Galactic Cosmic Rays with the DAMPE space mission

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8th Astroparticle Physics Scientific Fair

15 February 2021

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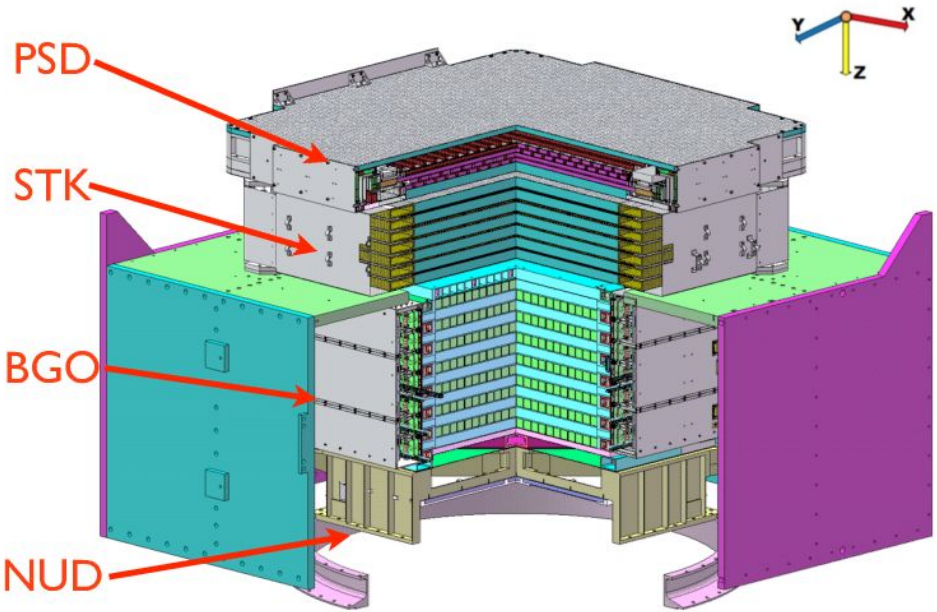
The DAMPE detector



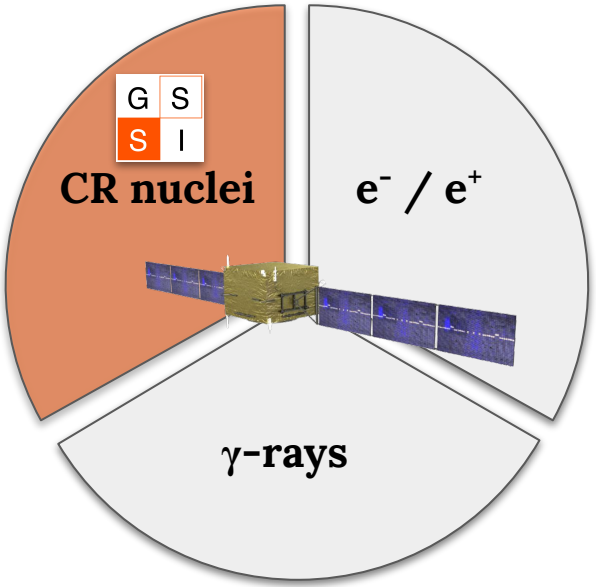
- **Plastic Scintillator Detector (PSD):**
  - 2 X/Y planes of scintillator bars
  - Charge measurement + Gamma-ray ID
- **Silicon Tracker (STK):**
  - 6 Si planes + W converter
  - Tracking + Additional charge measurement
- **BGO calorimeter (BGO):**
  - 14 layers of BGO bars (32 X_0)
  - Energy measurement + e/p separation
- **Neutron detector (NUD):**
  - 4 tiles of boron loaded scintillator
  - Further e/p separation

DAMPE physics goals

- **Multi-purpose CR detector** with the aim of:
  - **Studying Galactic Cosmic Ray spectra and composition**
  - Searching for Dark Matter signatures in lepton and photon spectra
  - Performing high energy gamma-ray astronomy

- **Key DAMPE features:**

Acceptance	~0.3 m^2 sr
Calorimeter thickness	32 X_0 and 1.6 Λ_I
e/γ energy range	10 GeV - 10 TeV
CR nuclei energy range	40 GeV - 200 TeV
e/γ energy resolution	1.2% at 100 GeV
e/γ angular resolution	0.2 deg at 100 GeV



