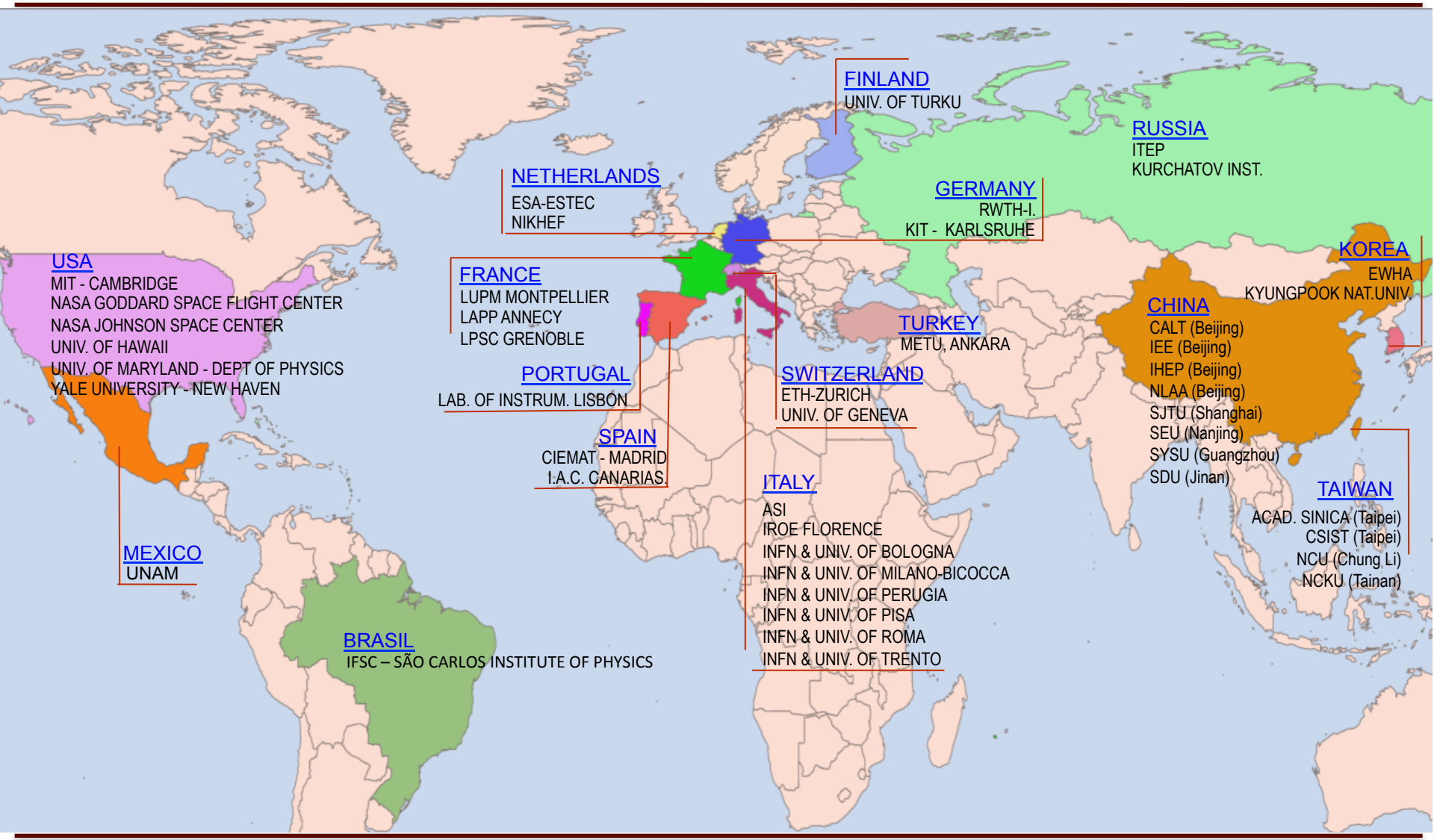
RICAP 18
7th Roma International Conference on AstroParticle Physics

The AMS-02 detector on the ISS
Status and highlights, after the first 7 years on orbit

INFN PERUGIA
Matteo Duranti on behalf of the AMS collaboration
INFN Sez. Perugia

The International Collaboration – 650 scientists, 17 years

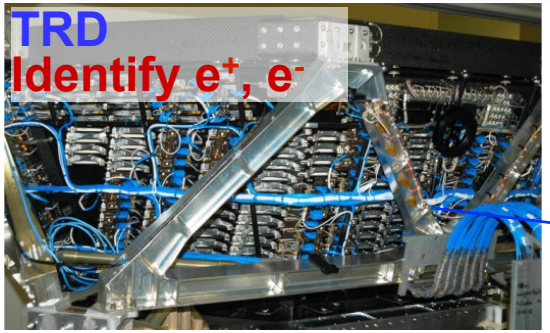


Objectives

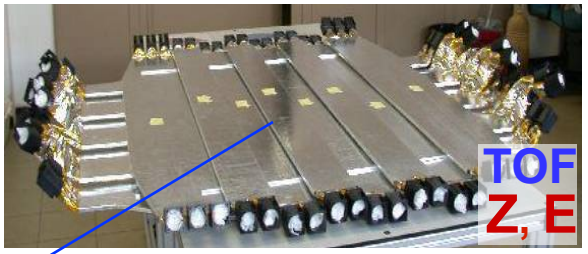
- Fundamental physics and antimatter:
  - Primordial Antimatter search with sensitivity of 10^{-9} (signal: anti-nuclei)
  - Dark Matter search (signal: positrons, anti-p, anti-D)

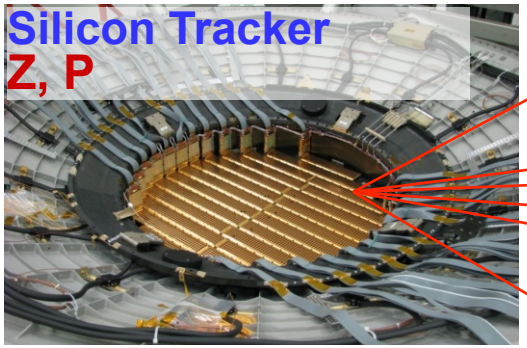
- CRs composition and energy spectrum
  - sources and acceleration: p, He, C, O
  - propagation in the ISM: relative abundances of nuclei and isotopes

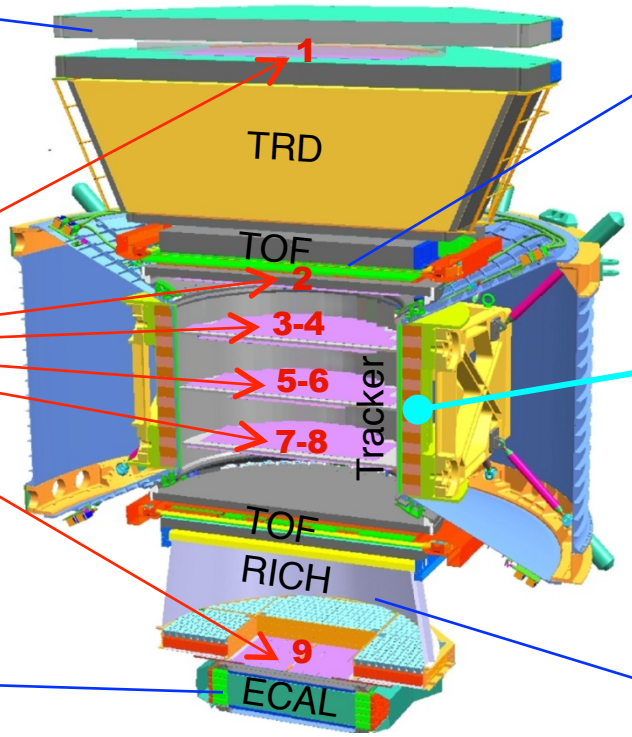
Alpha Magnetic Spectrometer – AMS-02

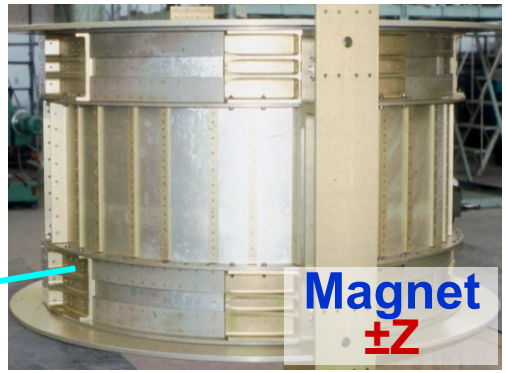


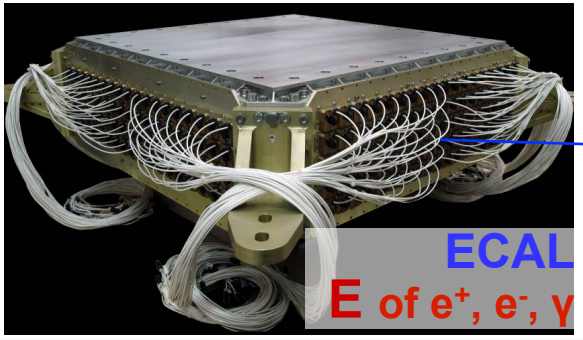
Z, P are measured independently by Tracker, RICH, TOF and ECAL

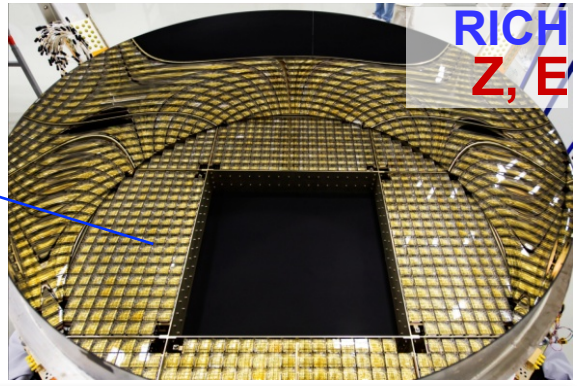


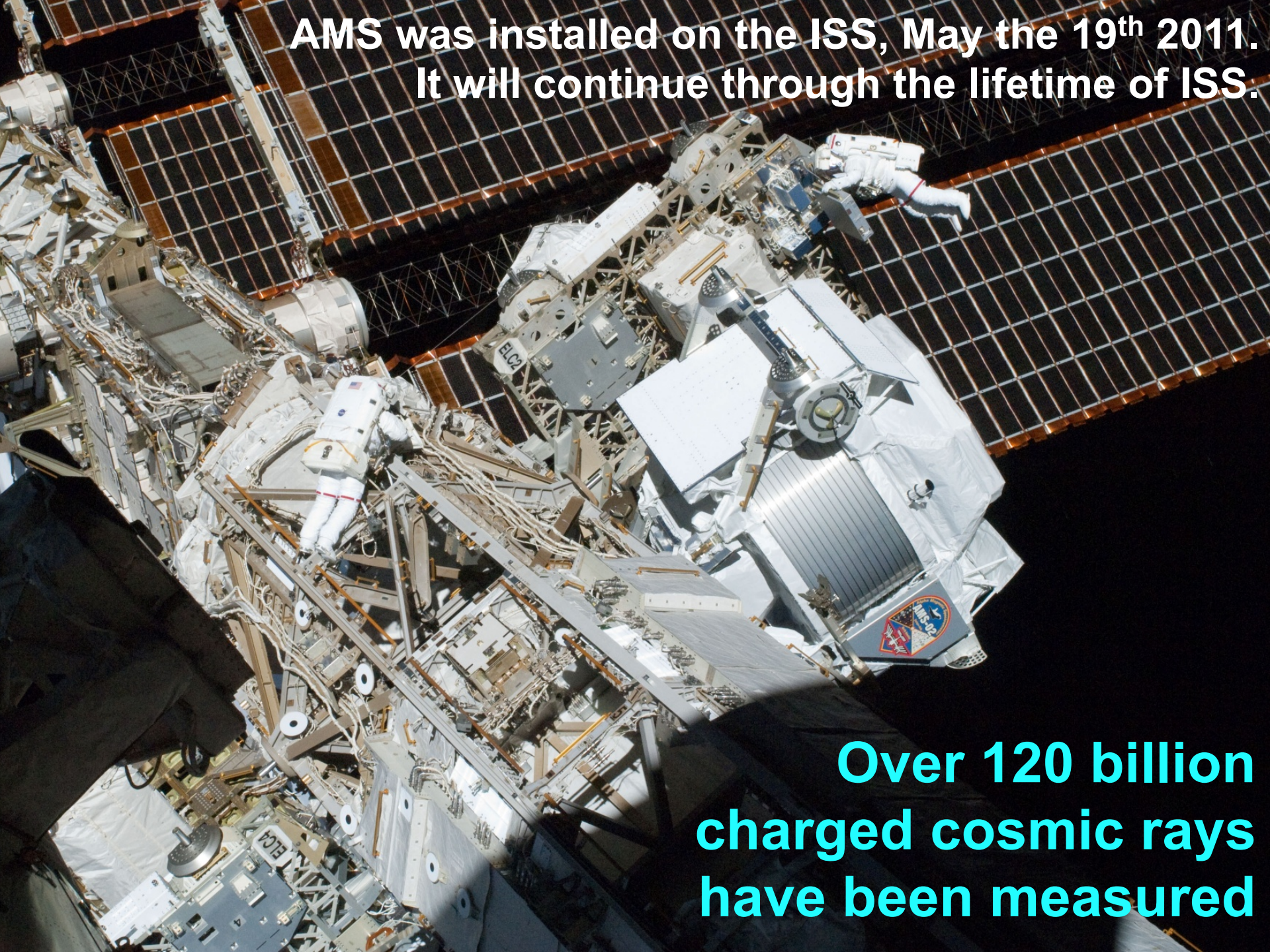




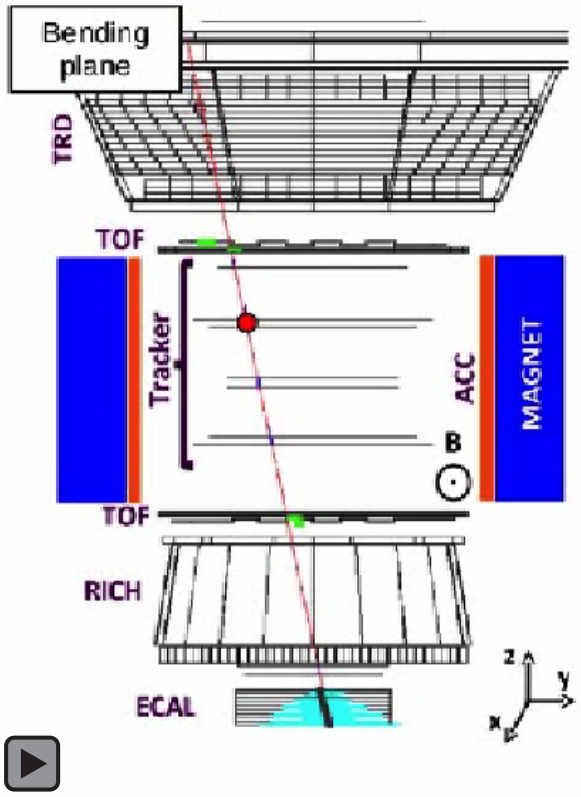







AMS was installed on the ISS, May the 19th 2011.
It will continue through the lifetime of ISS.
Over 120 billion
charged cosmic rays
have been measured

Single particle identification

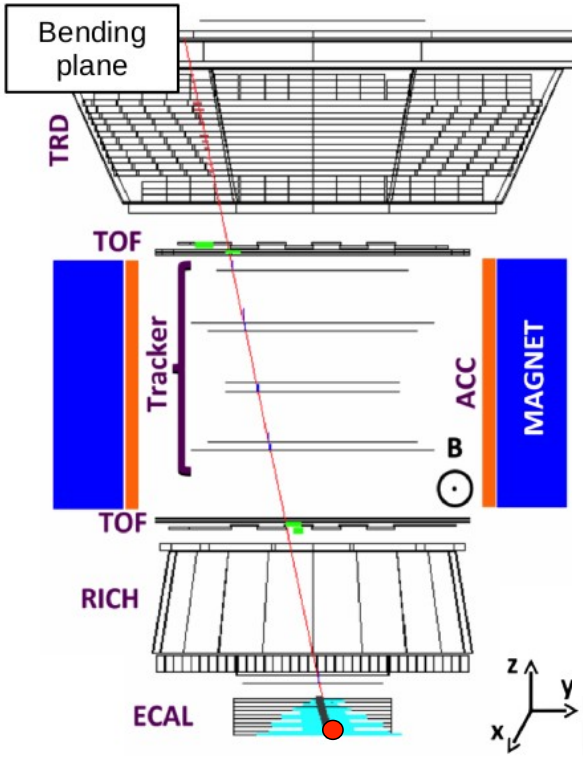


	e^-	p	He
TRD 20 layers			
TOF 4 layers			
TRK 9 layers			
RICH			
ECAL 20 layers			

e/p separation
charge (|Z|)

