Status of Nuclei Analysis

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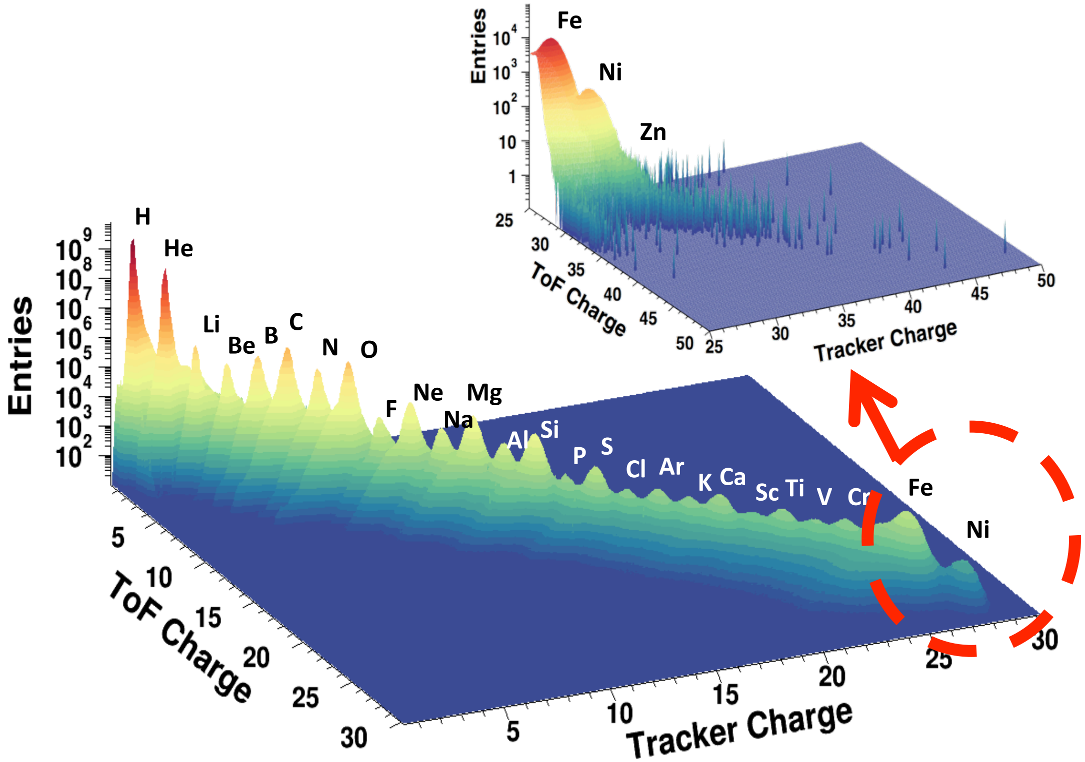
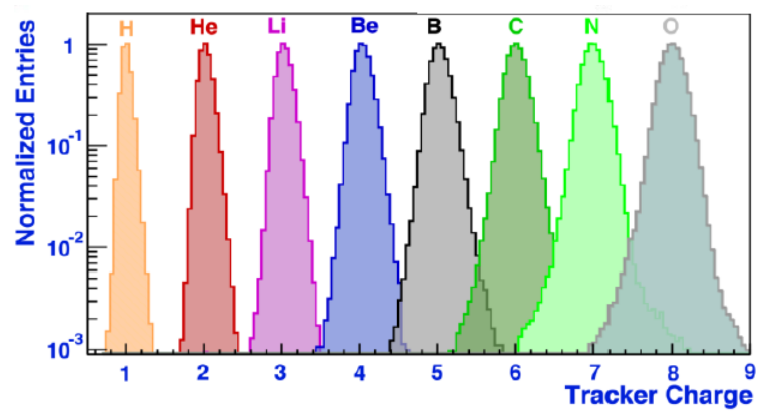
AMS Italy - 23/02/2018

Nuclei Identification



- Selections in the Inner Tracker and ToF
- Charge selections in the other sub-detectors to remove the contamination due by a fragmentation in the upper part of AMS-02

The redundancy of charge measurement in AMS-02 allows to obtain high purity samples up to Fe



Events Selection: Strategy

BASIC

- No SAA
- Live time > 0.5 && Zenith < 25 with

TOF

- $\beta > 0$
- Upper Tof charge $Q \in [Z - 0.75, Z + 0.75]$

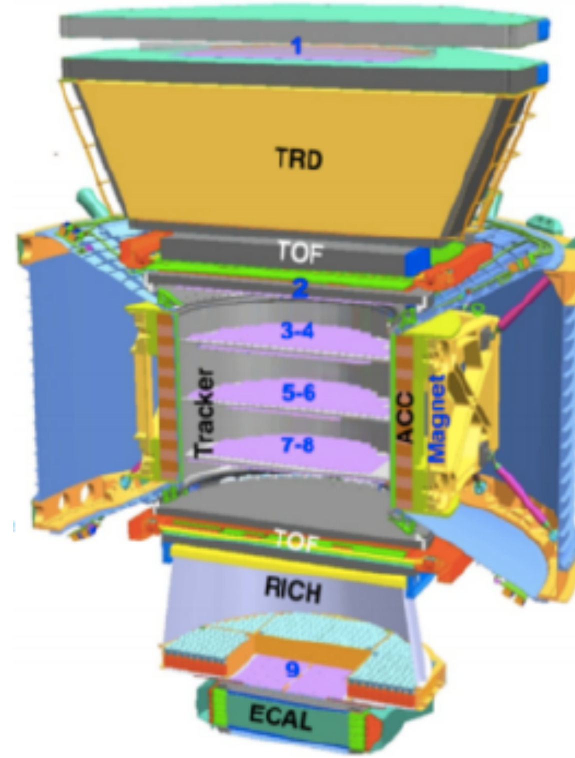
INNER TRK

- At least one track in IT with $Q \in [Z - 0.3, Z + 0.7]$
- Inner Tracker pattern on Y view: L2 && (3 || 4) && (5 || 6) && (7 || 8)
- $\chi^2 < 10$
- $R > 1.2 R_C$ (IGRF)
- $\sigma_Q / Q < 0.2$
- If there is a secondary positive track with > 3 hits, rigidity must be negative or below a given threshold