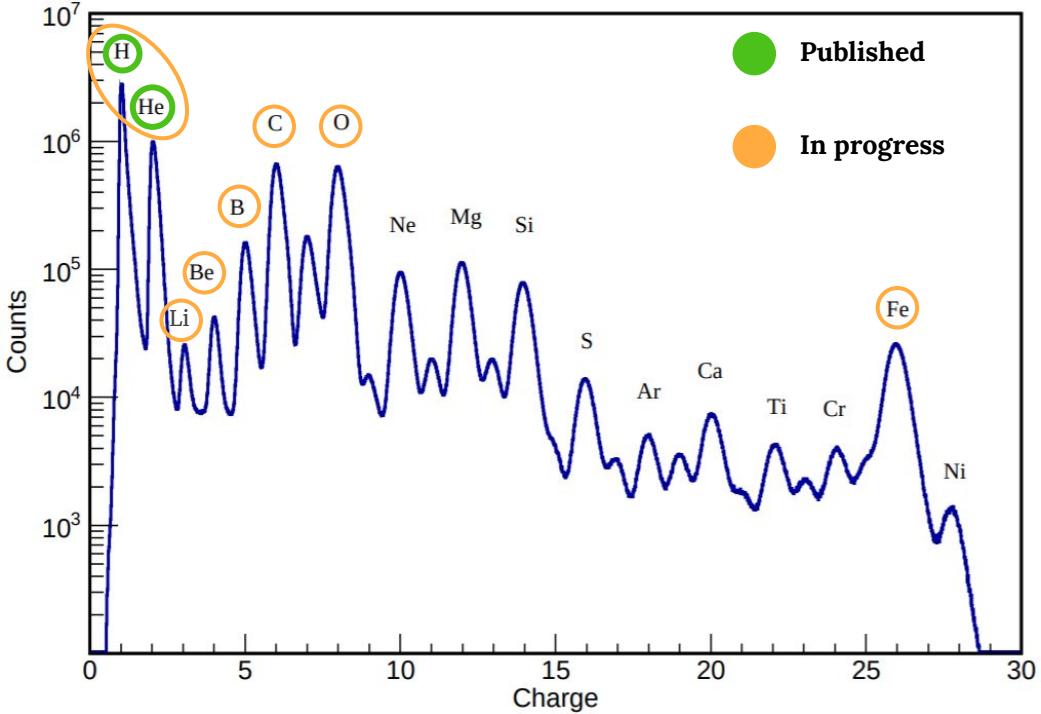
Galactic CR nuclei

CR nuclei analysis:

- Charge measurement with the PSD
- Background rejection with additional information from the STK
- Energy measurement with BGO

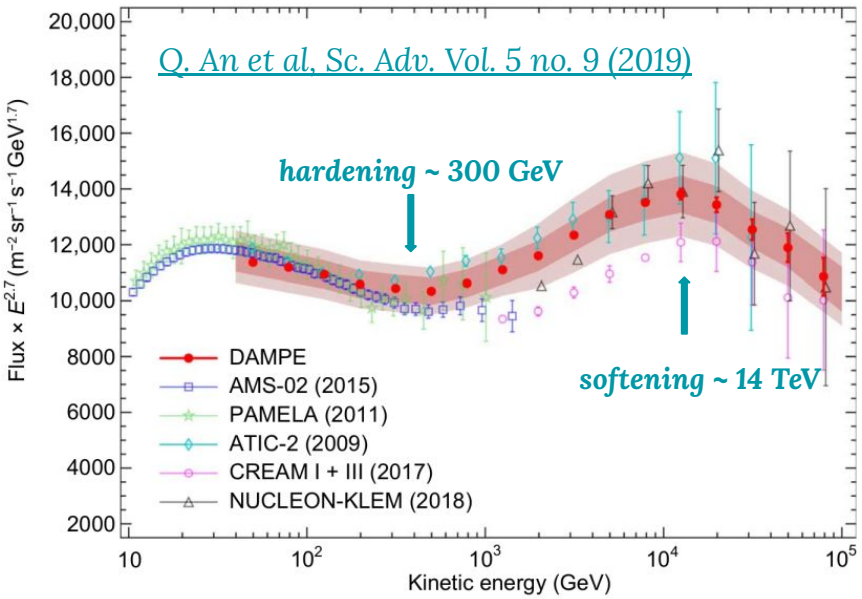
Results:

- p, He spectra published: new features unveiled
- A lot more science to be done!
  - Light component
  - Medium to heavy mass primaries
  - Secondaries