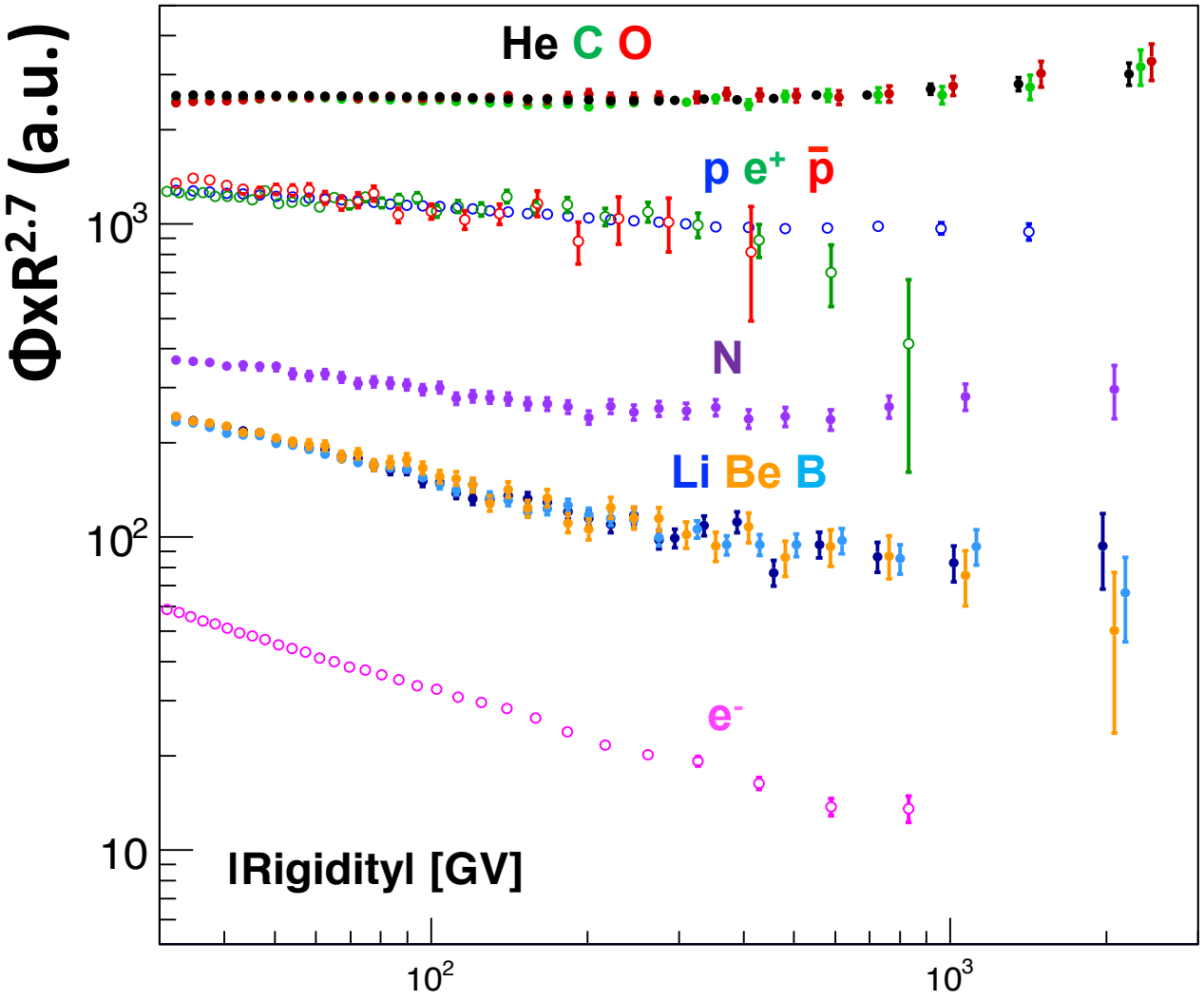
Single particle identification

Full coverage of anti-matter and CR physics

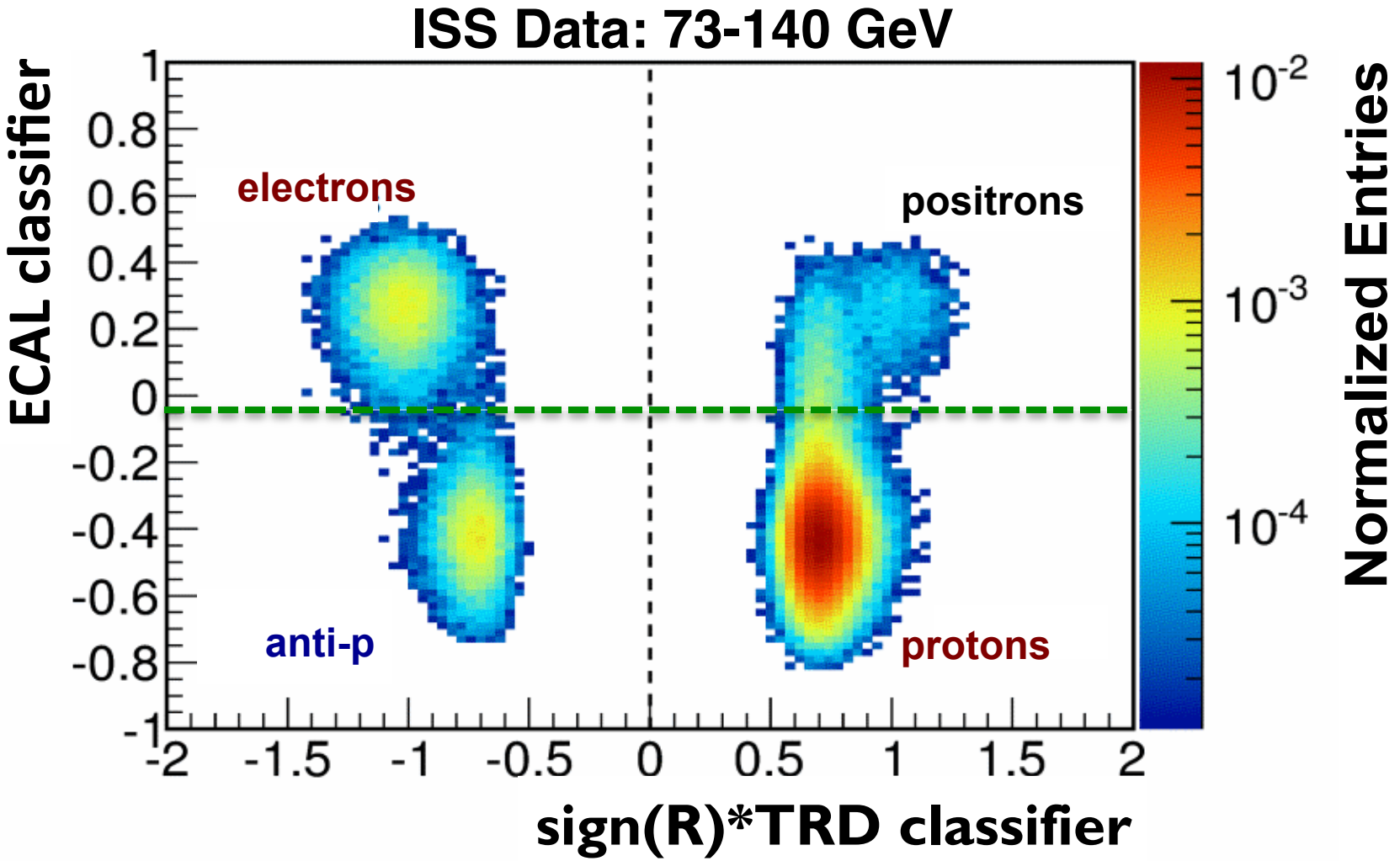


	e^-	p	He	
TRD 20 layers				e/p separation charge (|Z|)
TOF 4 layers				trigger velocity (β) charge (|Z|)
TRK 9 layers				momentum (p) sign (±Q) charge (|Z|)
RICH				velocity (β) charge (|Z|)
ECAL 20 layers				$e^{\pm}$ energy e/h separation γ trigger

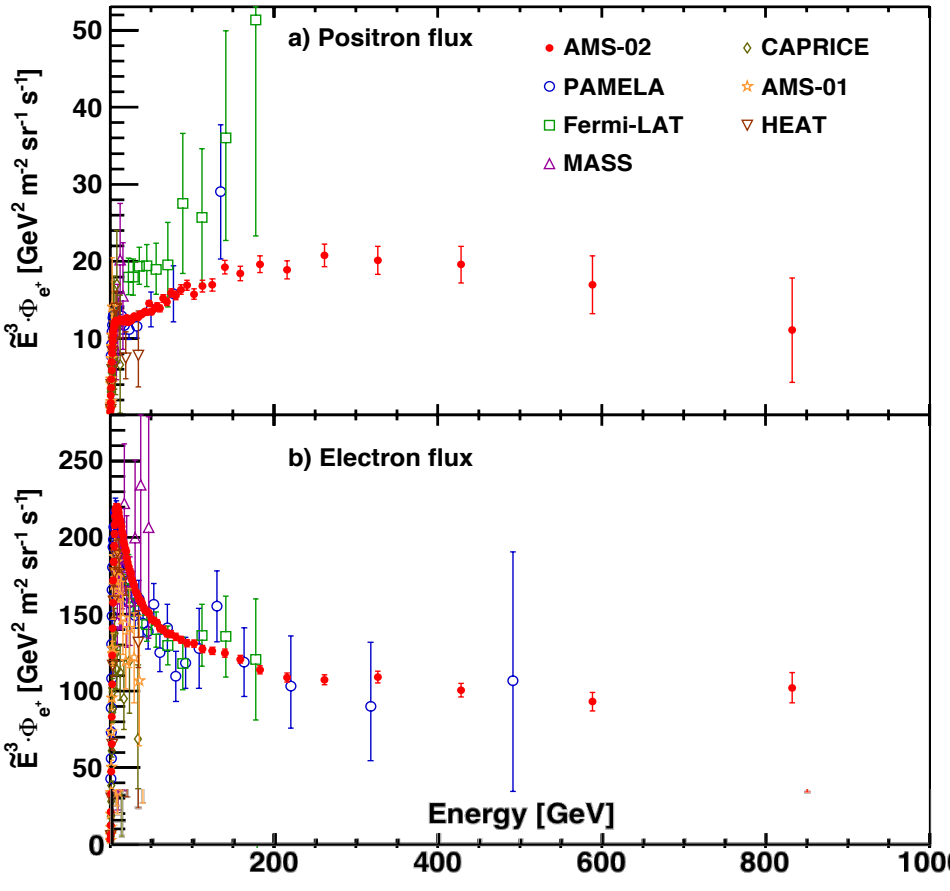
Single particle identification

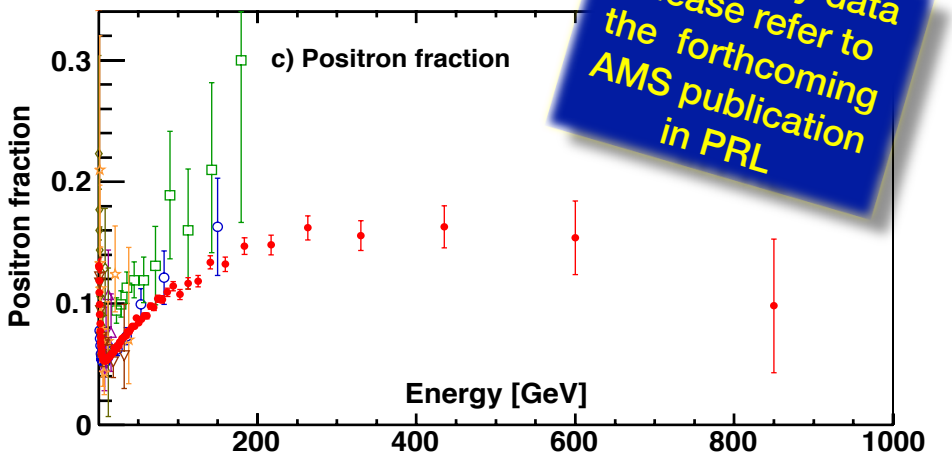


Redundancy and complementarity



Latest results on the positron and electron fluxes



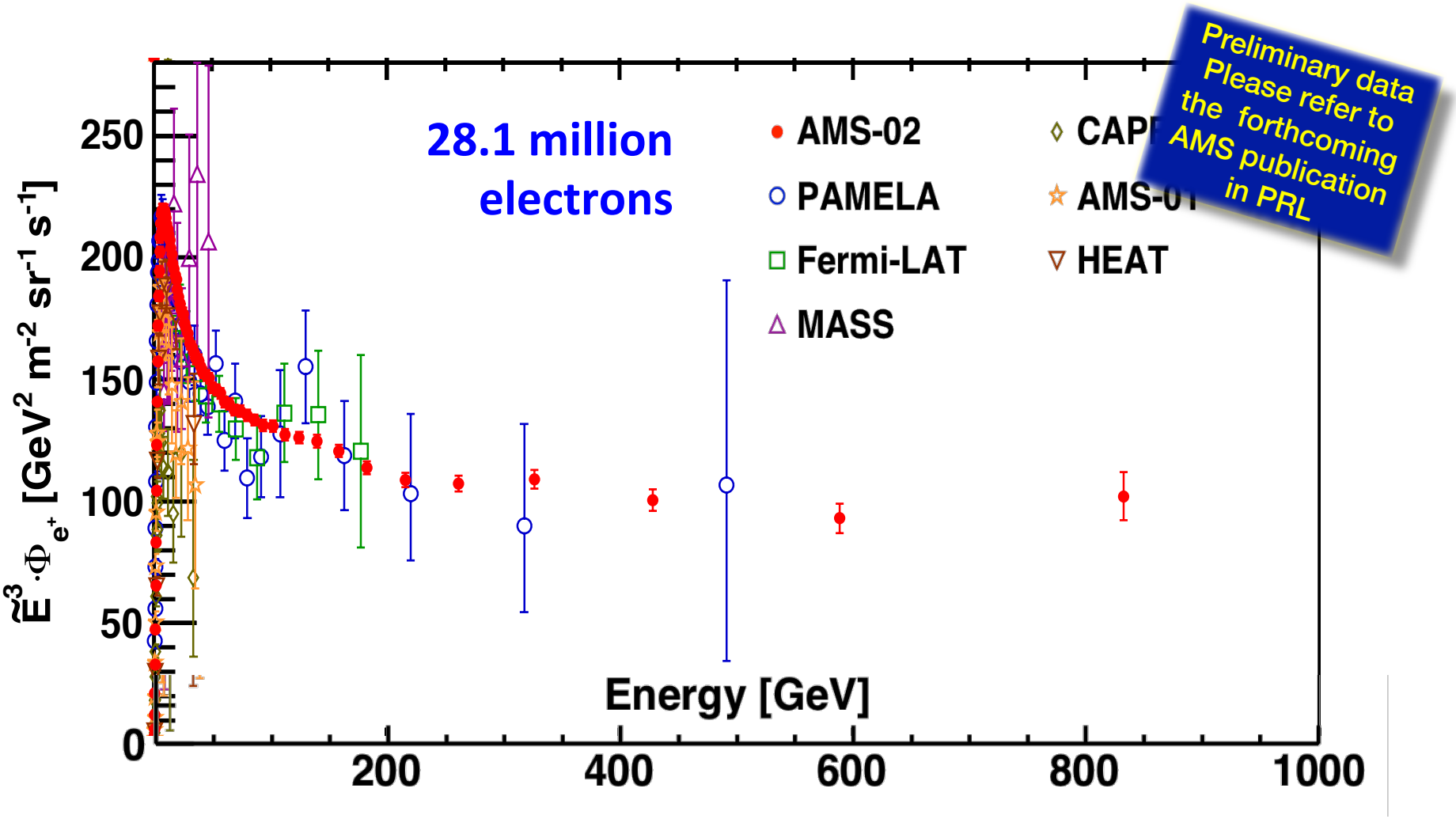


Preliminary data
Please refer to the forthcoming AMS publication in PRL

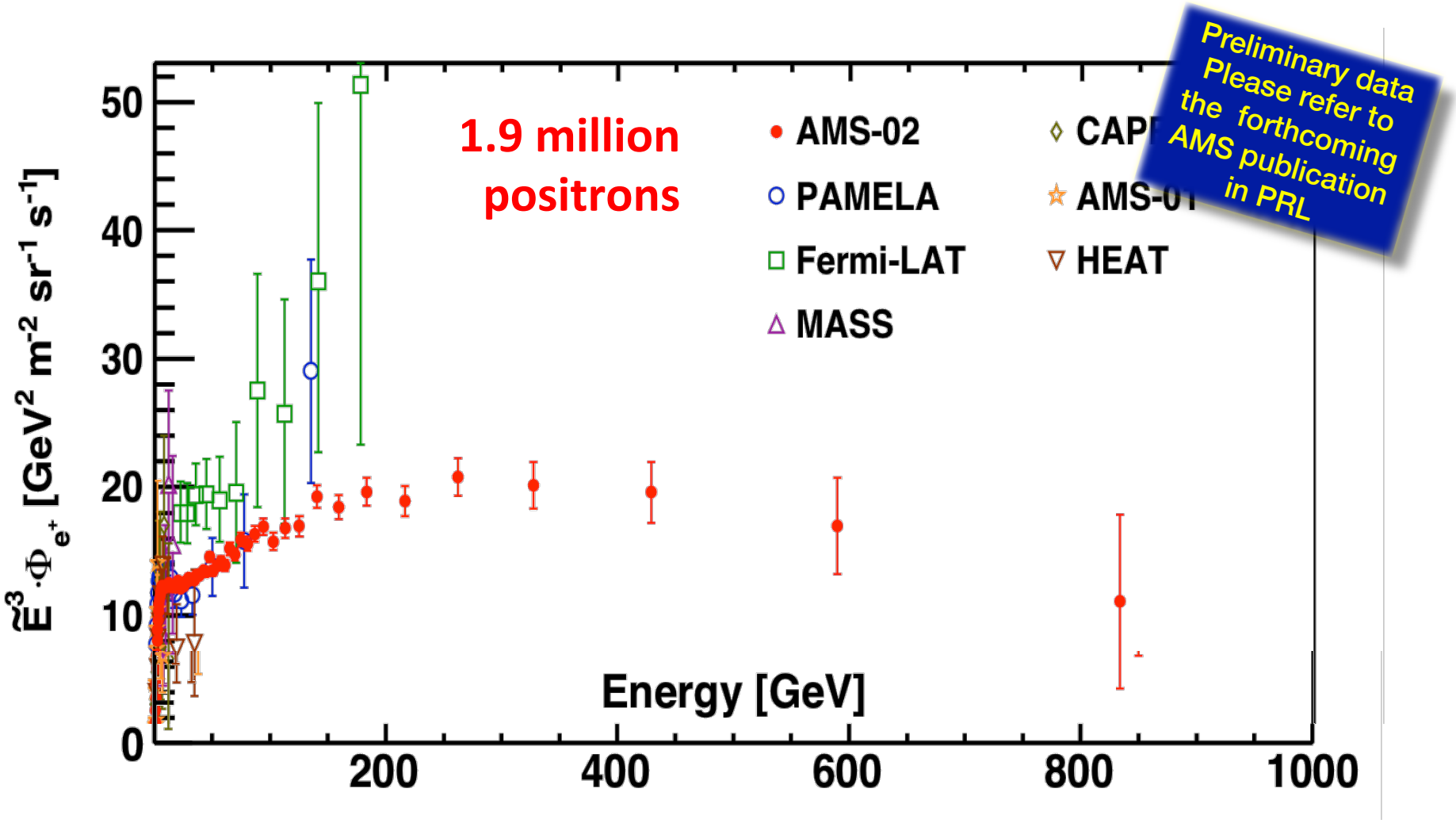
latest results based on:

- ~ 28.1 million electrons
- ~ 1.9 million positrons

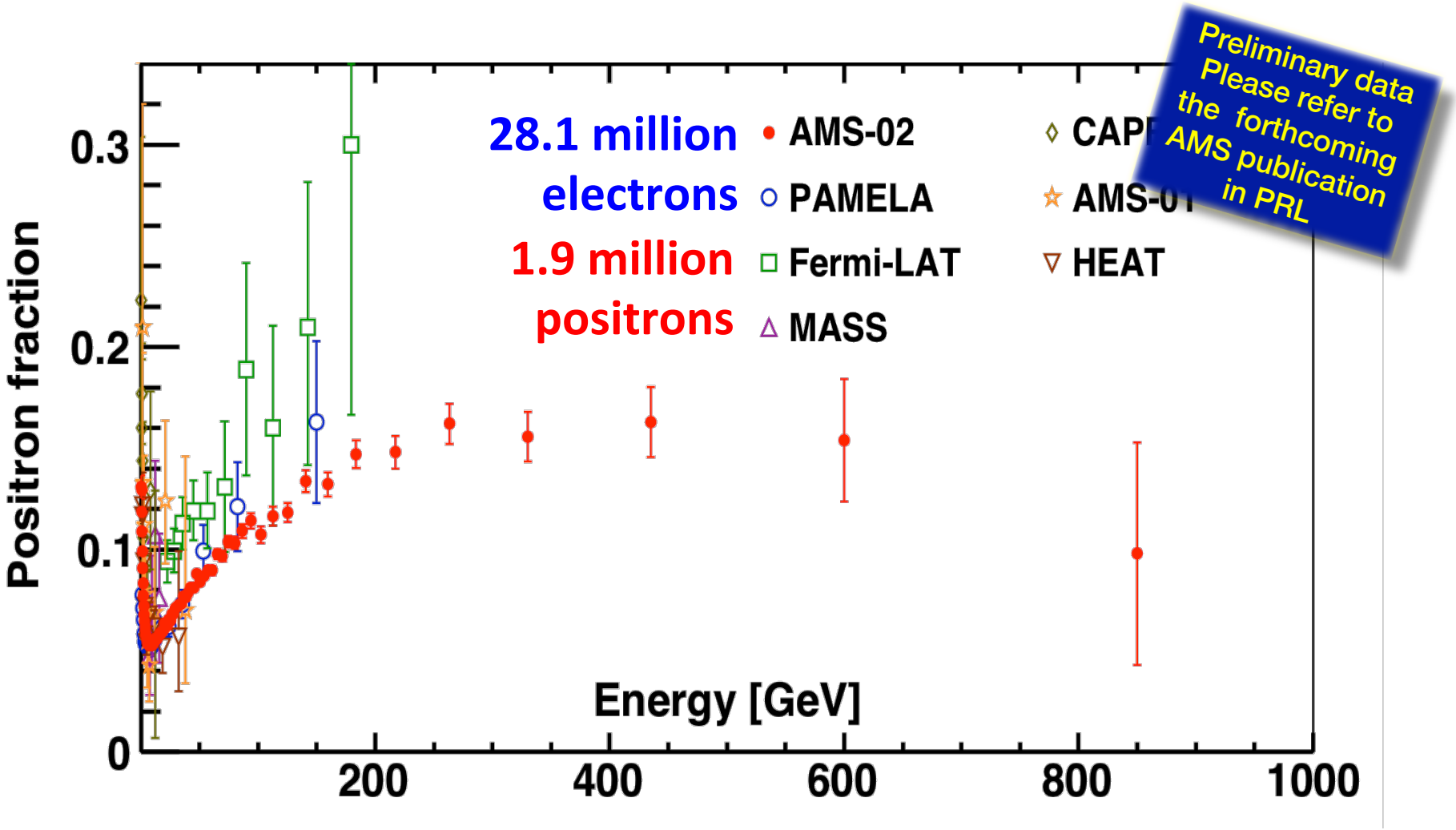
Latest results on the positron and electron fluxes



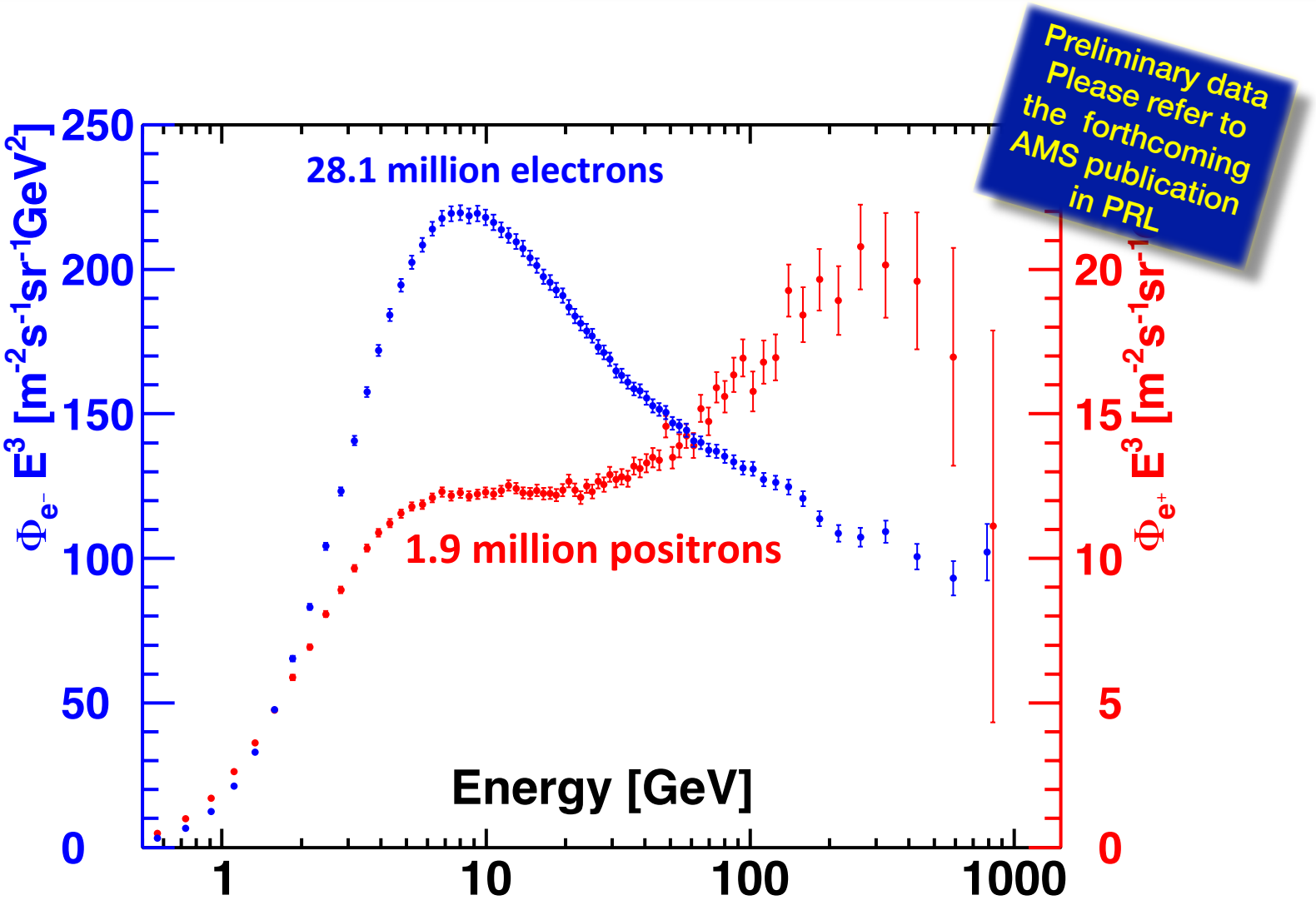
Latest results on the positron and electron fluxes



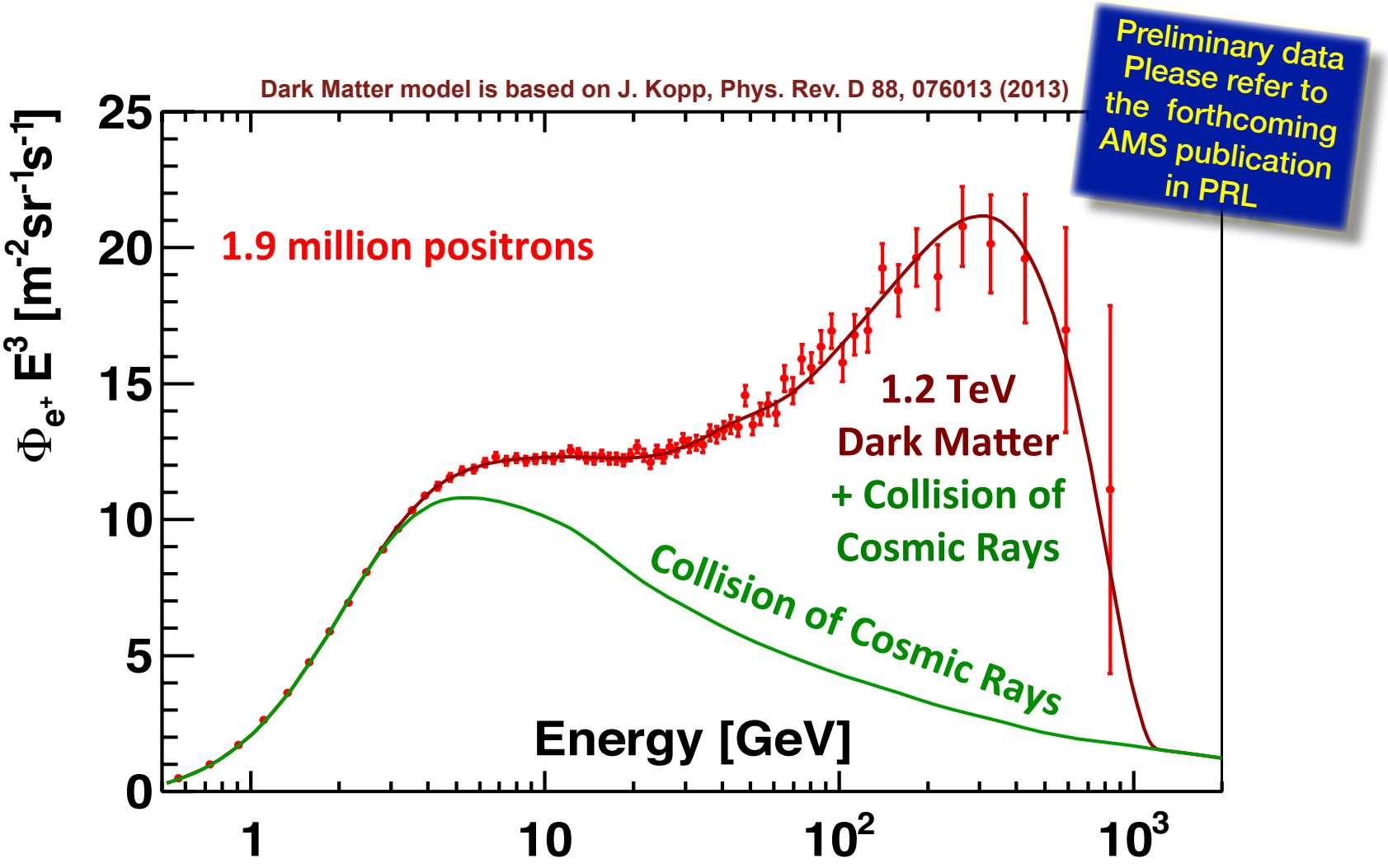
Latest results on the positron and electron fluxes



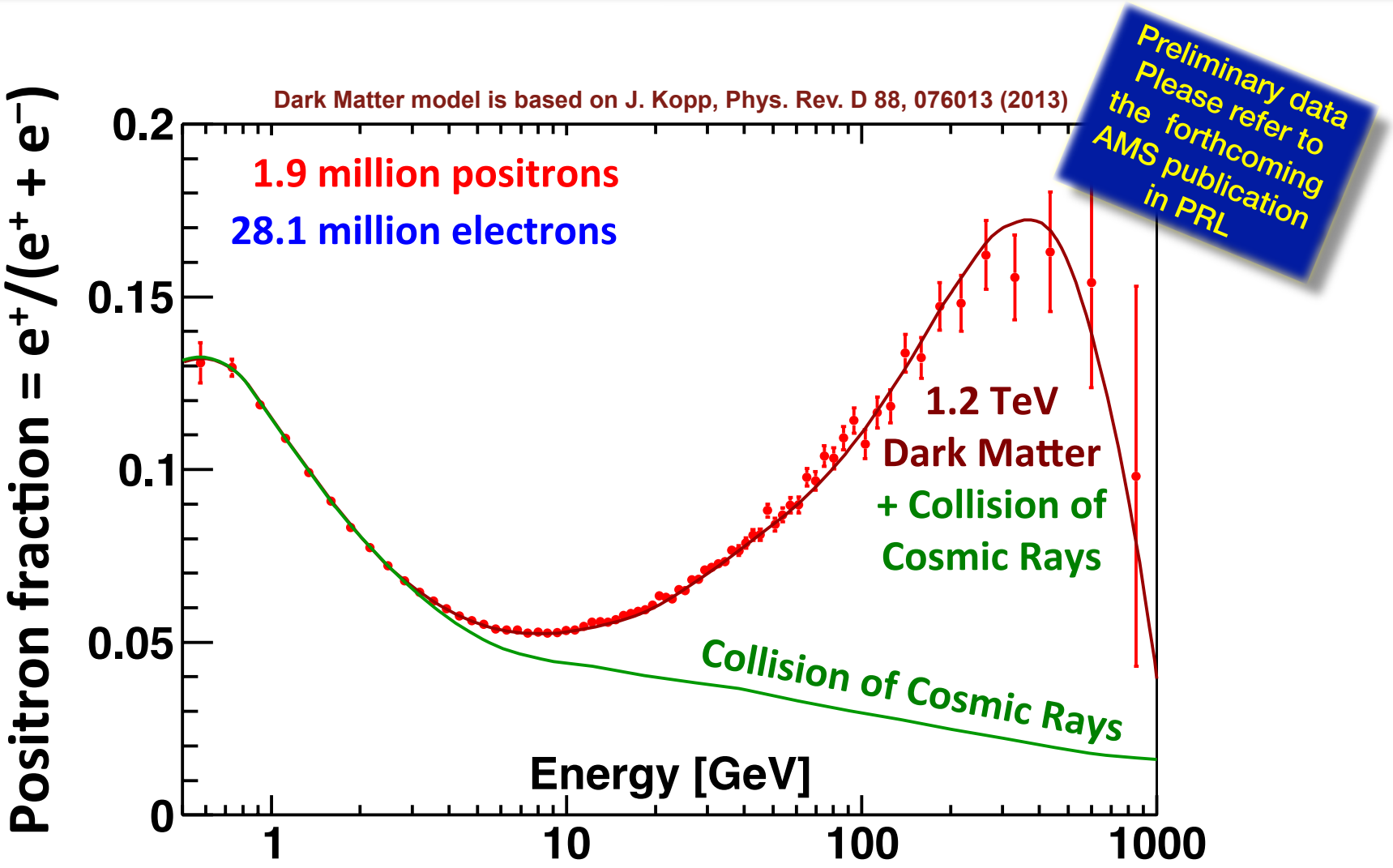
Latest results on the positron and electron fluxes