FS (IL1)

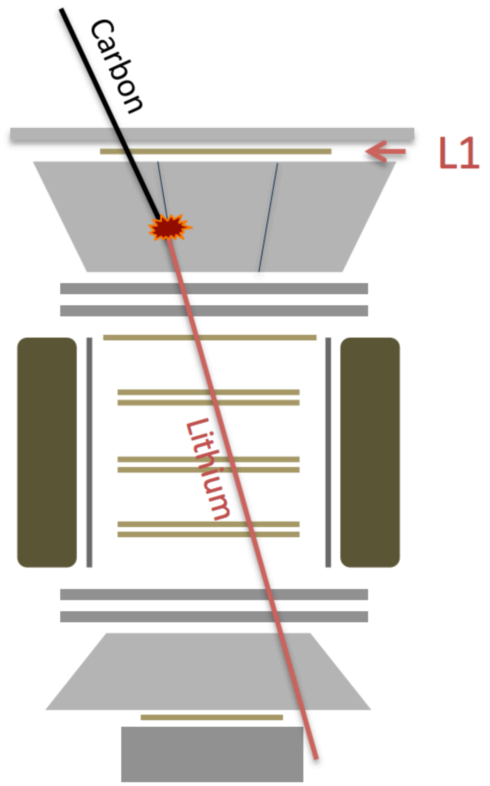
- Full-Span track (or Inner + L1)
- $\chi^2_{FS} < 10$ (or Inner + L1)
- L9 charge $Q \in [Z - 0.5, Z + 1]$
- $\delta\chi^2_{L1} = \chi^2_{L1}(n+1-3) - \chi^2_{I}(n-3) < 10$

+ **PURITY CUT (L1)**

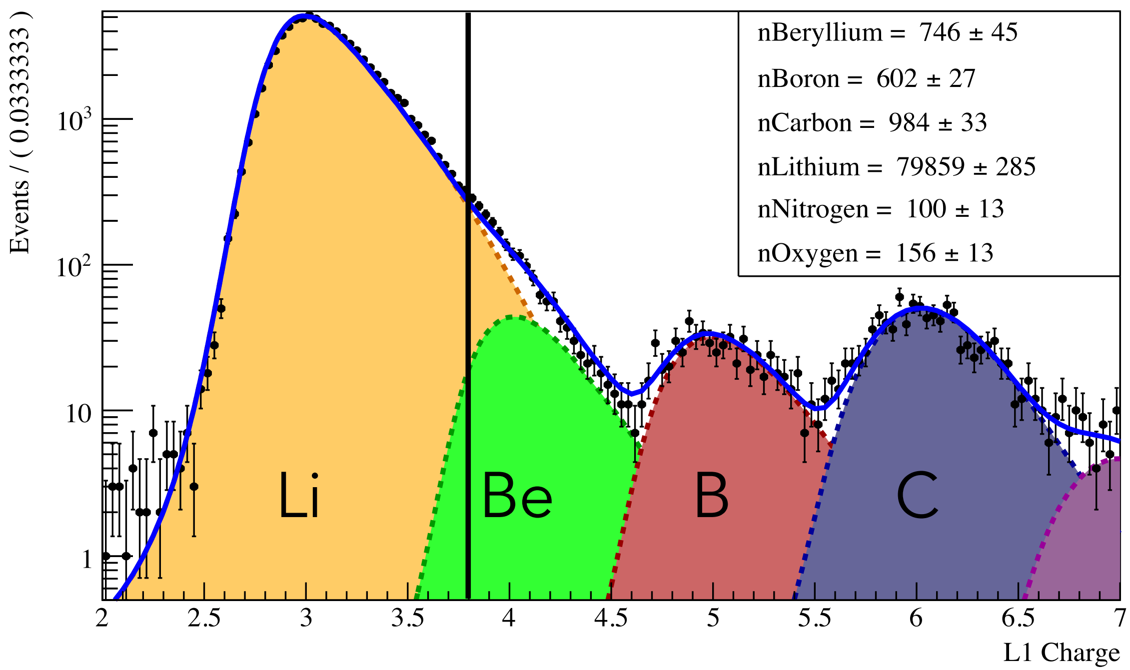


Contamination below L1

Nuclei can fragment below L1 (TRD and ToF) producing contamination in the sample selected with the Inner Tracker.



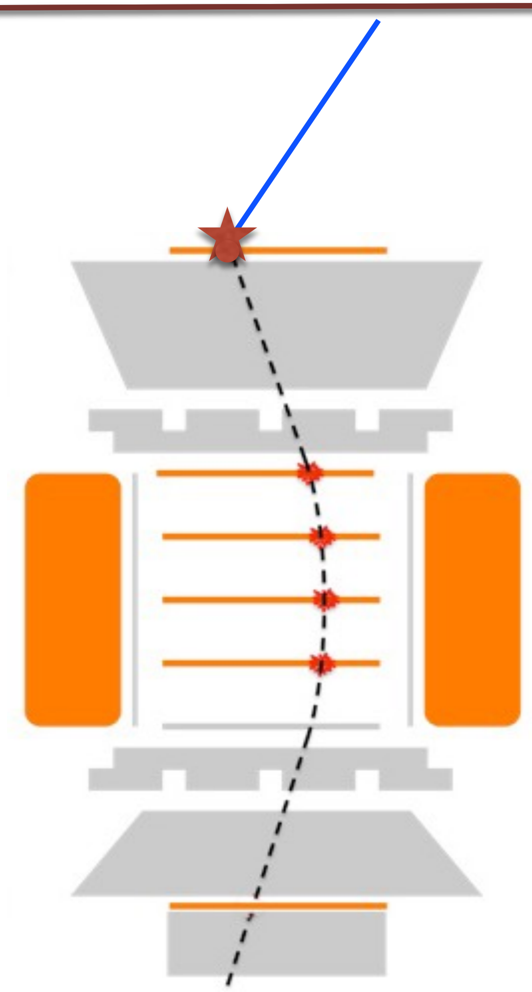
Check of the charge distribution on Layer 1



