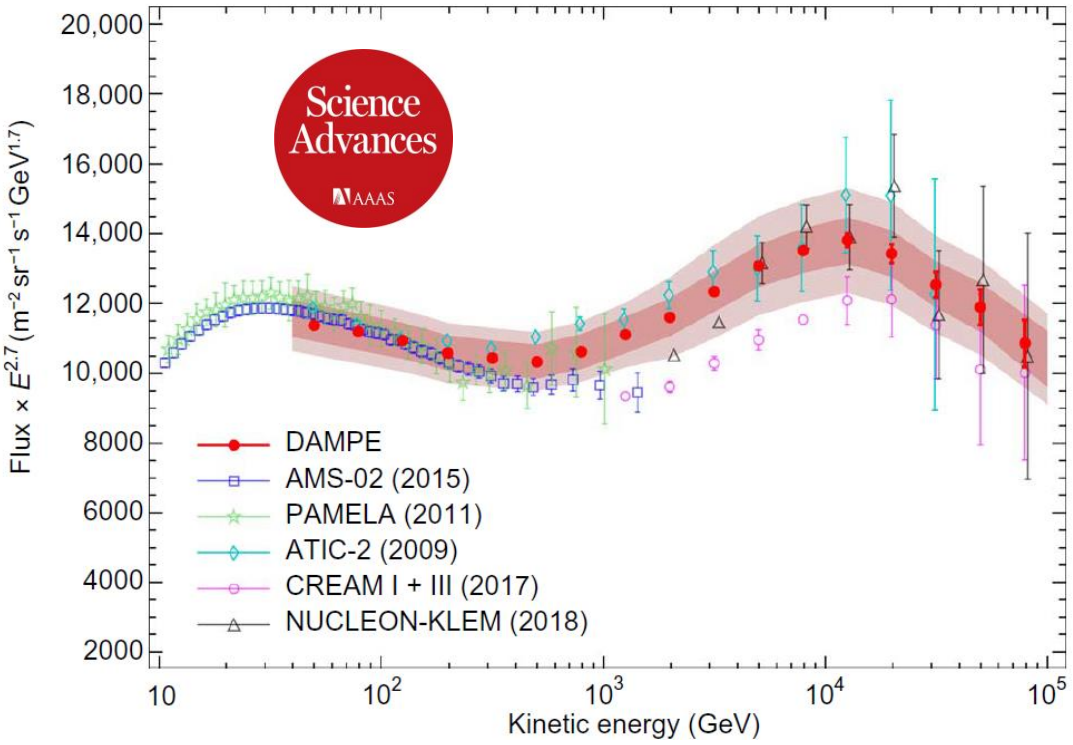


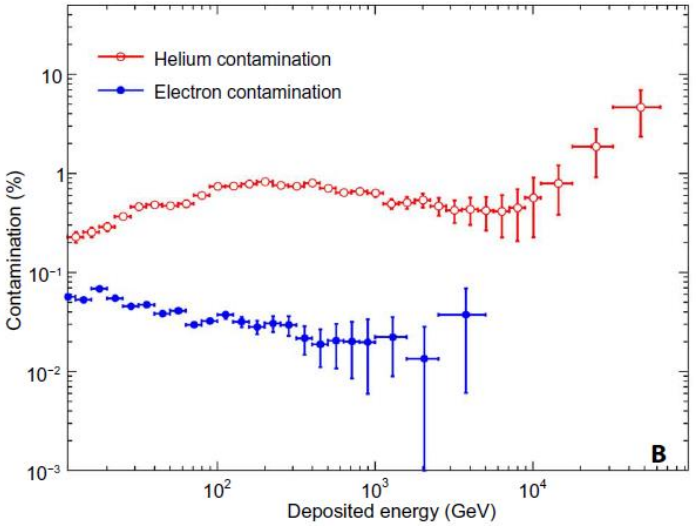




Charge measurement also given by STK and (with lower precision) by the BGO bars

Proton flux measurement





Electron contamination < 0.1% (negligible);