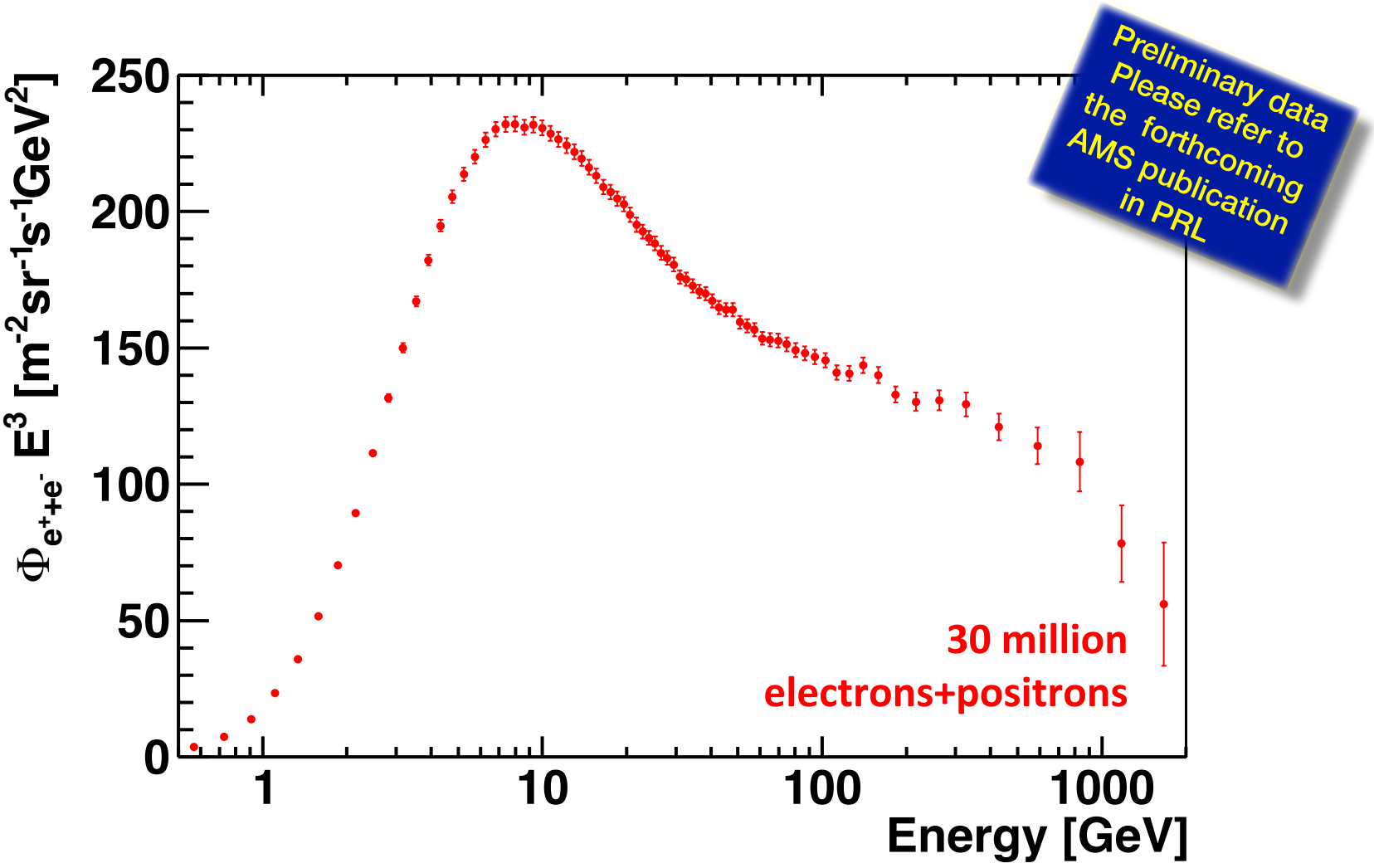
Latest results on the positron flux



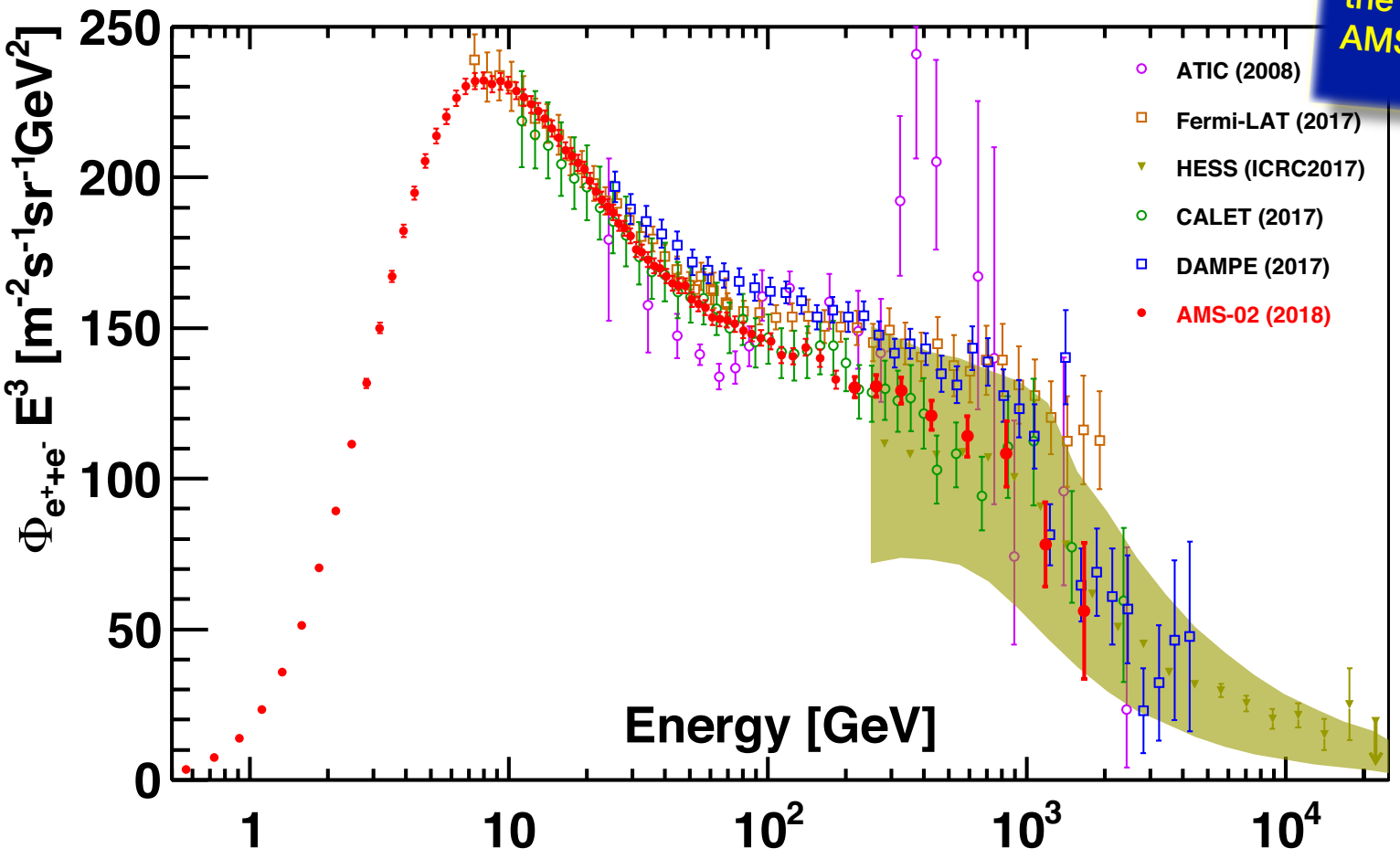
Latest results on the positron fraction



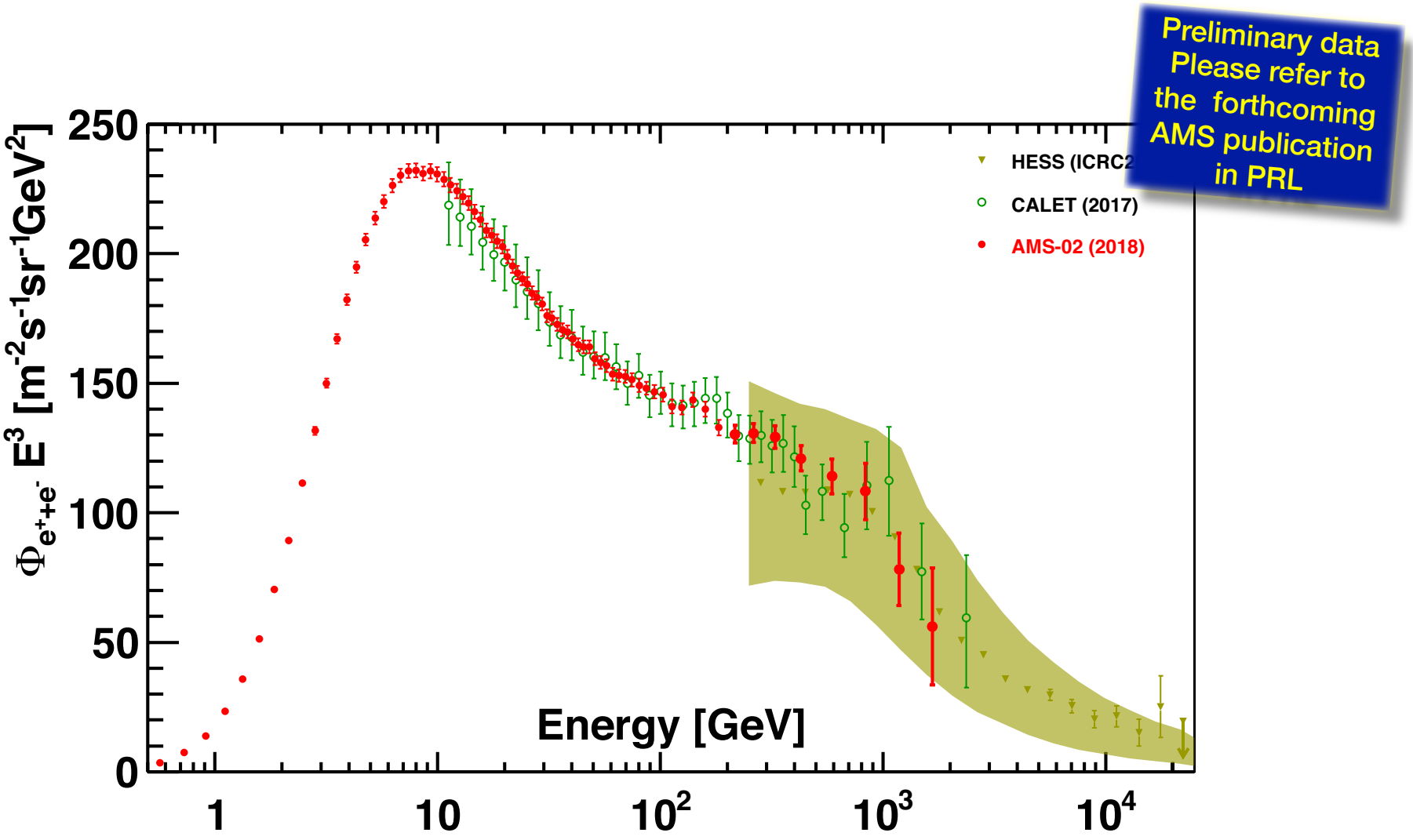
Latest results on the "all electron" flux



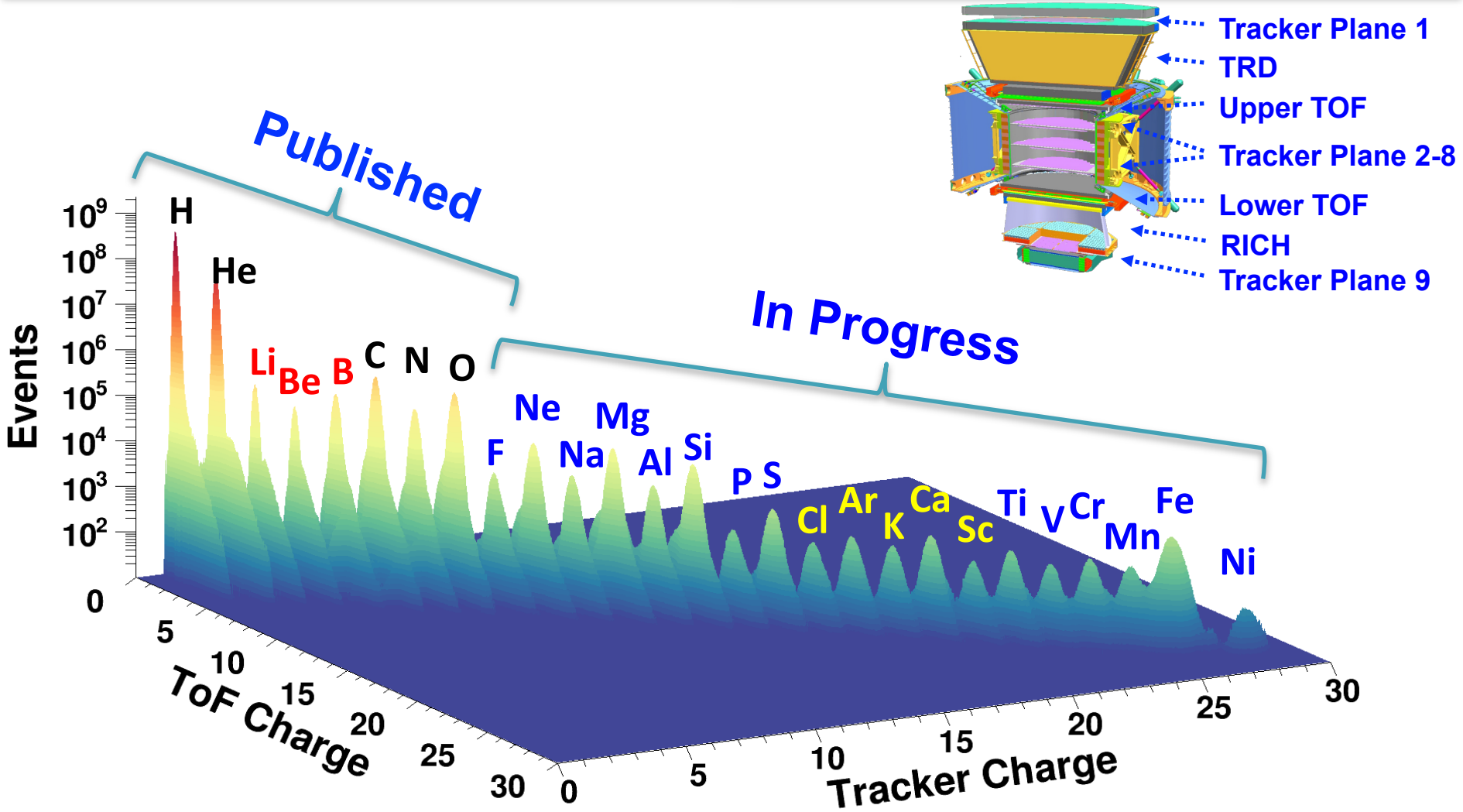
Latest results on the "all electron" flux



Latest results on the "all electron" flux

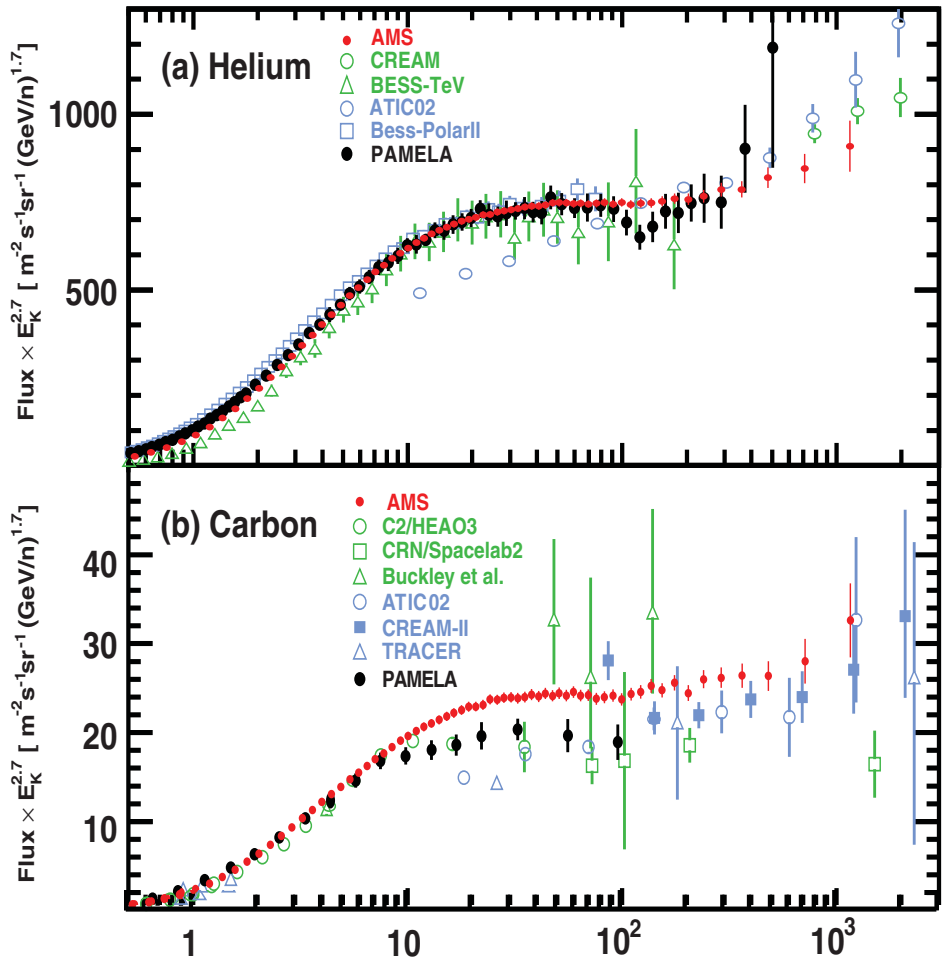


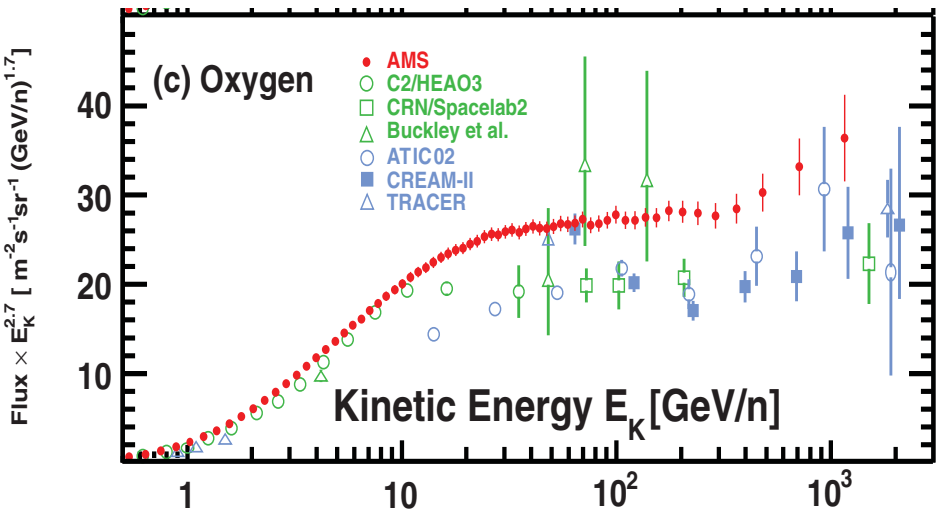
Precision measurement of all the nuclear species