Contamination above L1

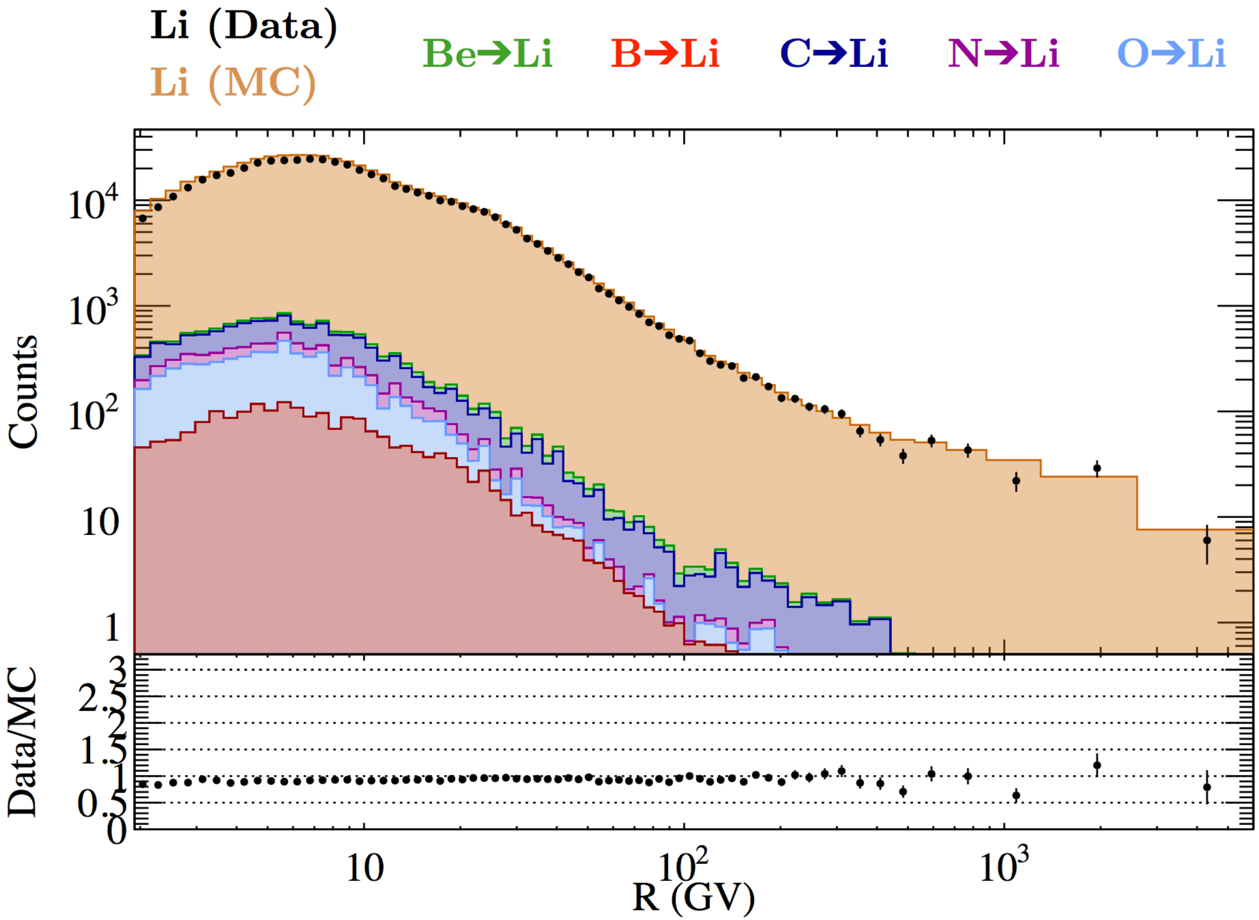
Nuclei can still interact above L1 and provide a source of irreducible contamination in other charge samples (e.g. C→Li).

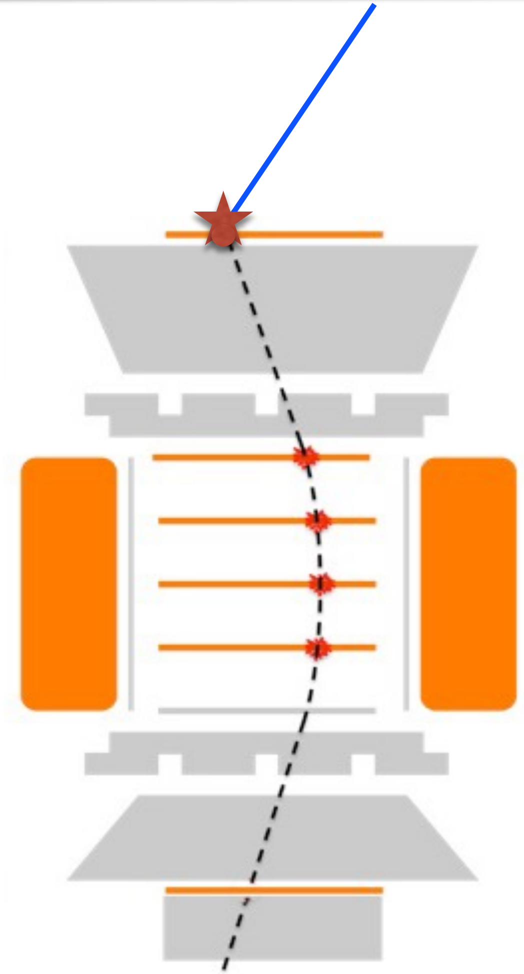
We use the MC simulation to estimate the amount of irreducible contamination in each sample.