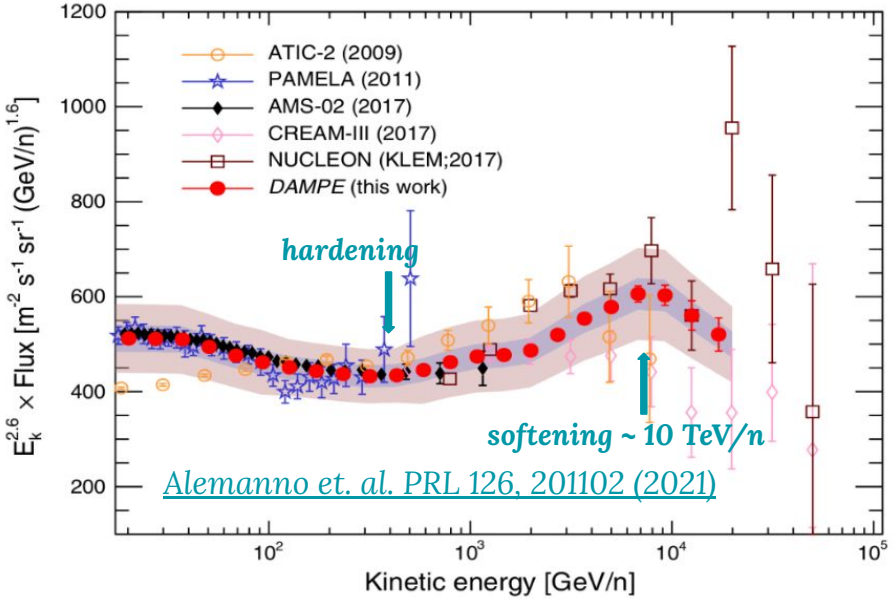


Light component

Proton



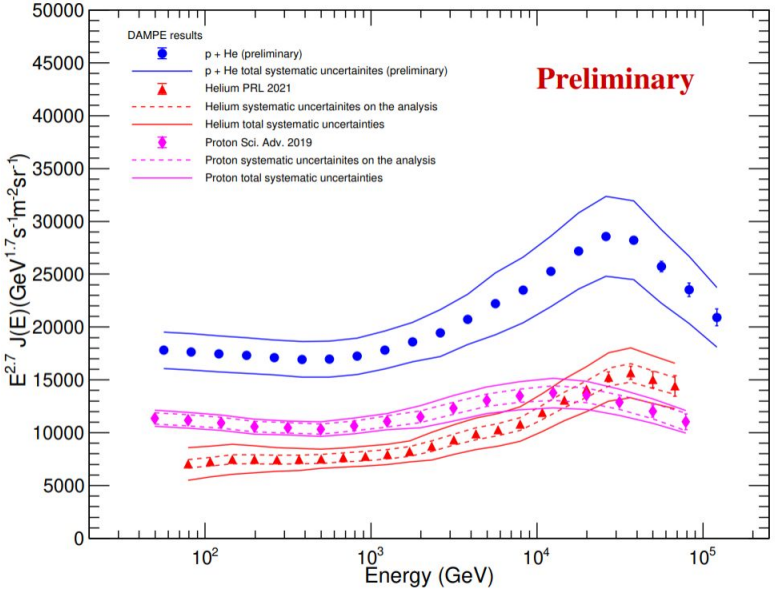
Helium

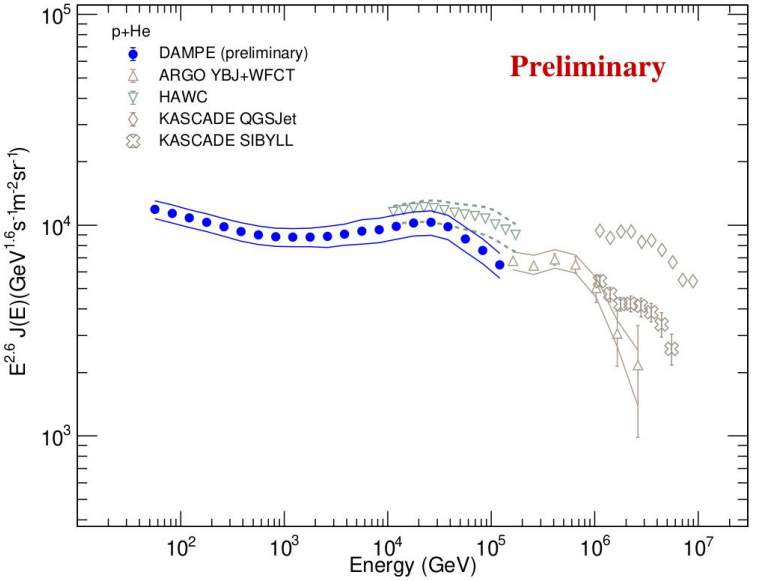


Proton and Helium:

- Most abundant CR nuclei, measurements extend to hundreds of TeV
- Hardening at few hundred GeV, propagation effect?
- Softening at tens of TeV, origin? Charge or mass dependence?