* more details were given in the V. Formato talk

Primary fluxes (PRL 119, 251101 – 2017)

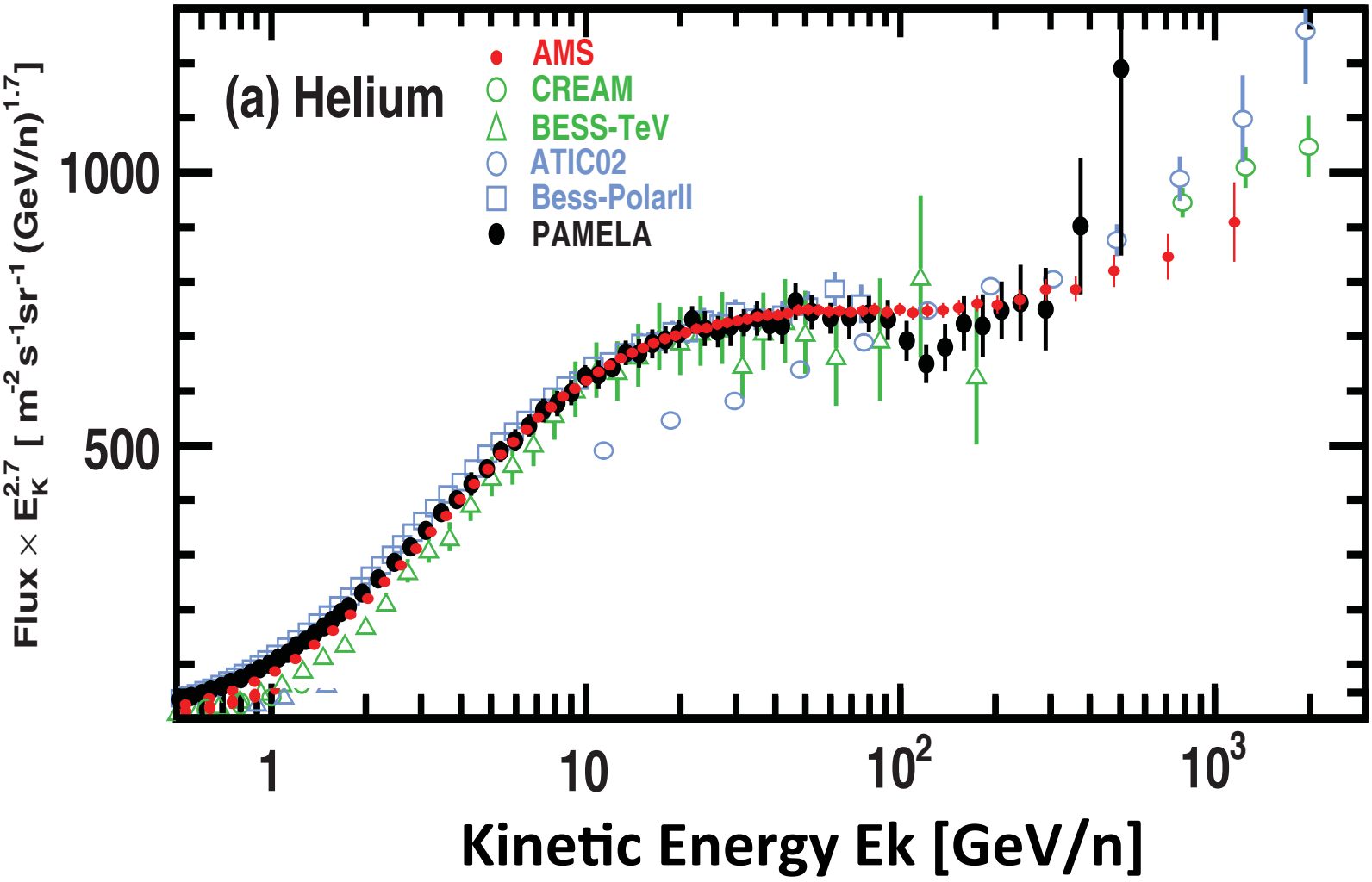




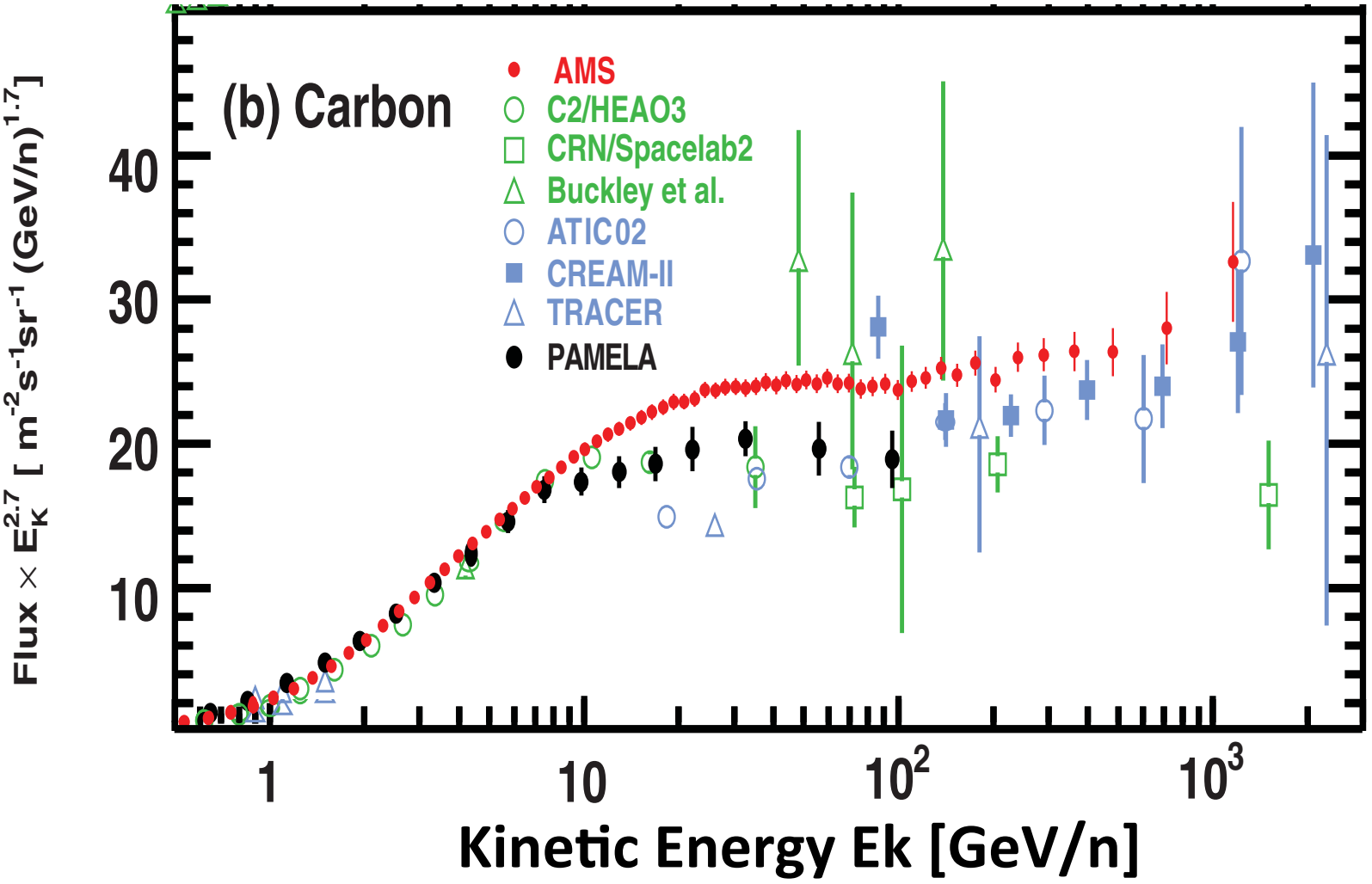
results based on:

- ~ 90 million helium nuclei
- ~ 8.5 million carbon nuclei
- ~ 7 million oxygen nuclei

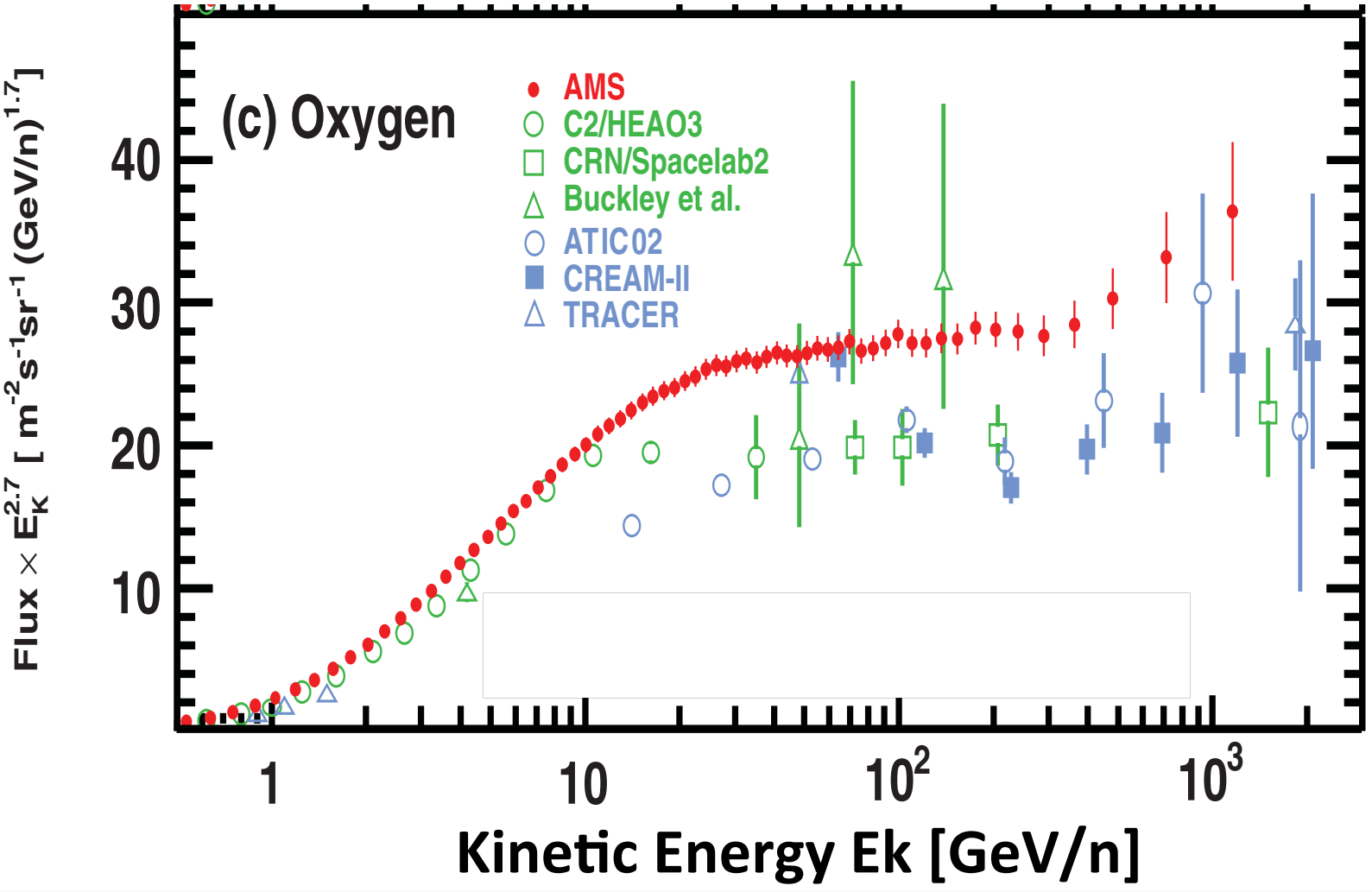
Primary fluxes (PRL 119, 251101 – 2017)



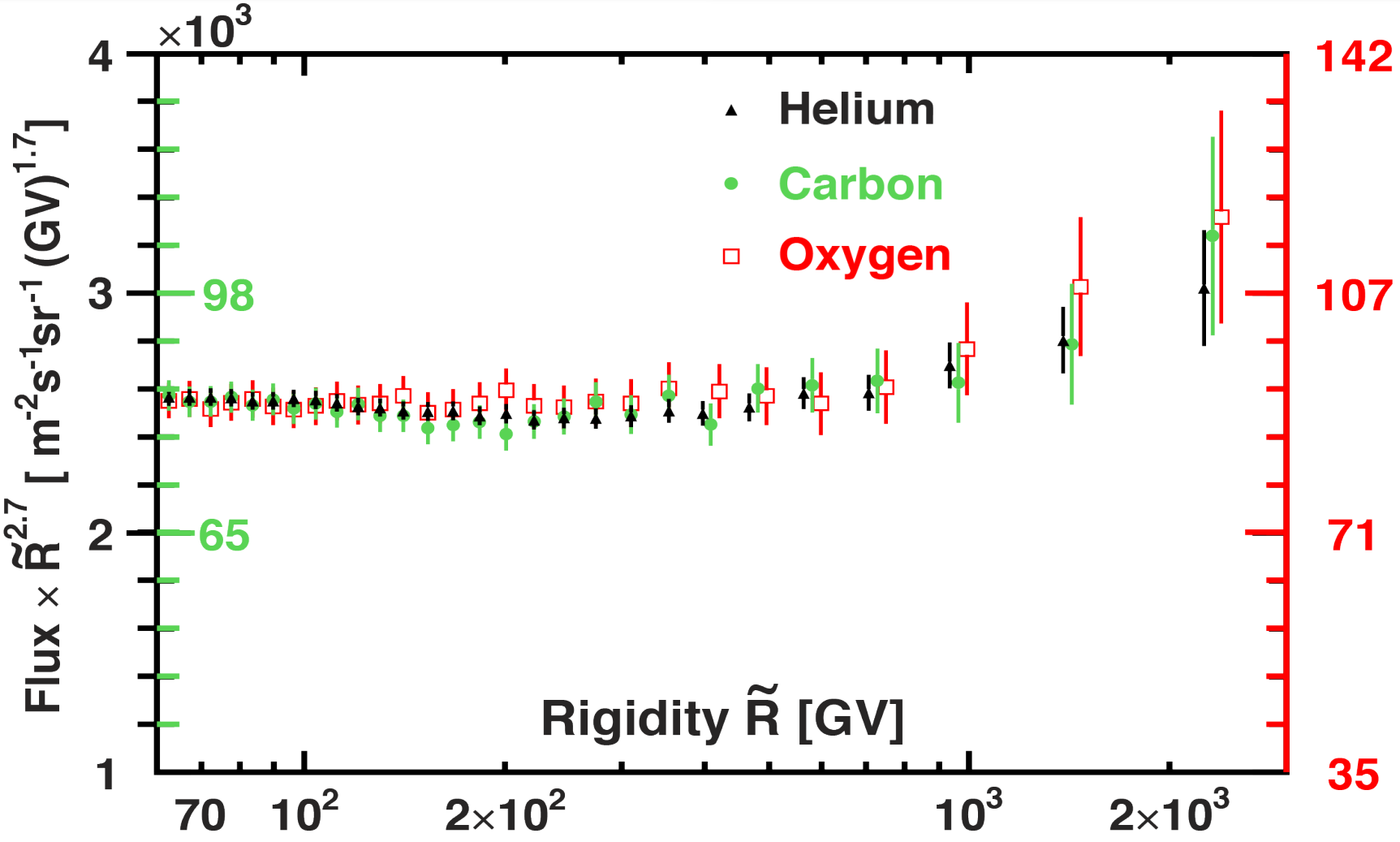
Primary fluxes (PRL 119, 251101 – 2017)