$$N_{\mathrm{Be}\to\mathrm{Li}}(R) = \Phi_{\mathrm{Be}}(R)\ T(R)\ A_{\mathrm{Be}\to\mathrm{Li}}(R)\Delta R$$
$$N_{\mathrm{B}\to\mathrm{Li}}(R) = \Phi_{\mathrm{B}}(R)\ T(R)\ A_{\mathrm{B}\to\mathrm{Li}}(R)\Delta R$$
$$N_{\mathrm{C}\to\mathrm{Li}}(R) = \Phi_{\mathrm{C}}(R)\ T(R)\ A_{\mathrm{C}\to\mathrm{Li}}(R)\Delta R$$
$$N_{\mathrm{N}\to\mathrm{Li}}(R) = \Phi_{\mathrm{N}}(R)\ T(R)\ A_{\mathrm{N}\to\mathrm{Li}}(R)\Delta R$$
$$N_{\mathrm{O}\to\mathrm{Li}}(R) = \Phi_{\mathrm{O}}(R)\ T(R)\ A_{\mathrm{O}\to\mathrm{Li}}(R)\Delta R$$

Contamination above L1

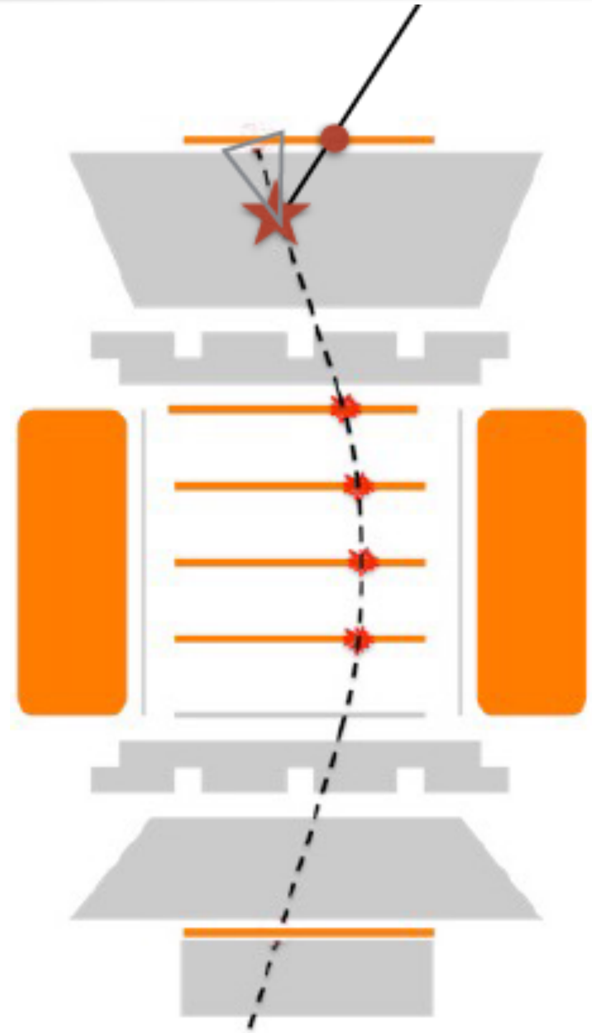




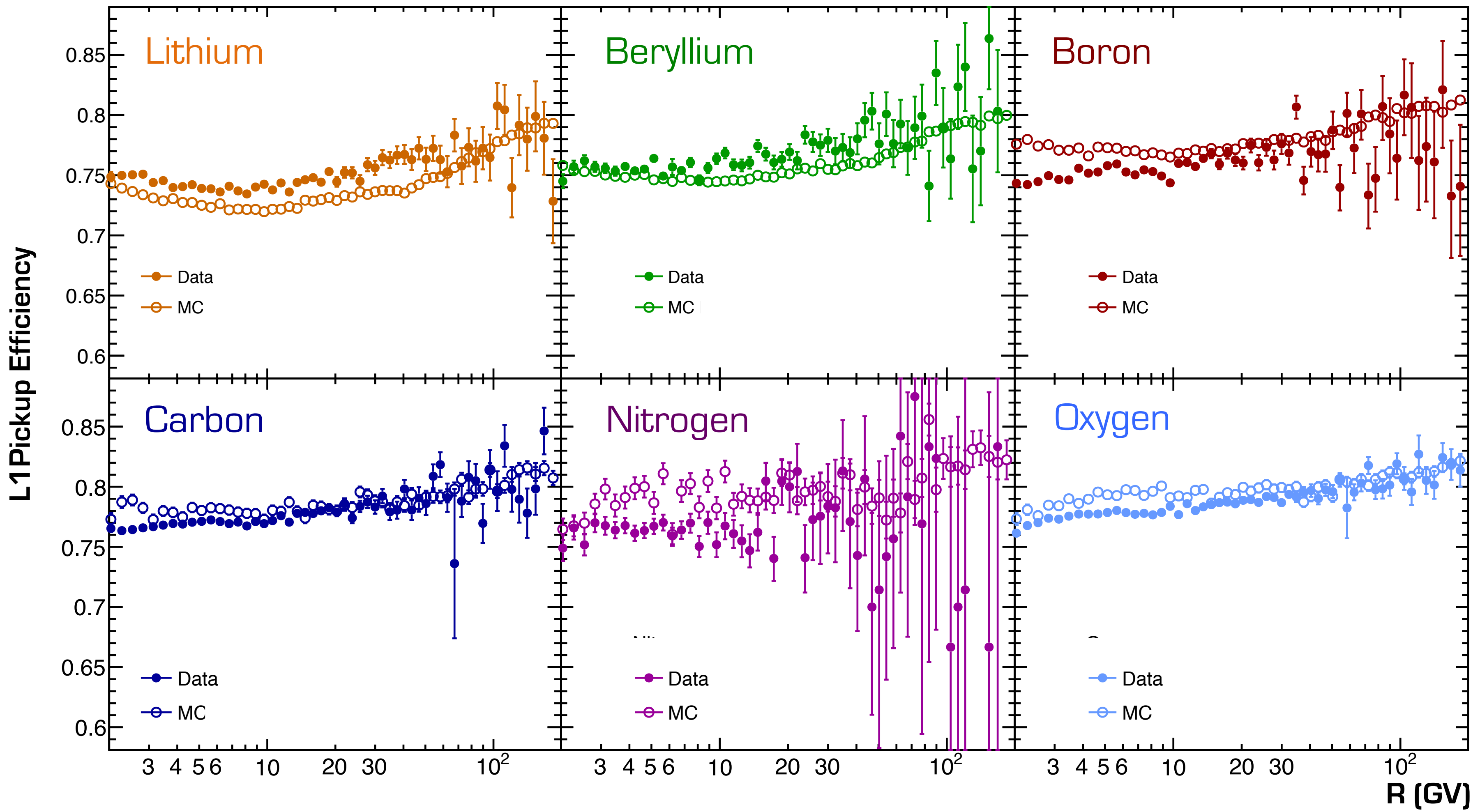
Interactions with AMS materials

➢ **(Quasi)Elastic interaction:**

validated by measuring the probability to have a good association between the track reconstructed in the Inner Tracker and the hit on L1