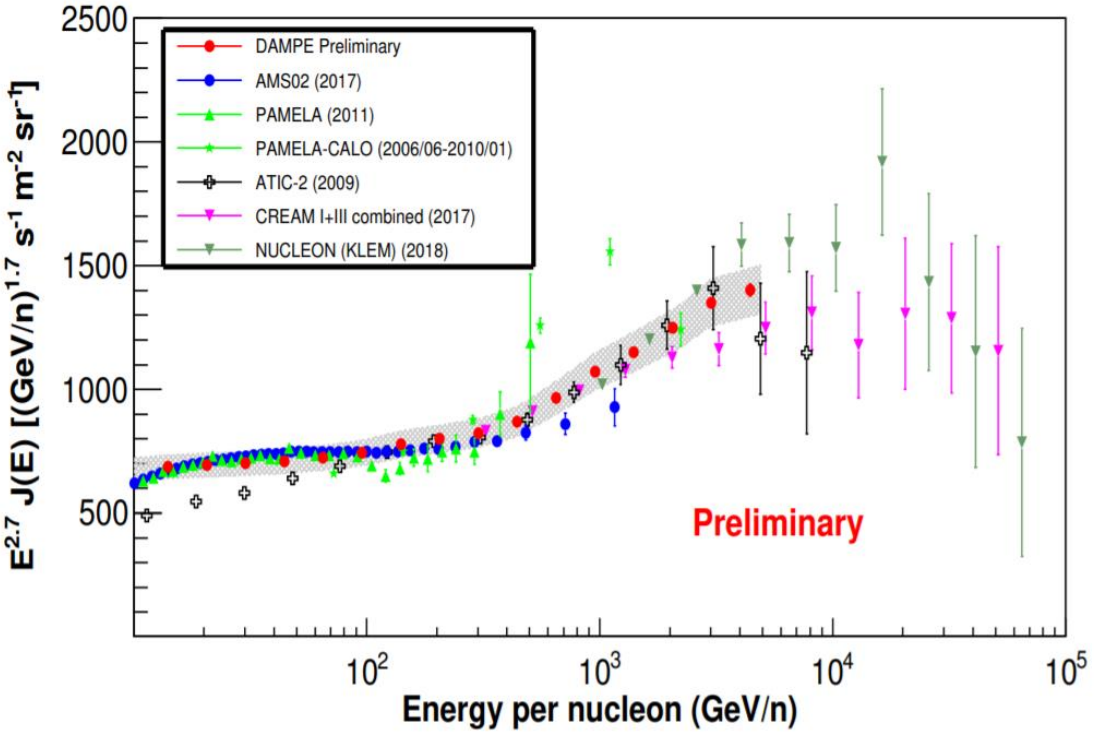
Helium contamination < 1 % up to 10 TeV, < 5% in total.

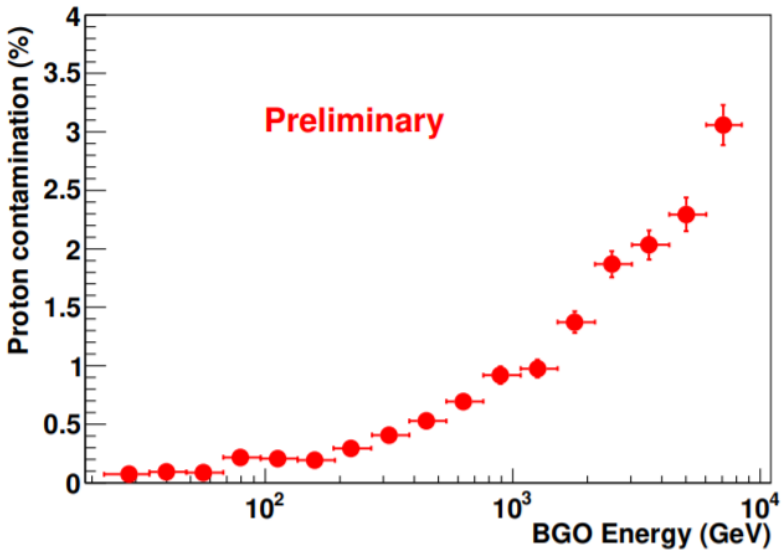
This result:

- **confirms the spectral hardening around 300 GeV observed by ATIC/CREAM/PAMELA/AMS-02**
- **confirms the spectral softening at ~13 TeV with 4.6 σ confidence level**

Helium flux measurement

DAMPE preliminary helium spectrum (From 36th ICRC)