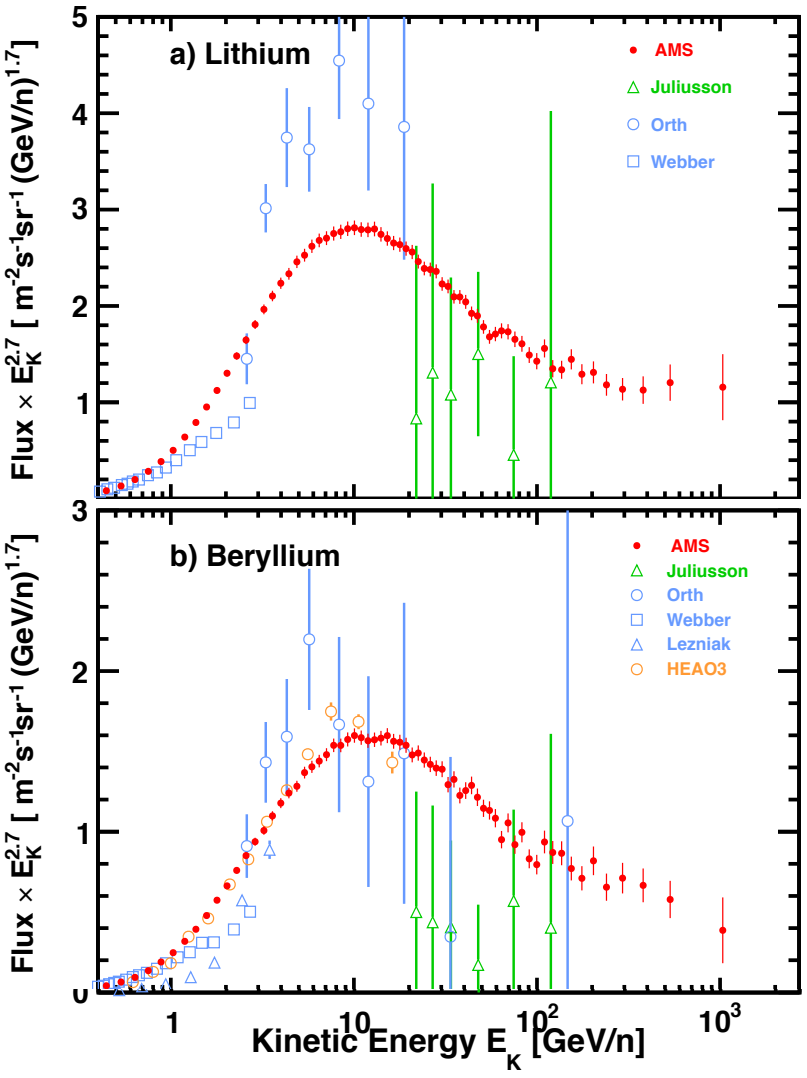
Primary fluxes (PRL 119, 251101 – 2017)

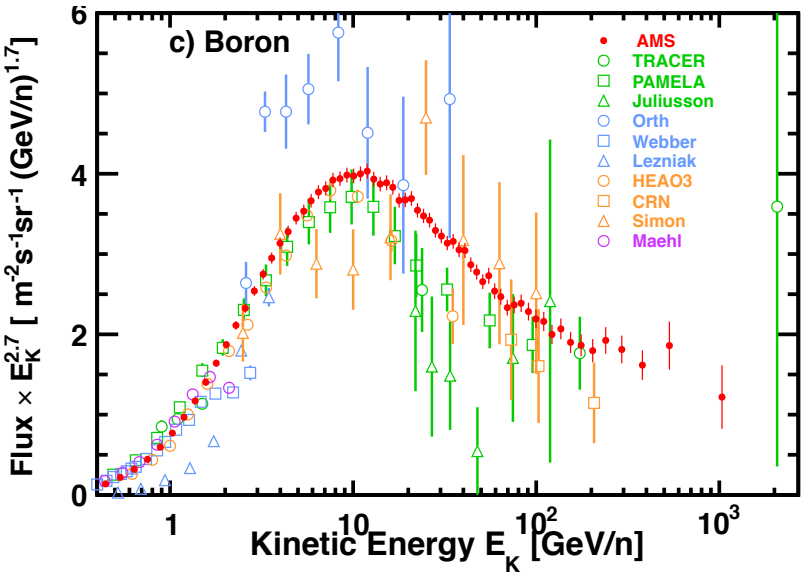


Primary fluxes (PRL 119, 251101 – 2017)



Secondary fluxes (PRL 120, 021101 – 2018)

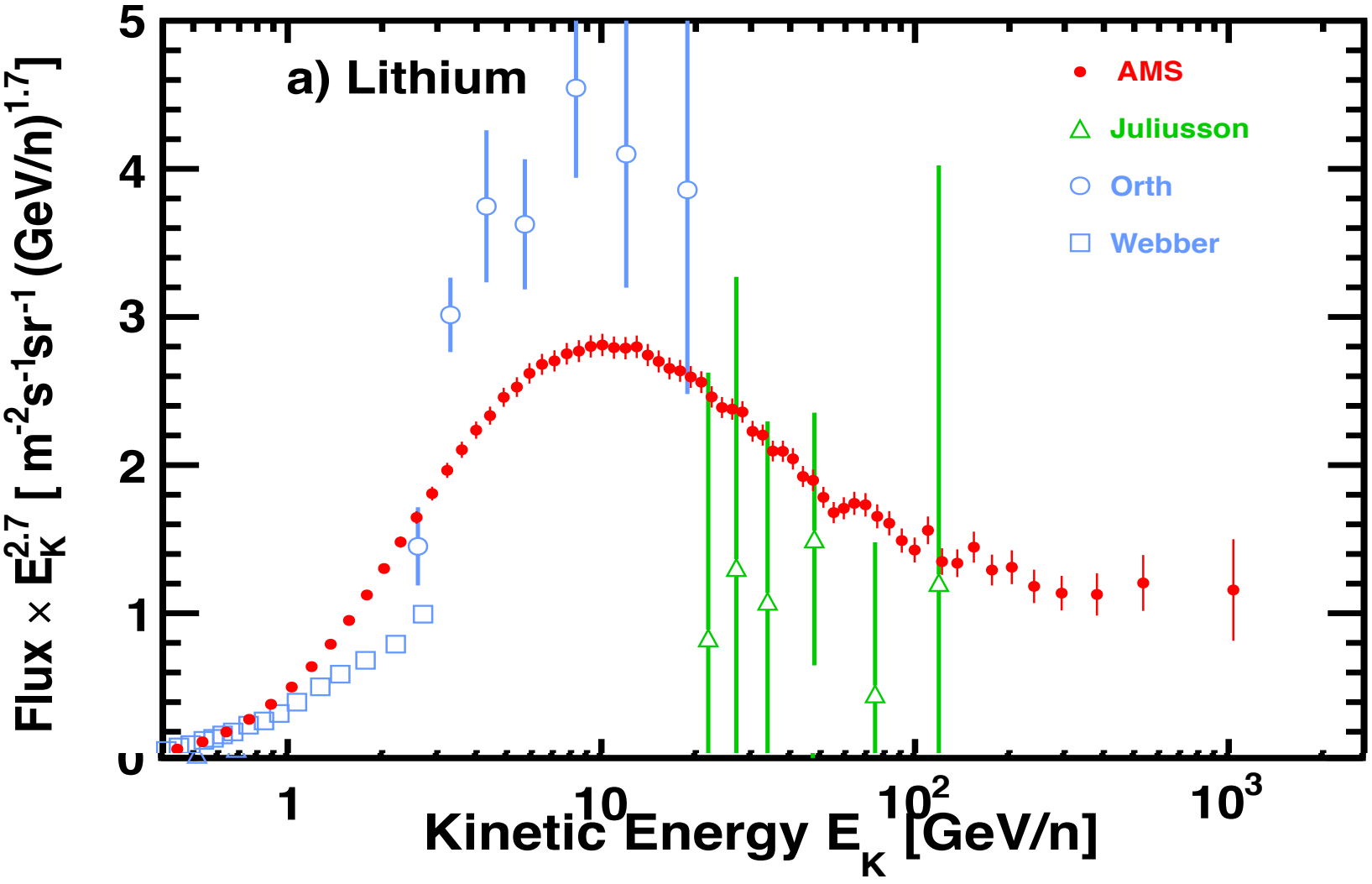




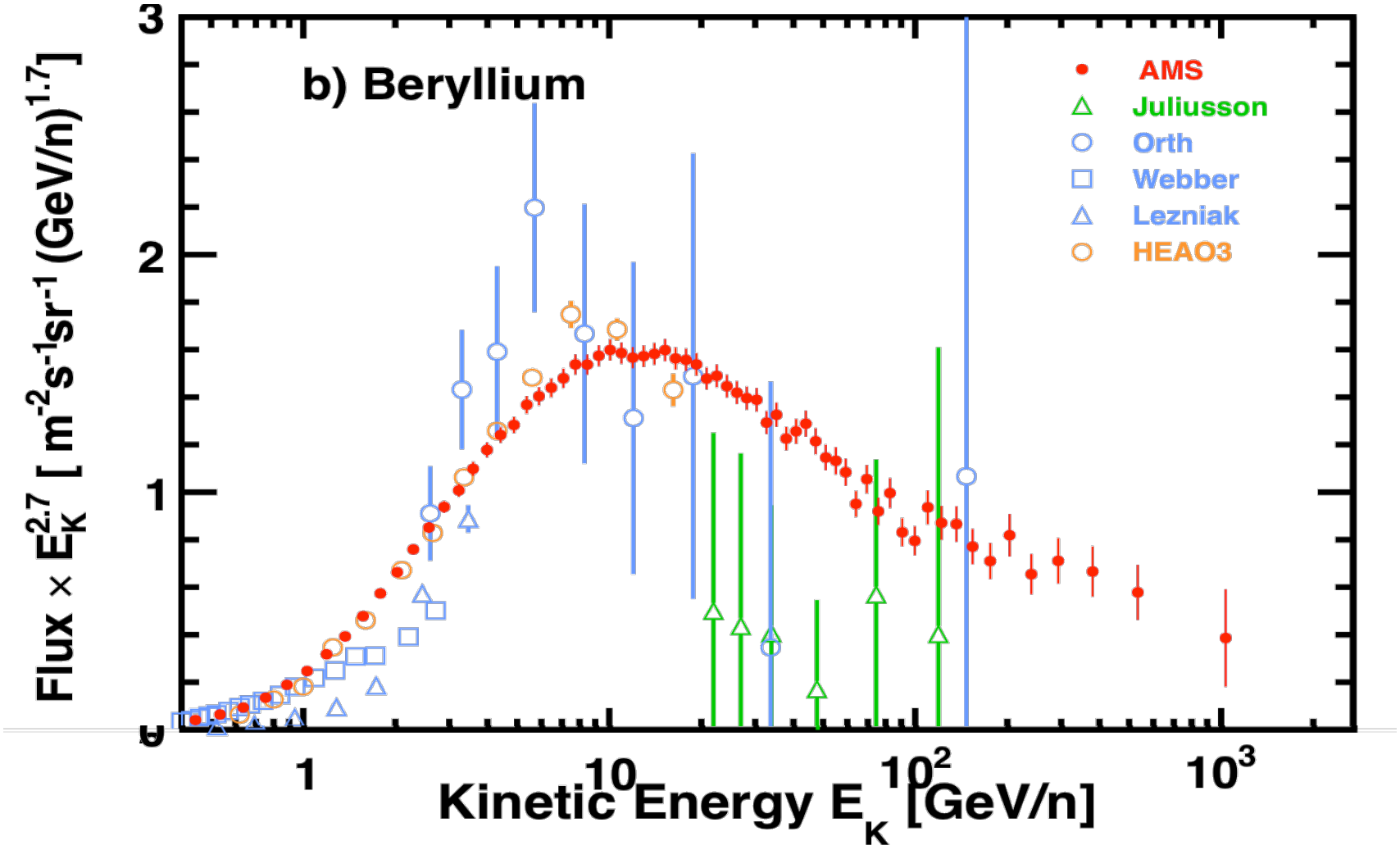
results based on:

- ~ 2.5 million boron nuclei
- ~ 2 million lithium nuclei
- ~ 1 million beryllium nuclei

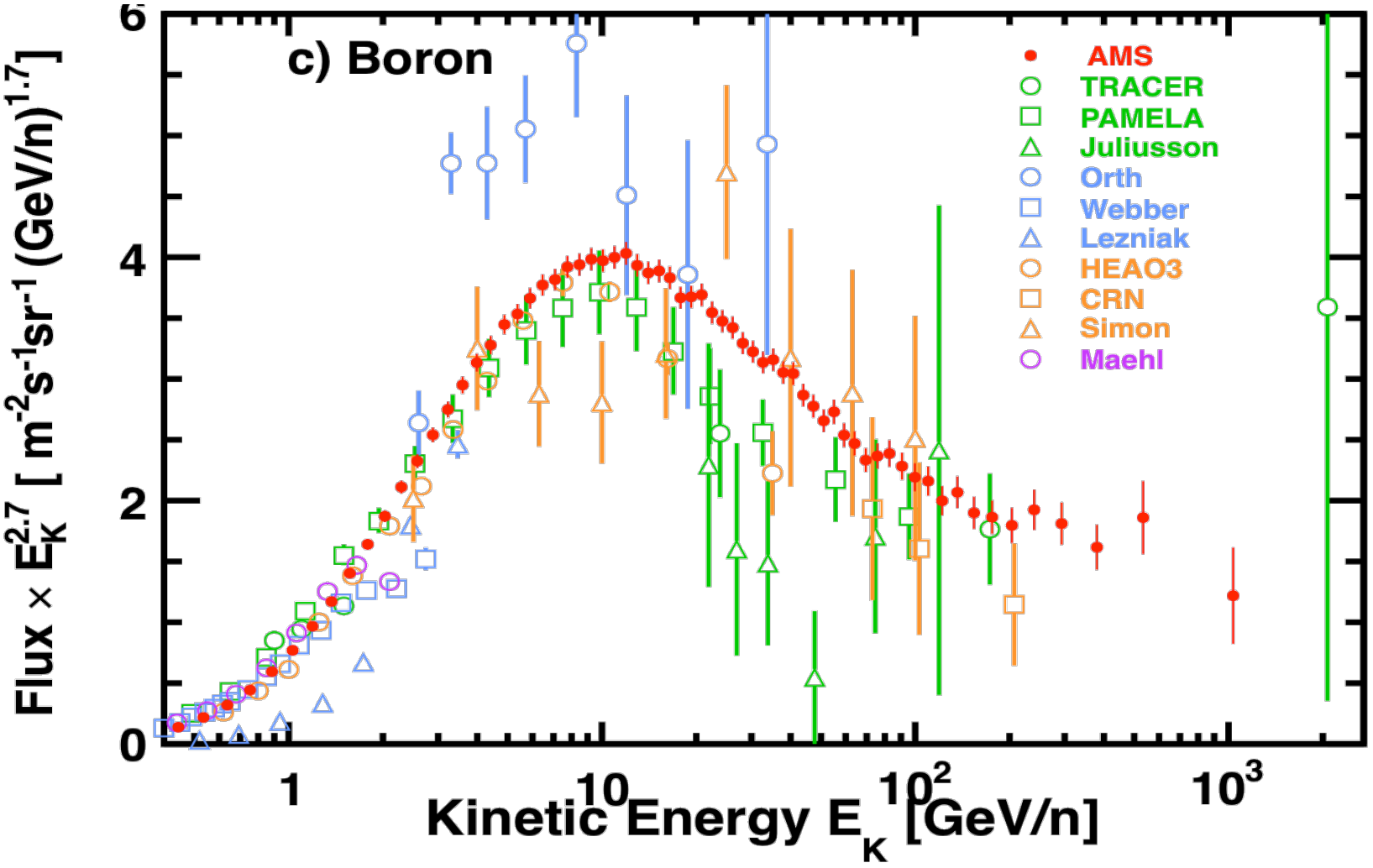
Secondary fluxes (PRL 120, 021101 – 2018)



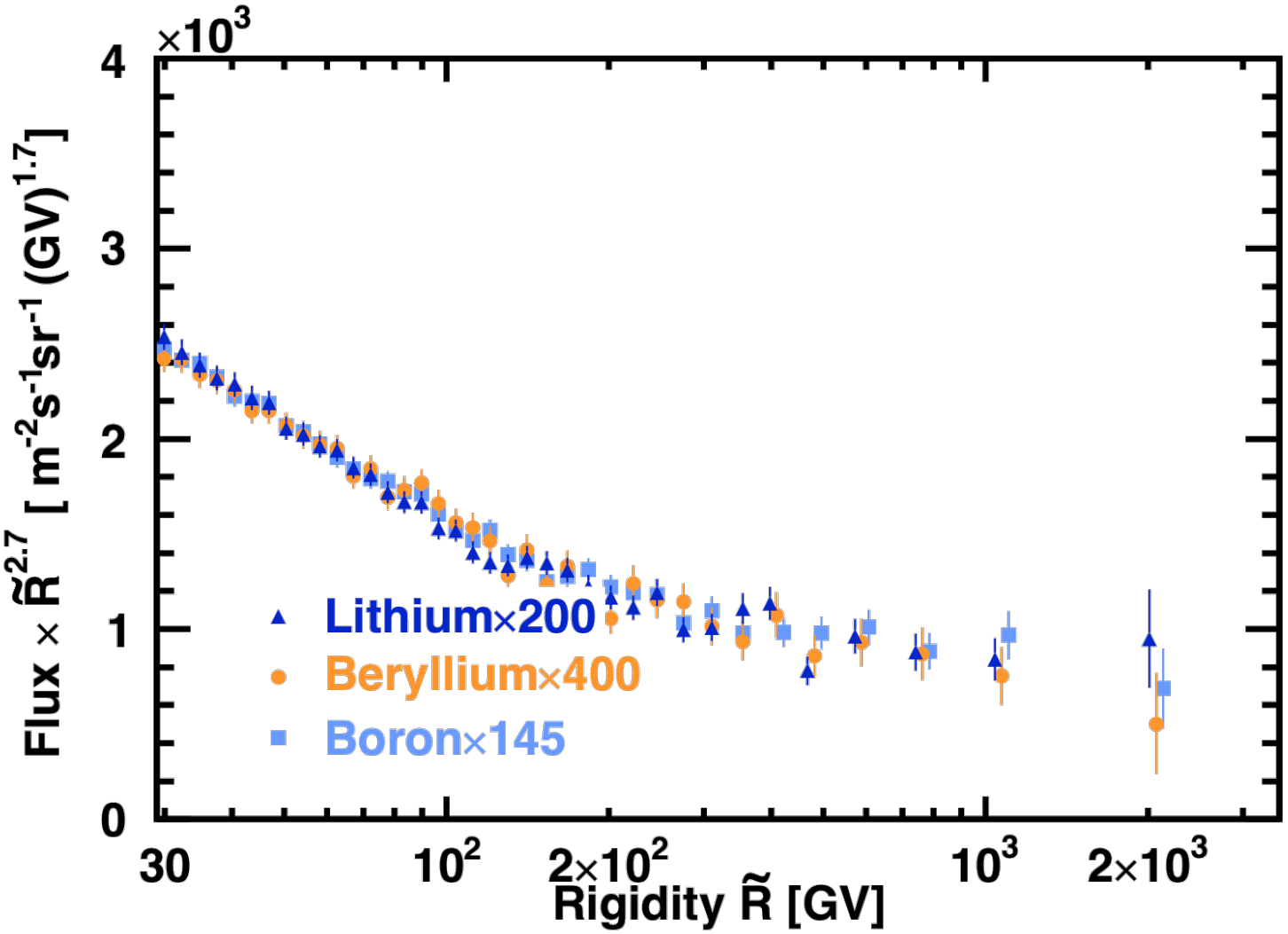
Secondary fluxes (PRL 120, 021101 – 2018)