L1Pickup Efficiency



Interactions with AMS materials

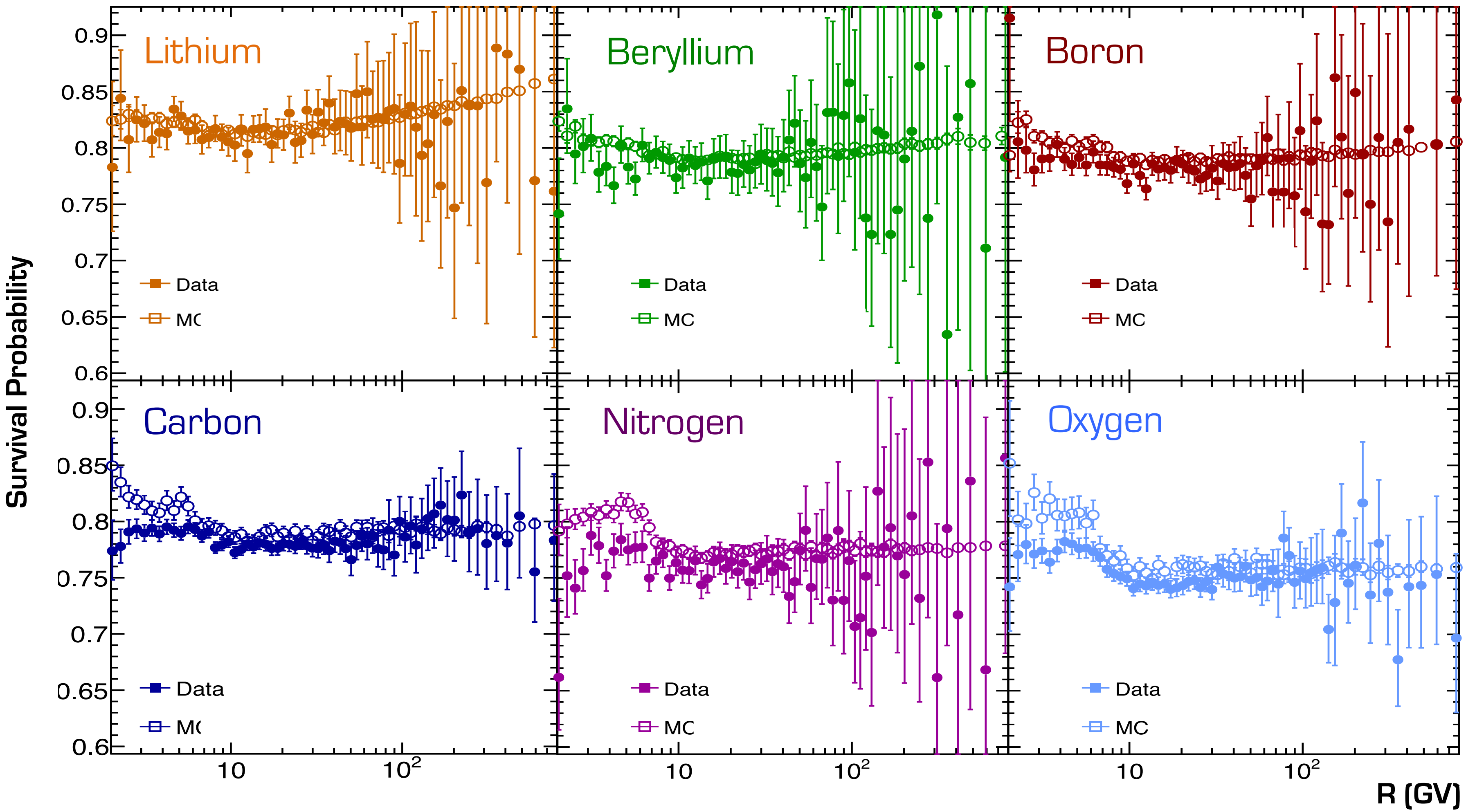
- **(Quasi)Elastic interaction:**

  validated by measuring the probability to have a good association between the track reconstructed in the Inner Tracker and the hit on L1