Light component (2)

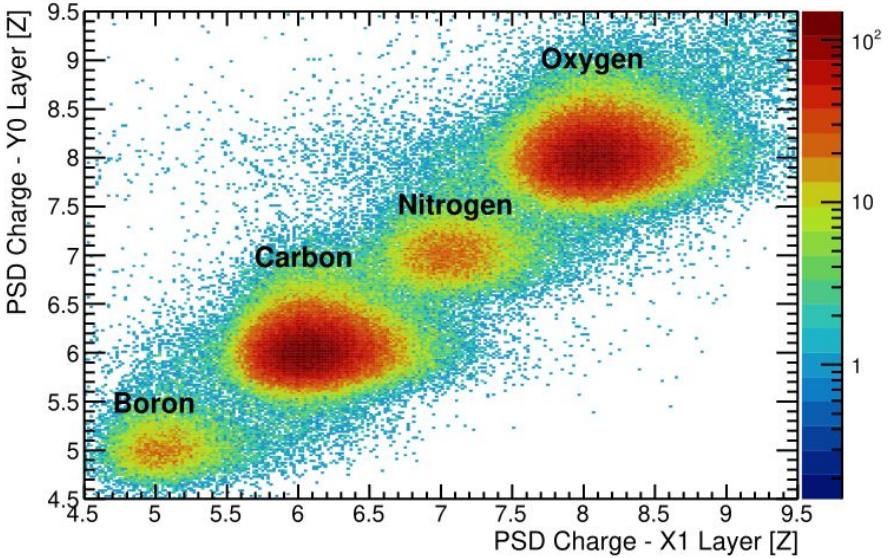


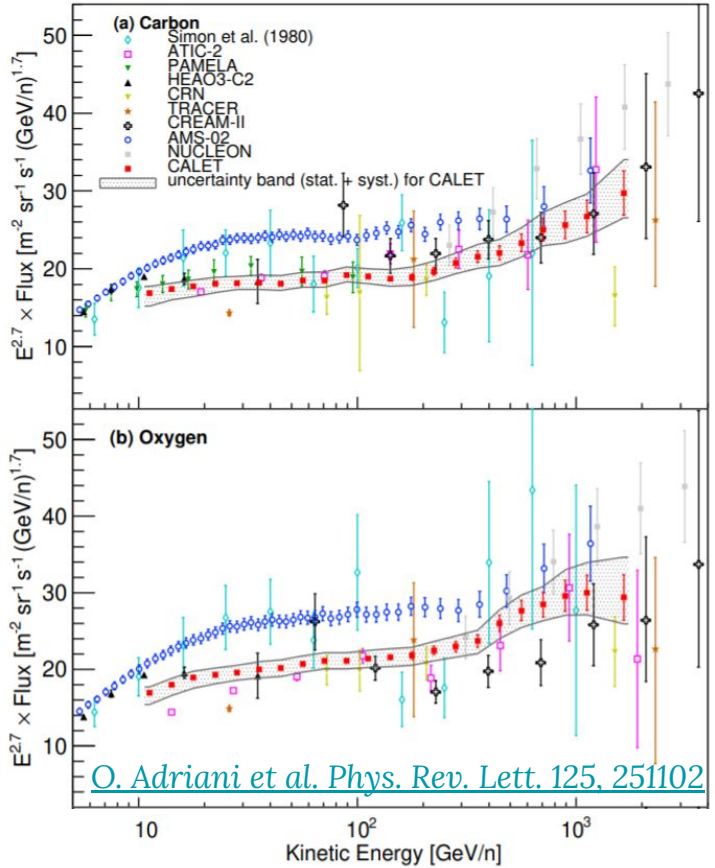


Proton + Helium:

- Negligible background, reach even higher energies than single p, He spectra
- Hardening and softening visible
- Possible comparison between direct and indirect experiments