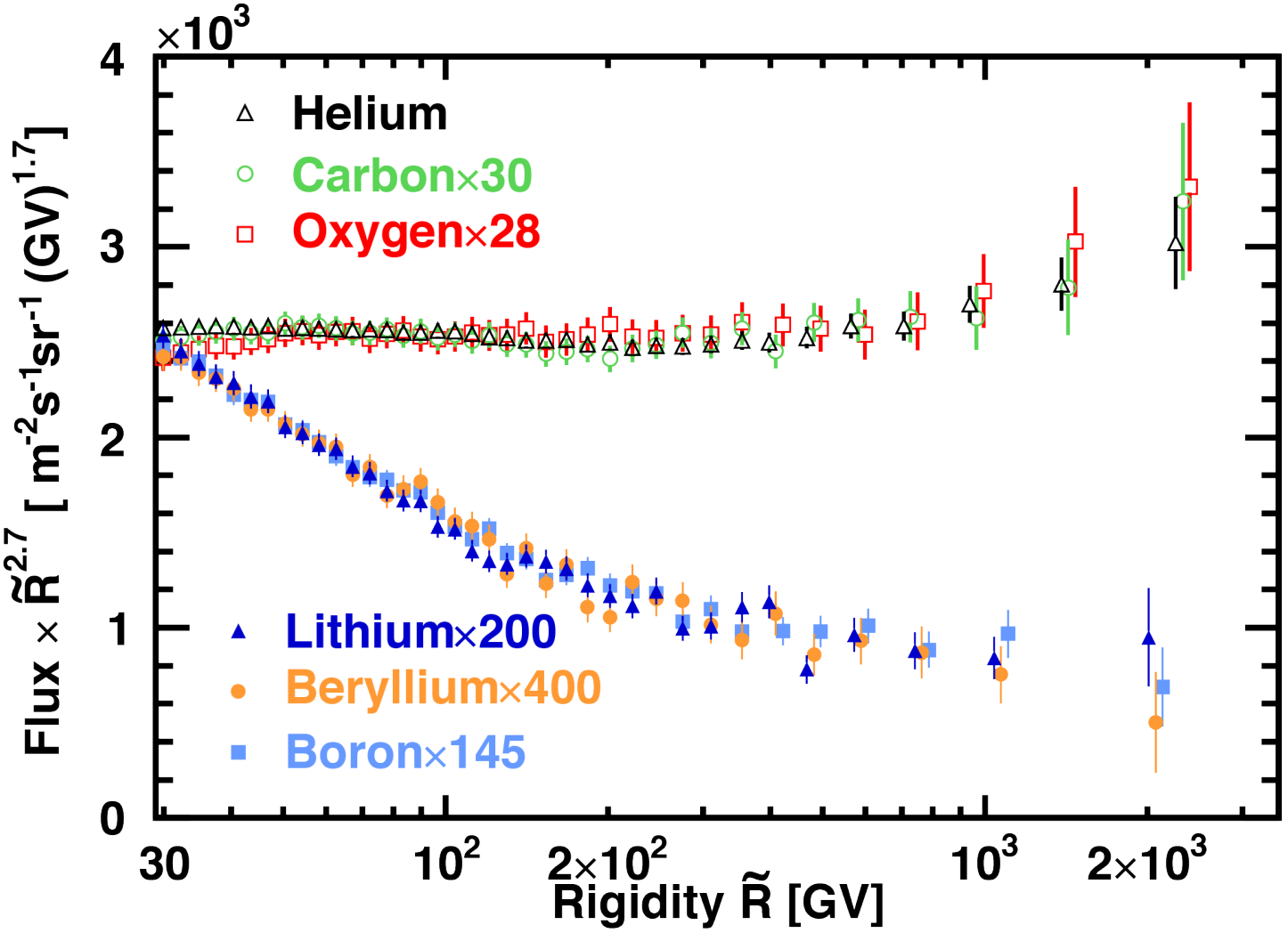
Secondary fluxes (PRL 120, 021101 – 2018)



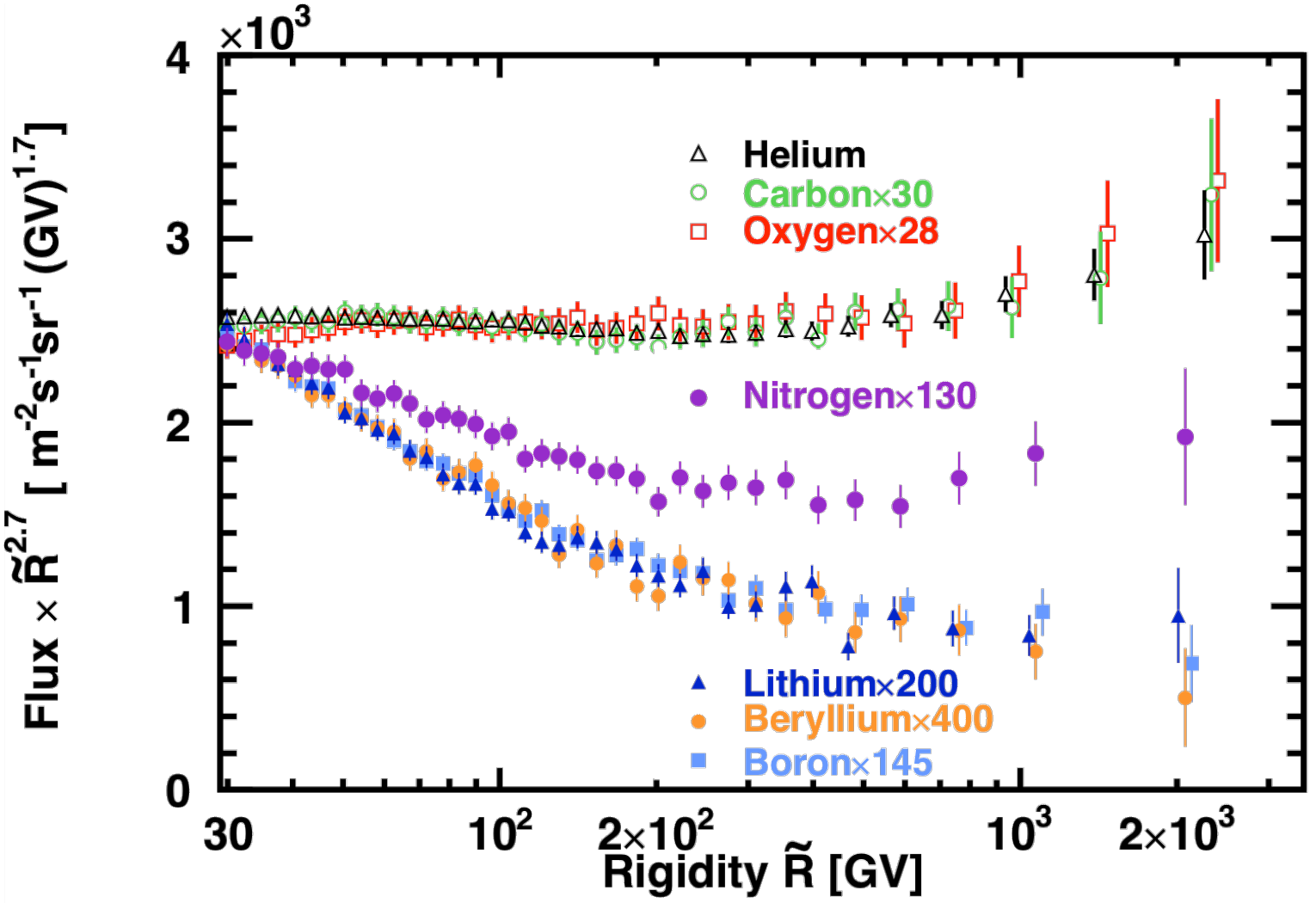
Primary and secondary fluxes (PRL 120, 021101 – 2018)



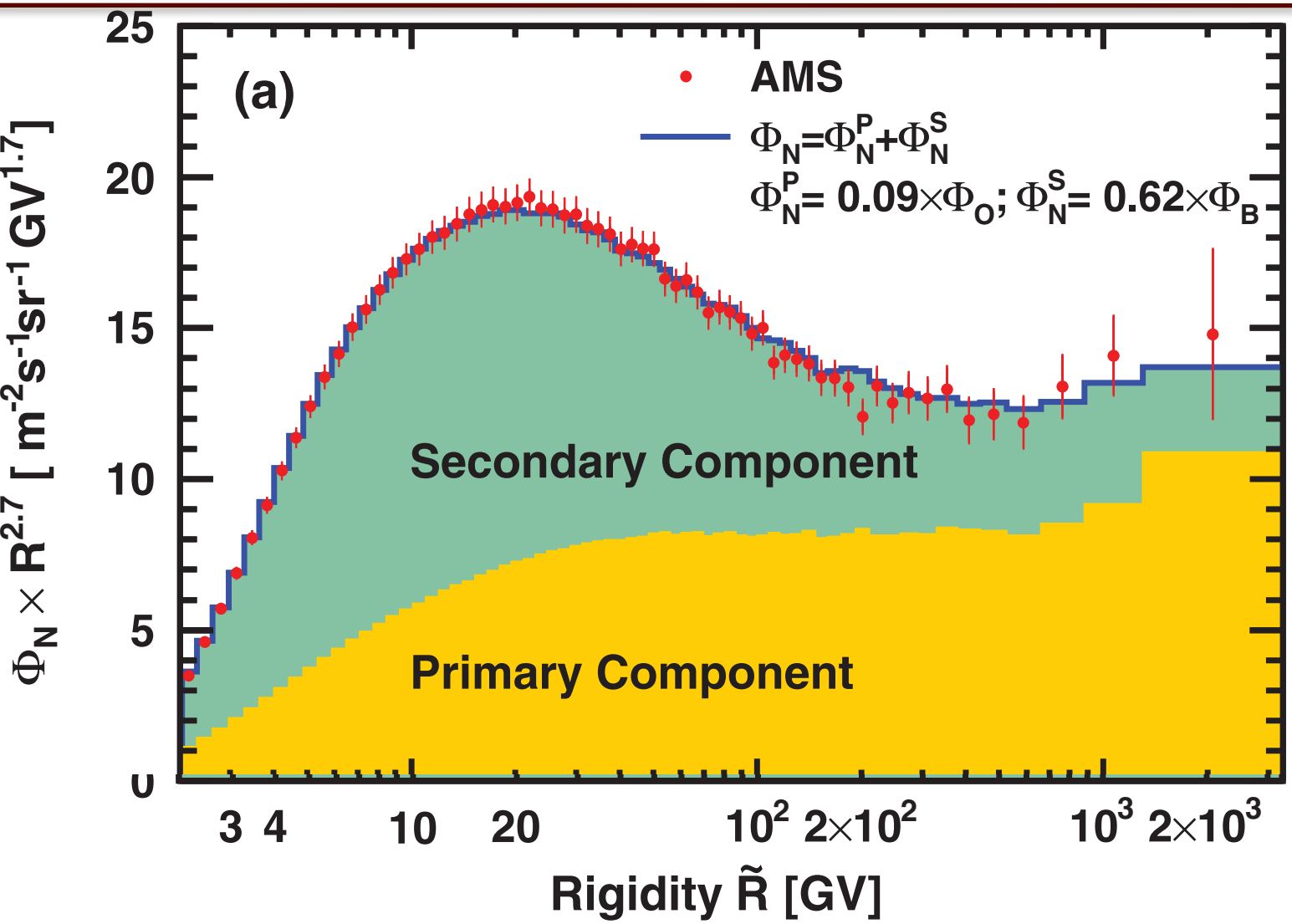
Primary and secondary fluxes (PRL 120, 021101 – 2018)



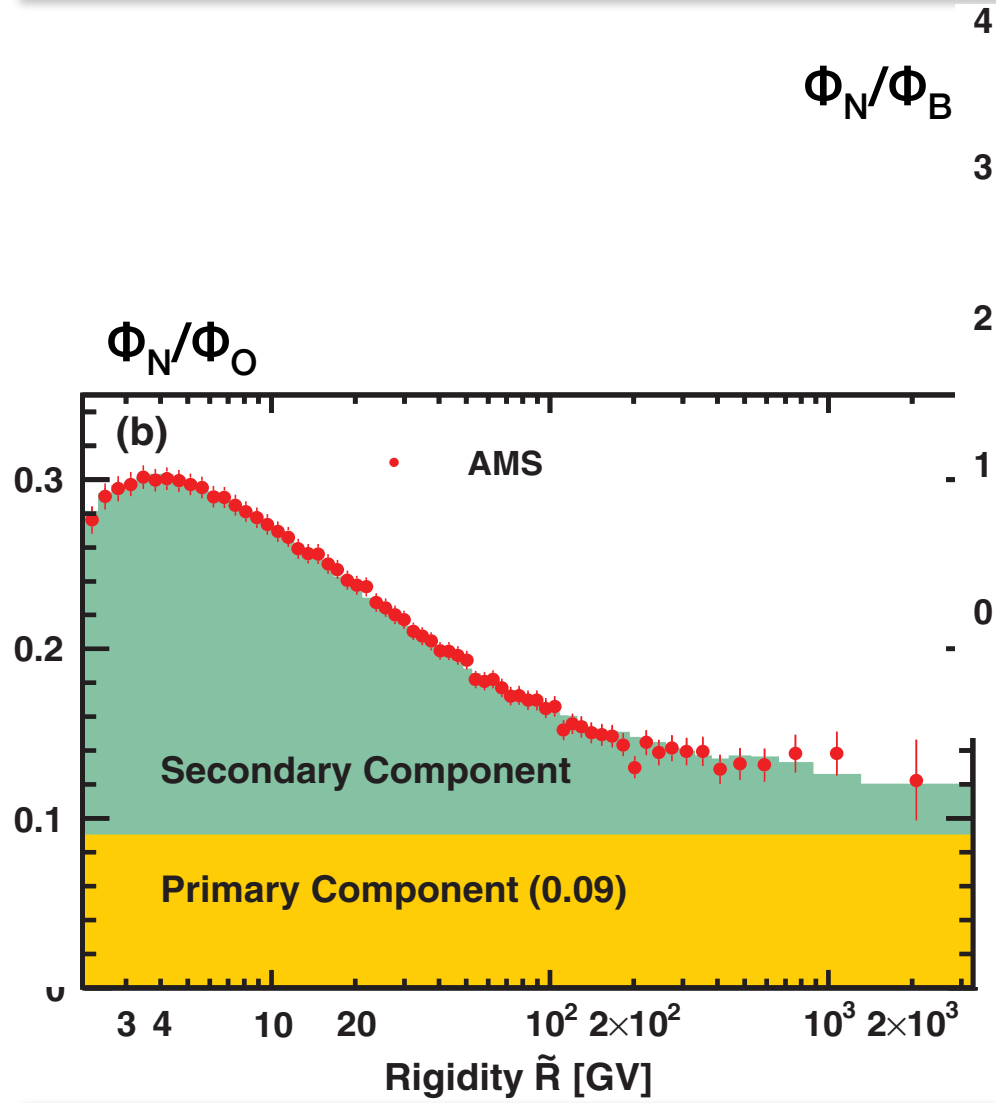
Light nuclei fluxes (PRL 121, 051103 – 2018)