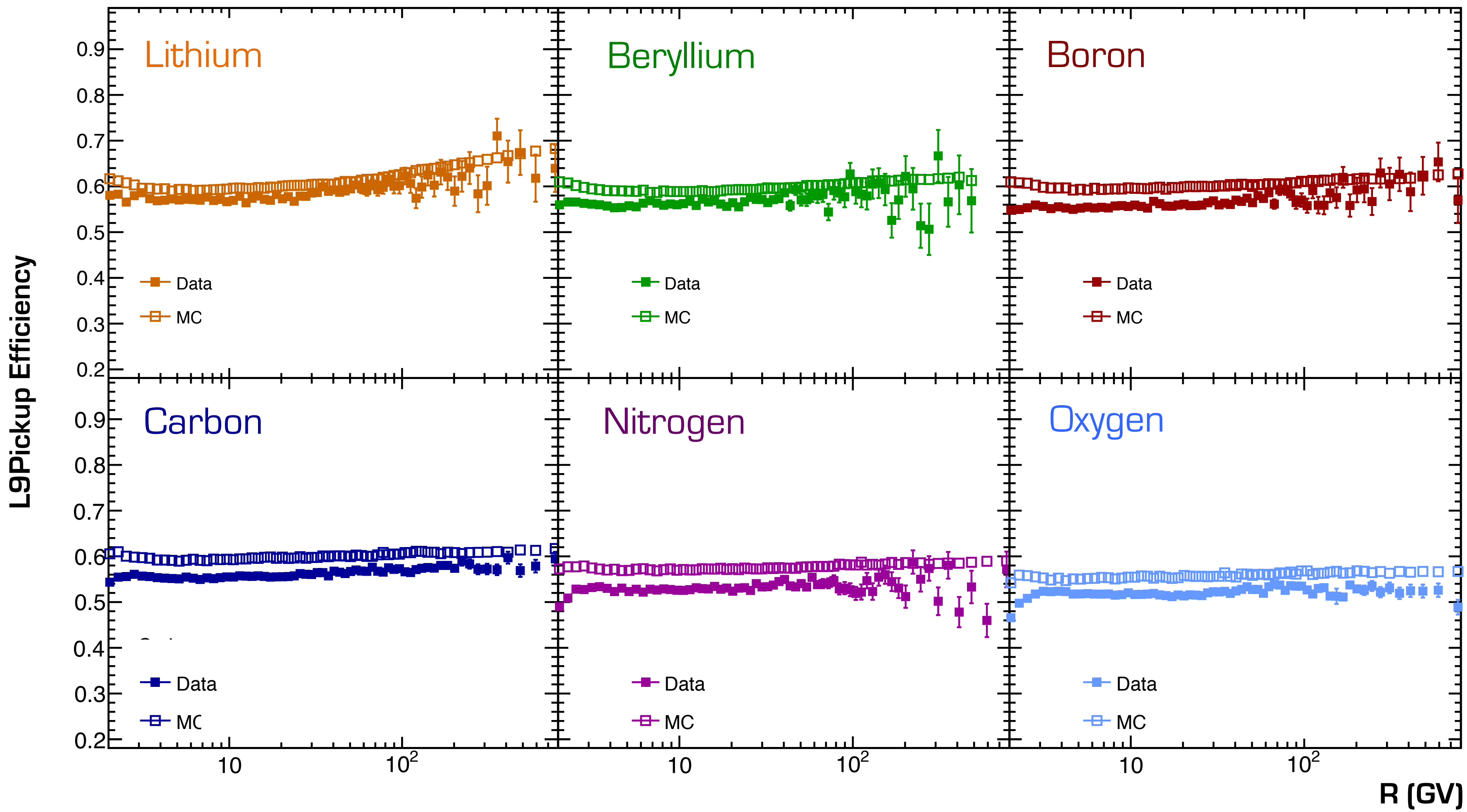
- **Inelastic interaction:**

  validated by measuring the survival probability of nuclei in the material of the detector