Medium mass primaries





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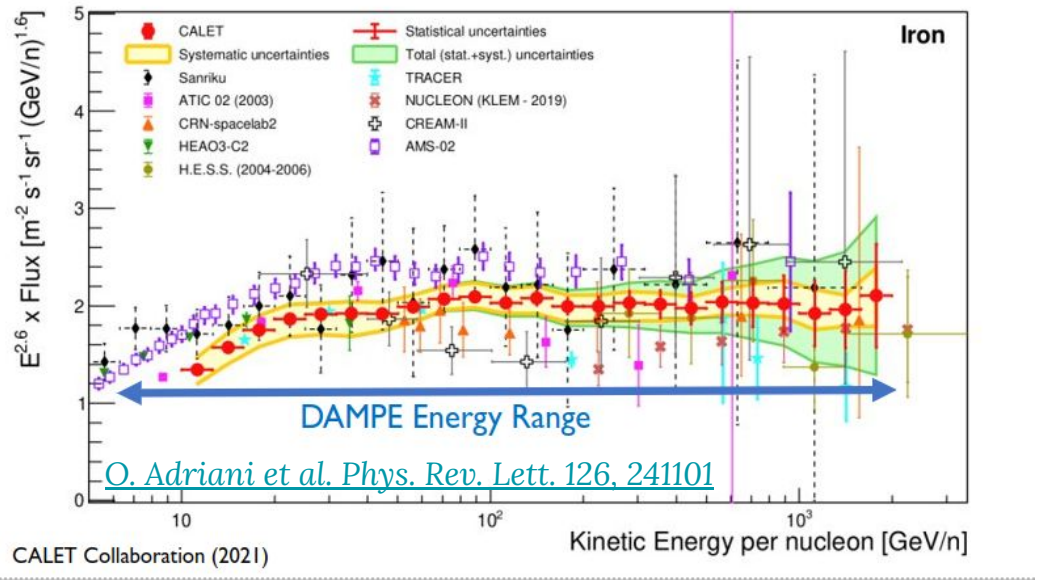
Carbon and Oxygen:

- Medium mass primaries
- Hardening observed at few hundred GeV/n
- AMS and CALET seem to have a different normalization... DAMPE?

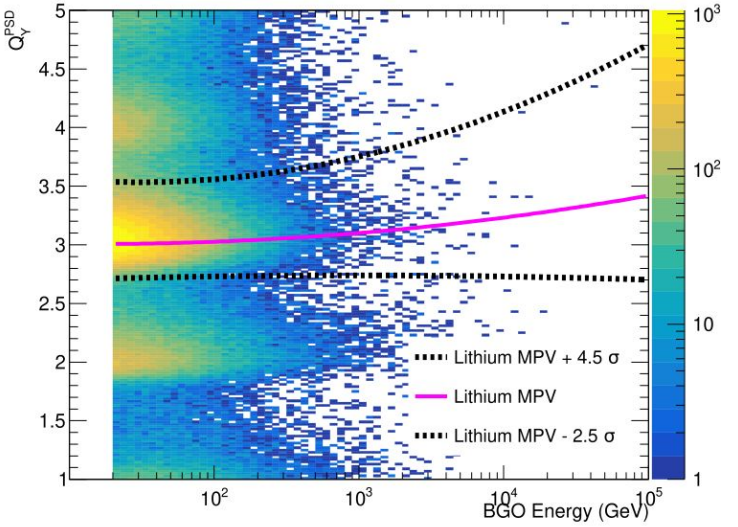
Heavy mass primaries

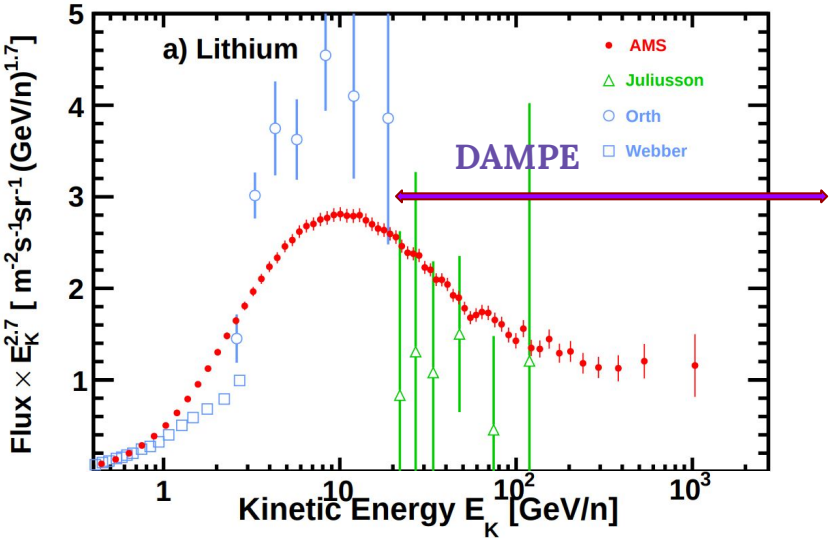


Iron:

- Heavy mass primary, most abundant nucleus with highest charge: insight into CR acceleration and propagation (test models at high Z)
- Similar behaviour to He, C and O
- AMS and CALET still seem to have a different normalization... DAMPE?