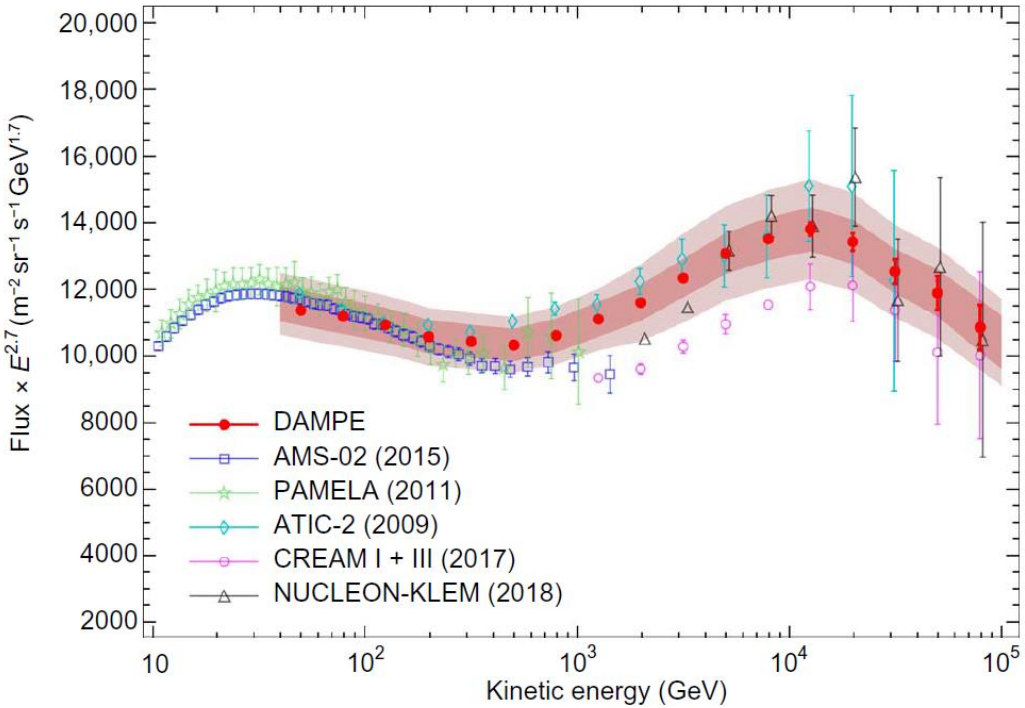


Proton contamination < 1.5% up to 2 TeV, < 3.5% up to 10 TeV.