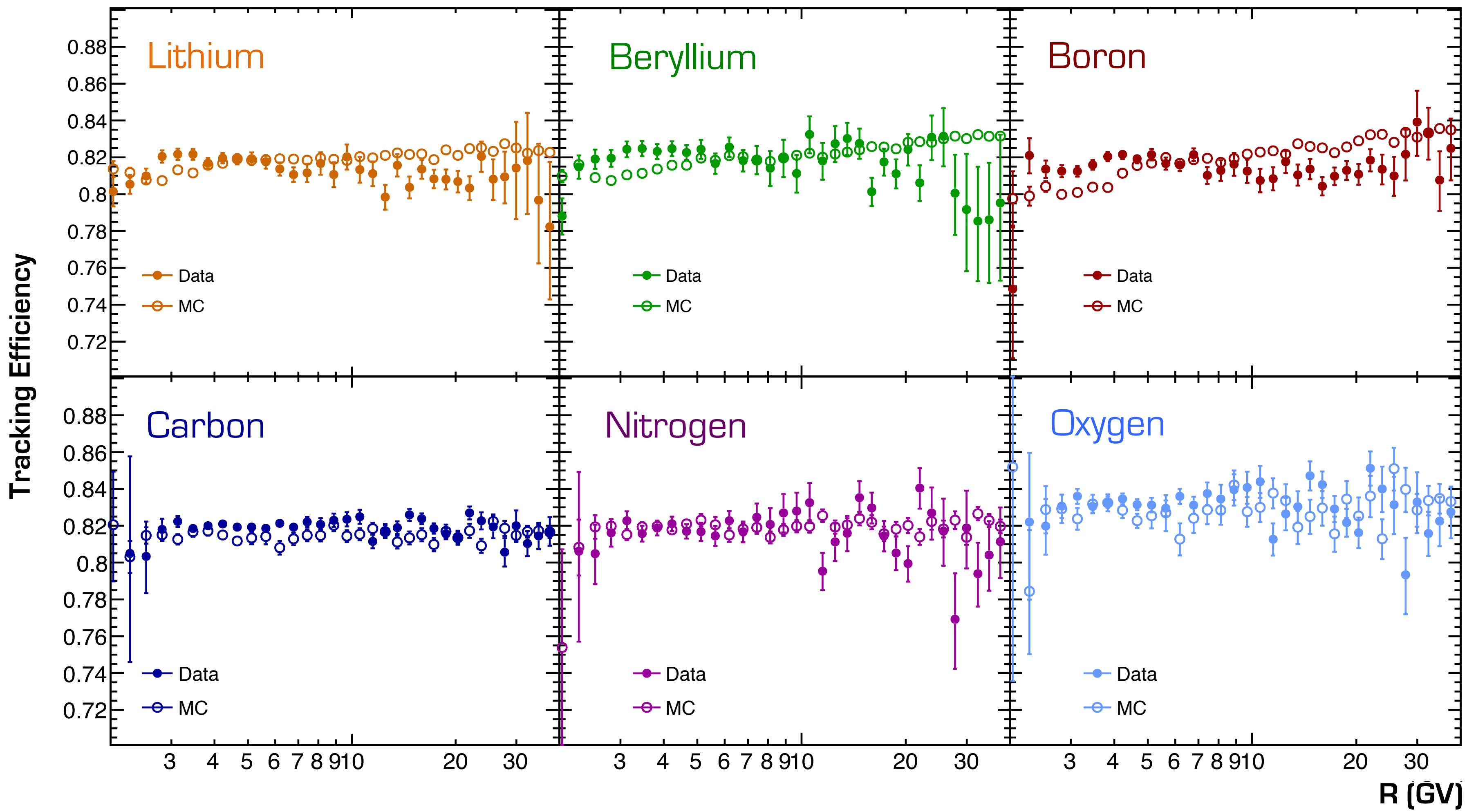
Survival Probability



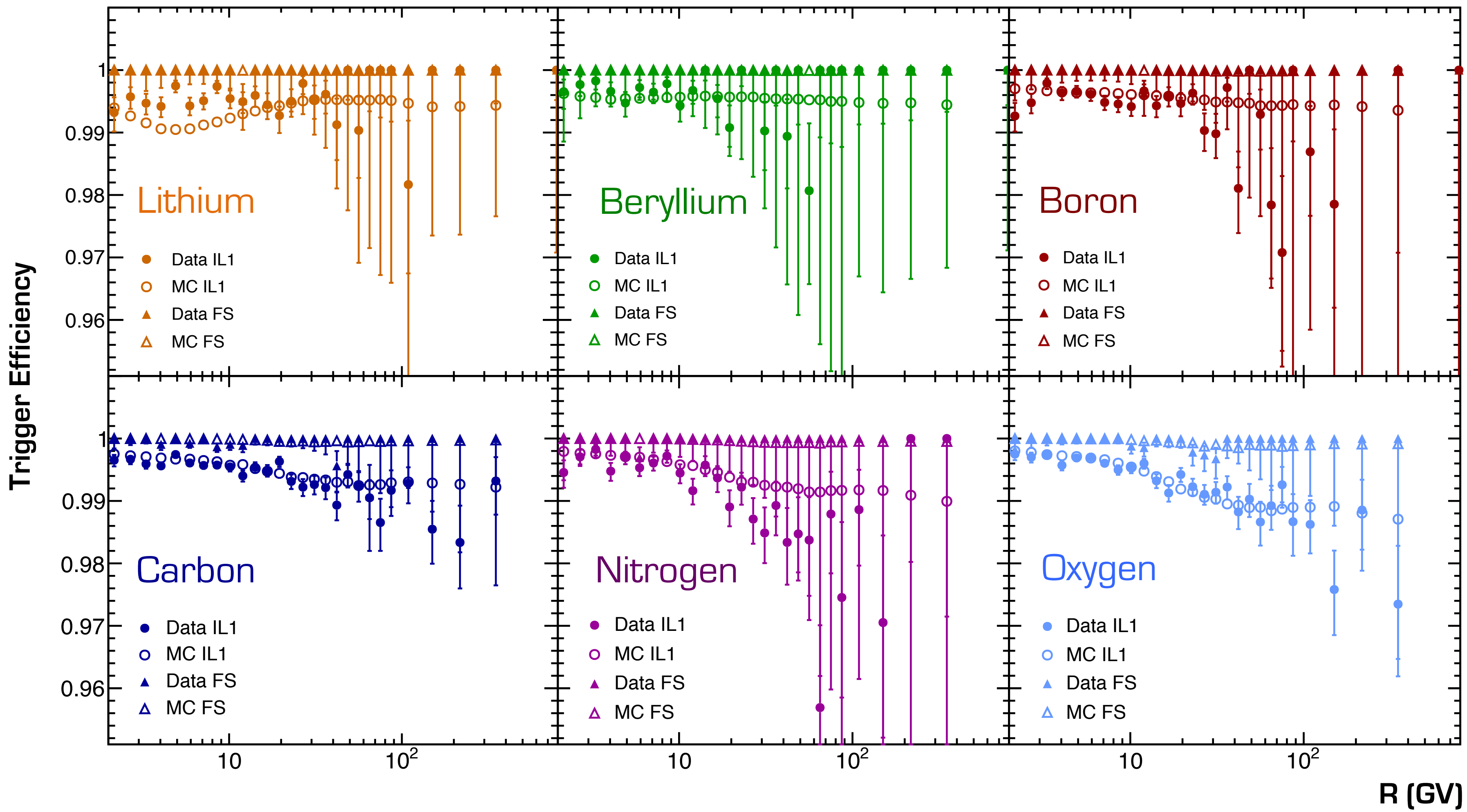
L9Pickup Efficiency



Tracking Efficiency

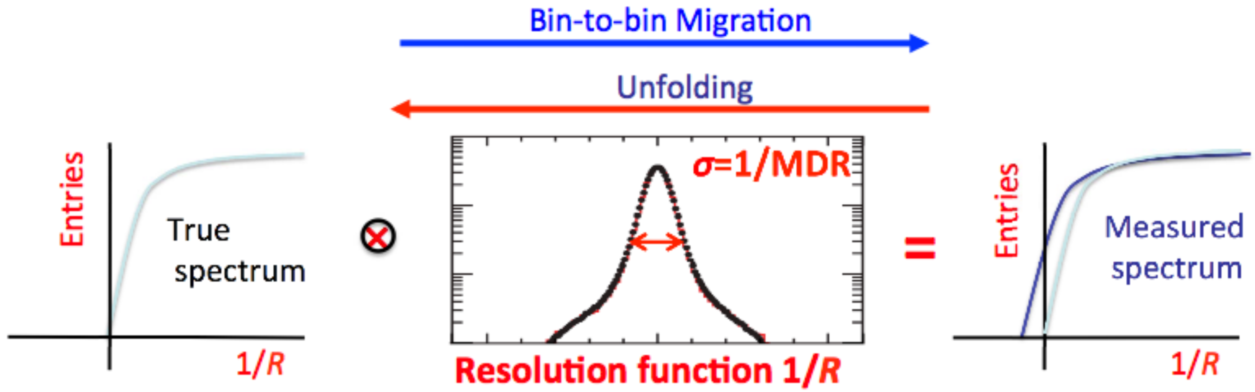