Secondary cosmic rays

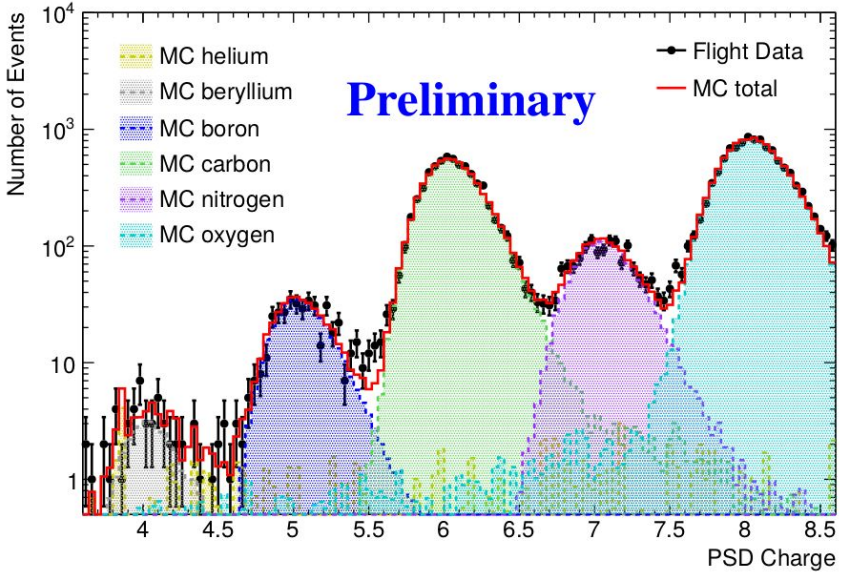


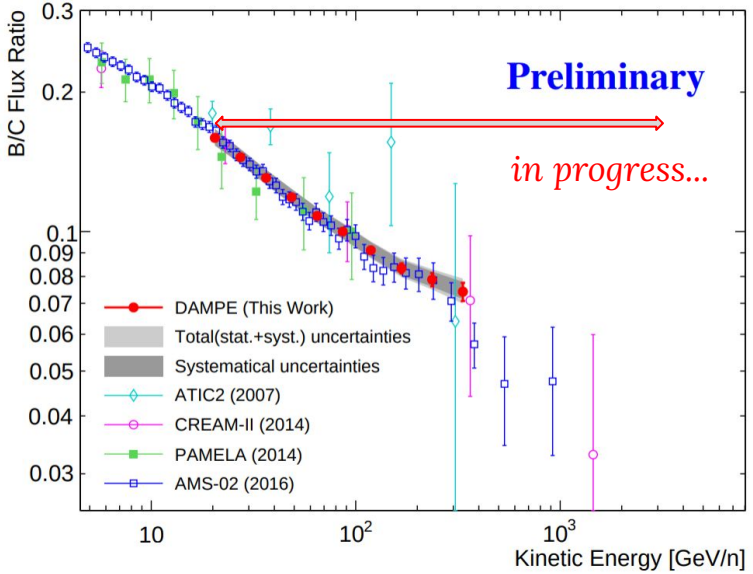


Lithium, Beryllium and Boron:

- Li, Be and B are mainly produced by primary CRs interacting with the interstellar medium
- Fundamental to probe propagation and investigate the origin of the hardening
- Extend measurement to higher energies than AMS-02

Secondary over primary ratio





Boron over Carbon:

- Secondary over primary ratios such as B/C, Be/C, … are useful to determine CR diffusion parameters
- DAMPE aims at extending the B/C measurement beyond the TeV/n scale

Conclusions

- The study of **Galactic Cosmic Rays** is a rich and active physics field.
- Latest spectral measurements, including those of **DAMPE**, show a complex picture with many new features.
- A lot more to come! Measurements at higher energy and of heavier mass nuclei are necessary to provide a better understanding of galactic CRs origin and propagation.