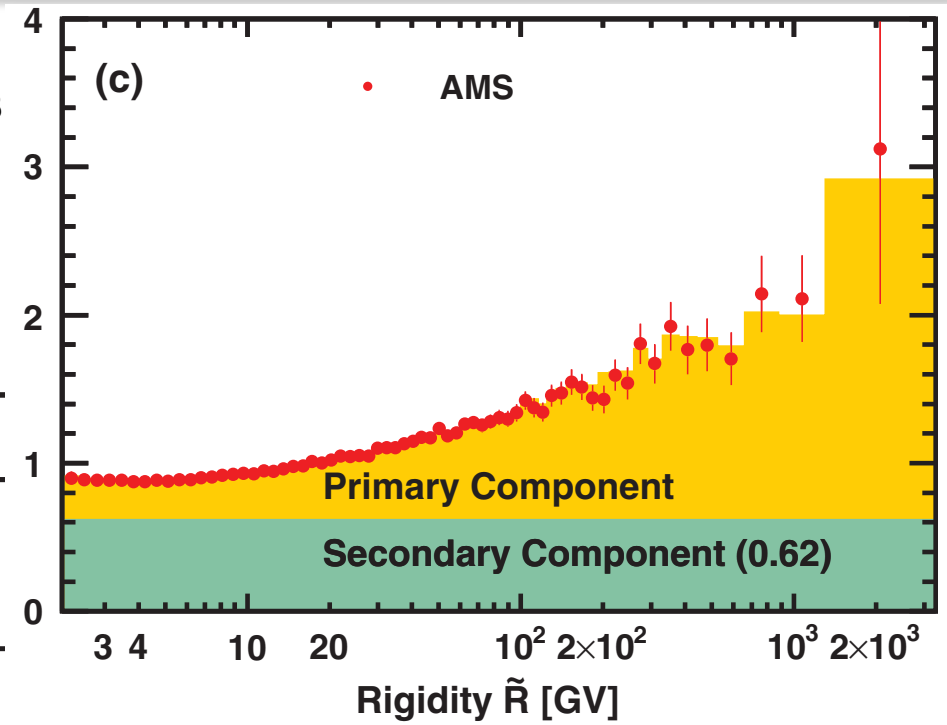


Nitrogen flux (PRL 121, 051103 – 2018)



Nitrogen flux (PRL 121, 051103 – 2018)



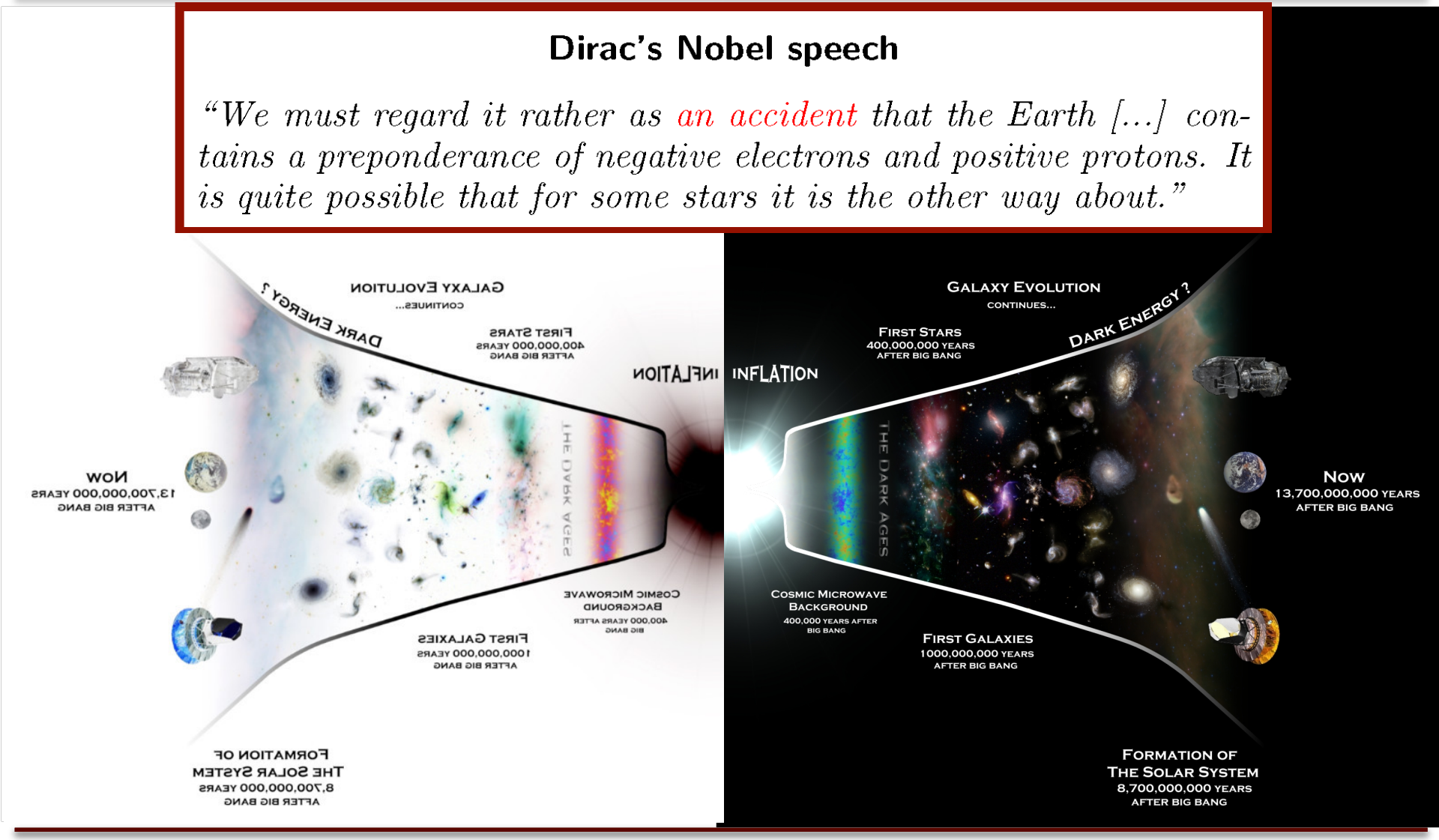


at high energies the "primary" components becomes dominating

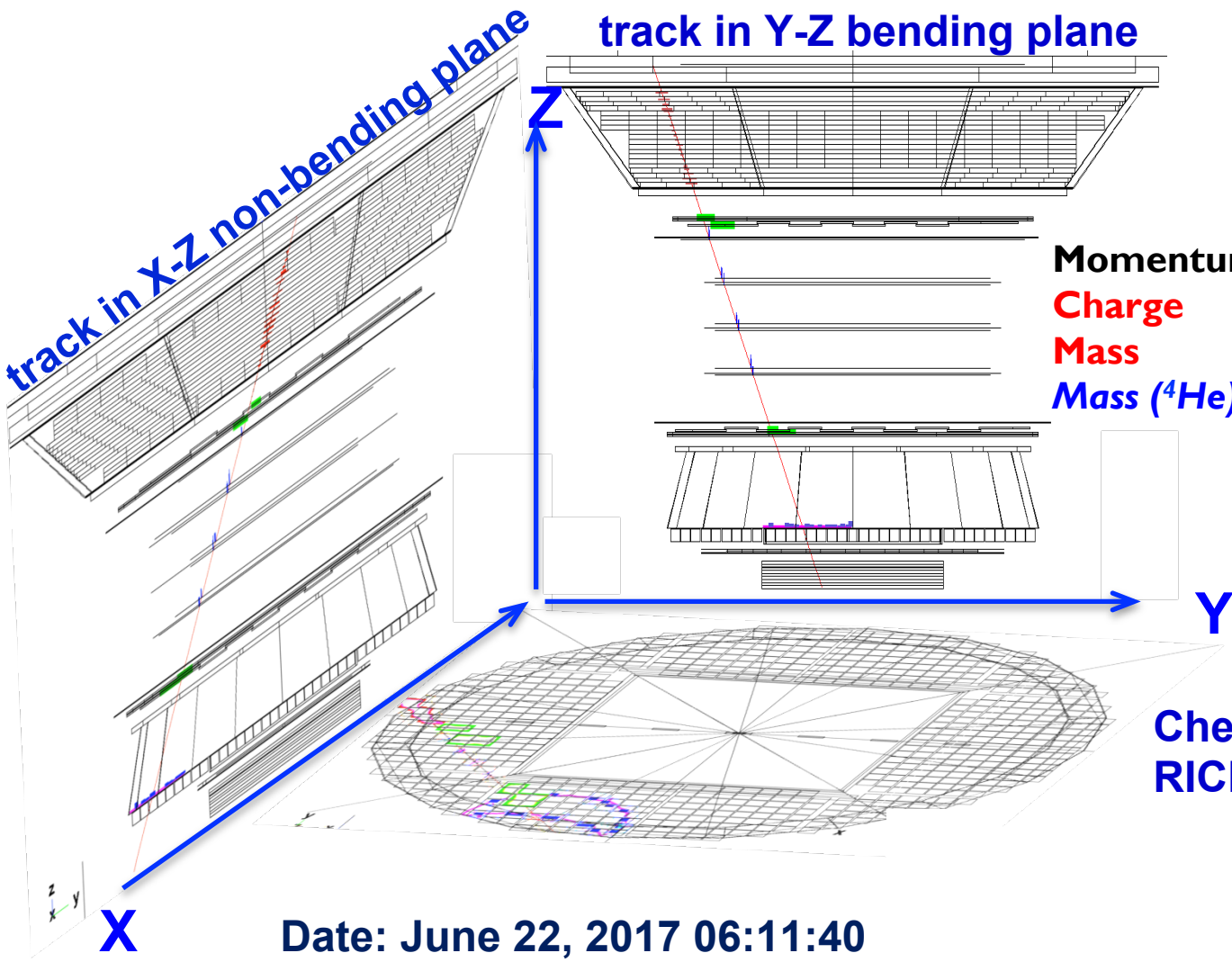
The quest for antimatter…

Dirac's Nobel speech

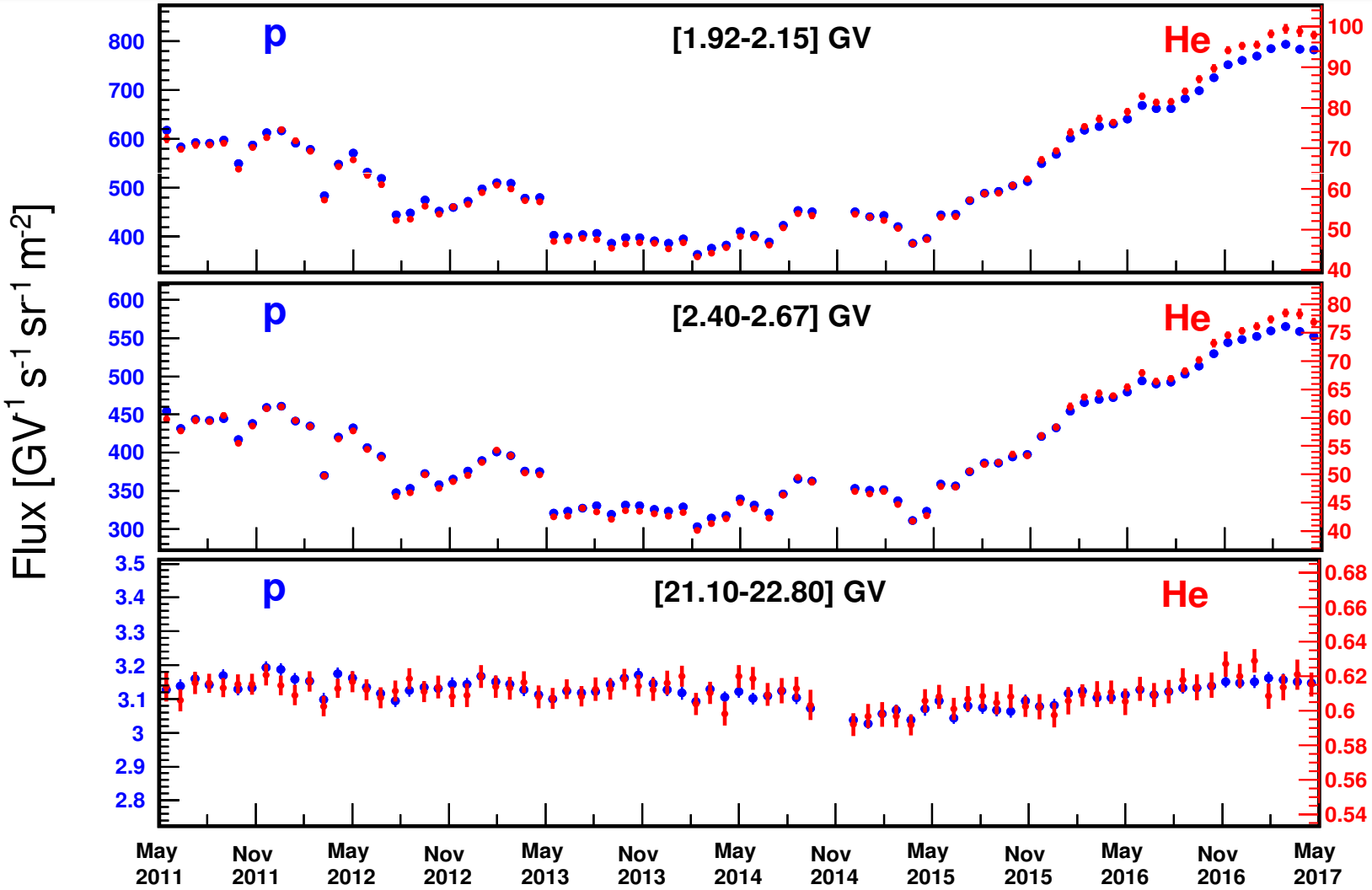
"We must regard it rather as an accident that the Earth [...] contains a preponderance of negative electrons and positive protons. It is quite possible that for some stars it is the other way about."



The quest for antimatter…

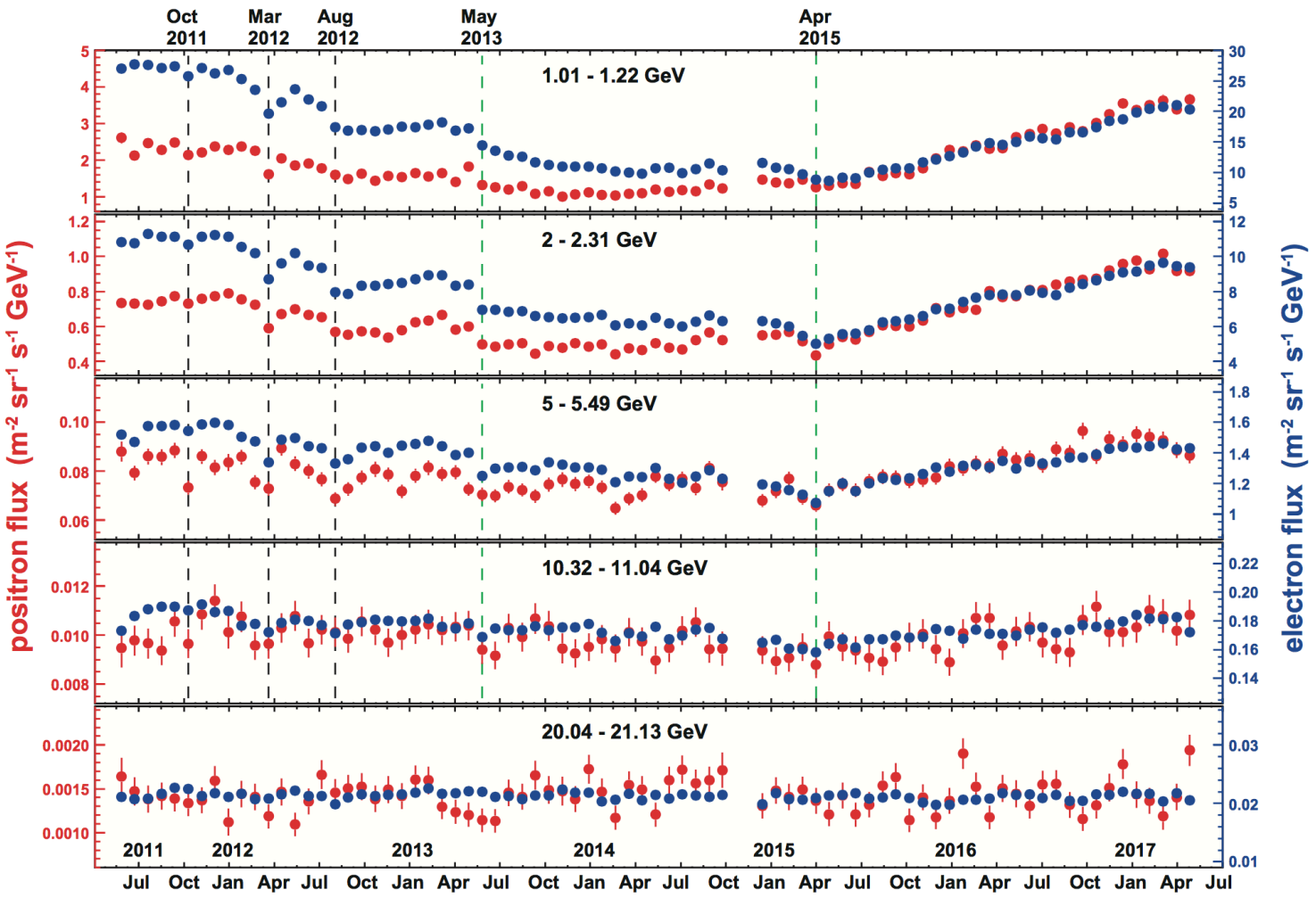


p and He monthly fluxes (PRL 121, 051101 – 2018)



* more details were given in M. Graziani talk

e^+/e^- monthly fluxes and charge sign effects (PRL 121, 051102 – 2018)



* more details were given in M. Graziani talk

Conclusions

- The collaboration is providing the measurement of the fluxes of the various species (up to Iron and above) up to the TeV region
- The accuracy of the experimental measurements is currently better than the uncertainty in the phenomenological models
- AMS is the Cosmic Rays observatory of the next decade

AMS will take data up to 2024