More precise analysis on helium spectrum is in progress…

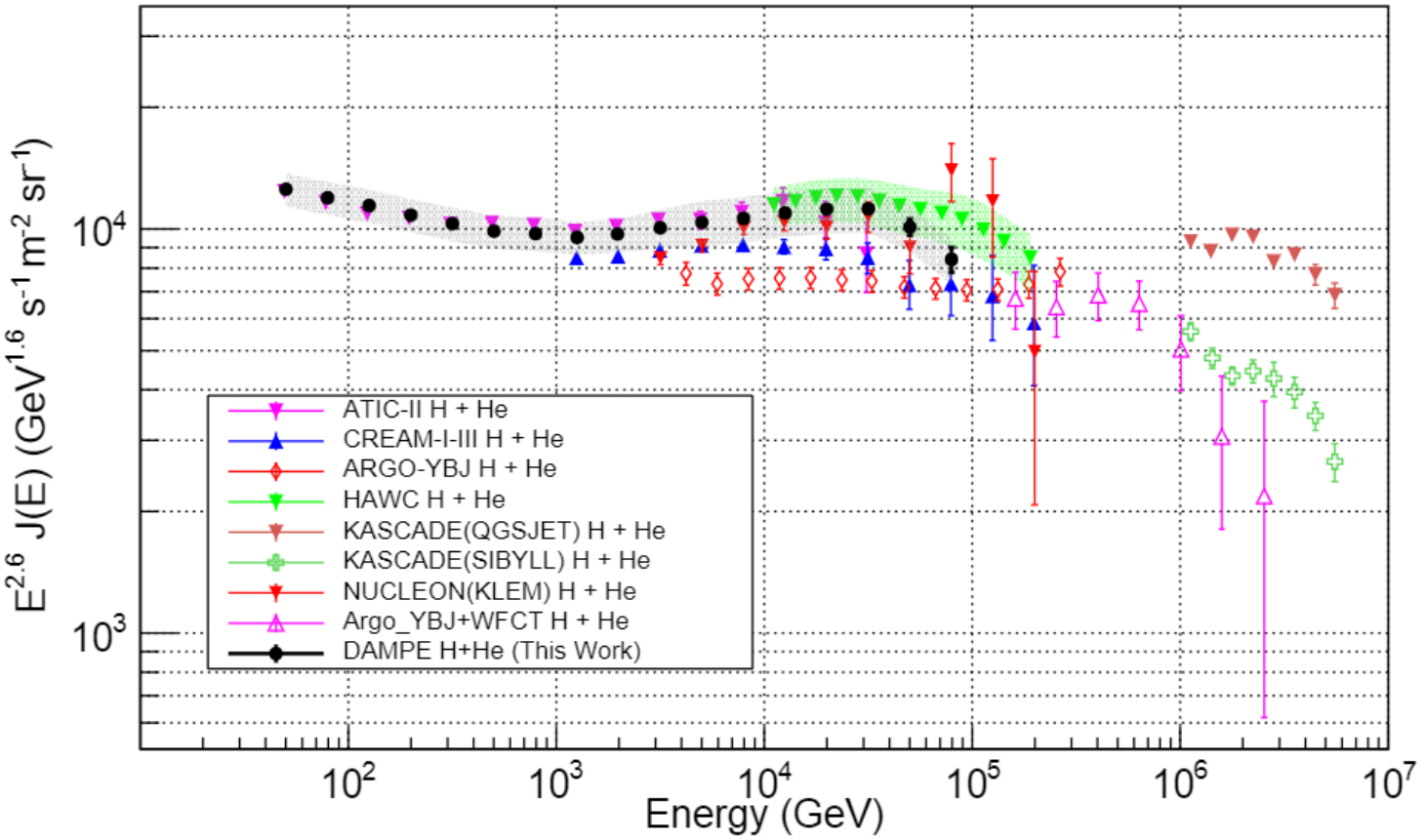
p + He spectrum

Why do we study the p + He spectrum?

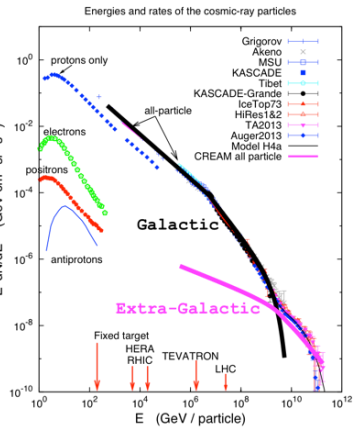


- A spectral softening at 10-15 TeV
- Crosscheck for p and He individual spectra
- Negligible background from other nuclei
- No effects of p <-> He misidentification
- Compare the p + He spectrum with measurements from ground-based experiments at the highest energies

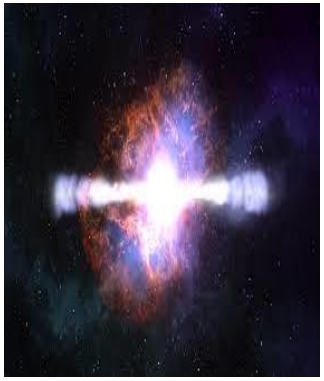
p + He spectrum



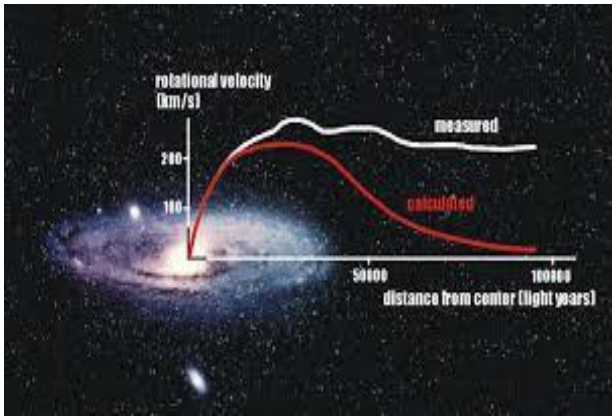
- Good agreement with previous measurements
- A softening at ~30 TeV



DAMPE is a promising scientific project, many interesting topics can be studied, including CR anisotropy, CR B/C flux ratio up to hundred TeV, other heavy nuclei spectrum…



Join DAMPE, Where you could learn a lot!!



Thanks for your attention!