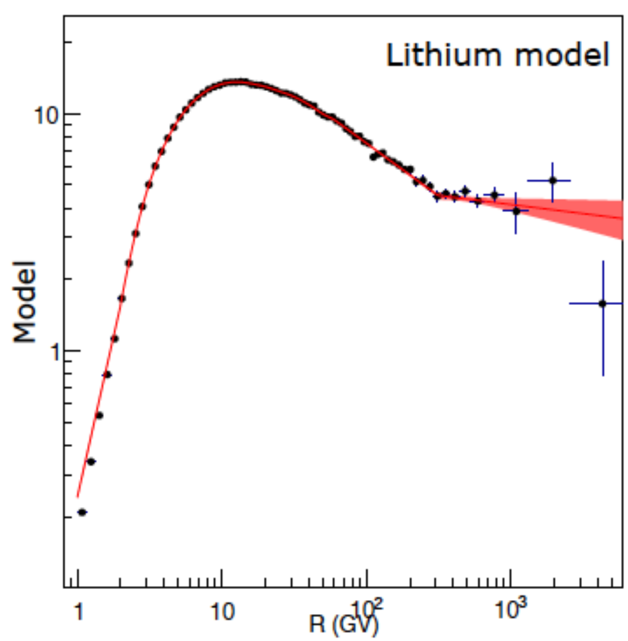
Trigger Efficiency

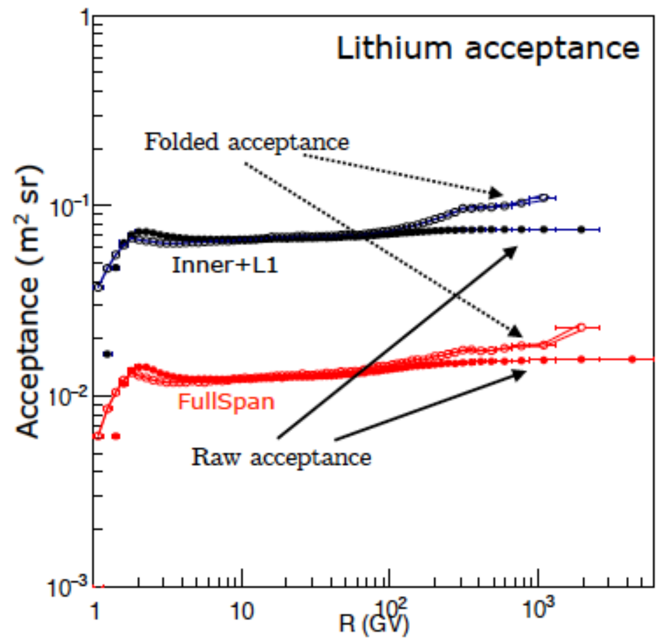


Unfolding

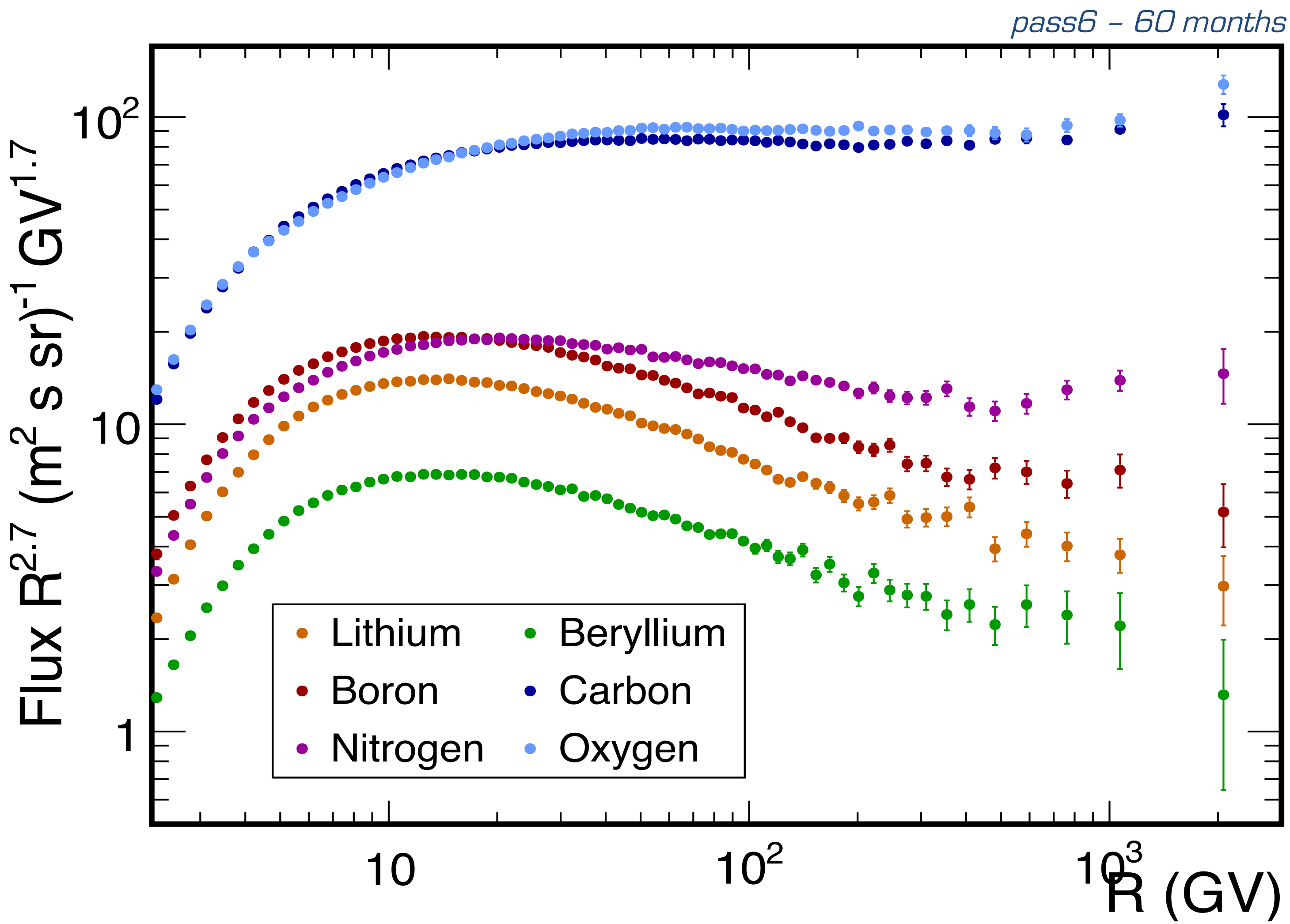
Unfolding with Folded Acceptance method







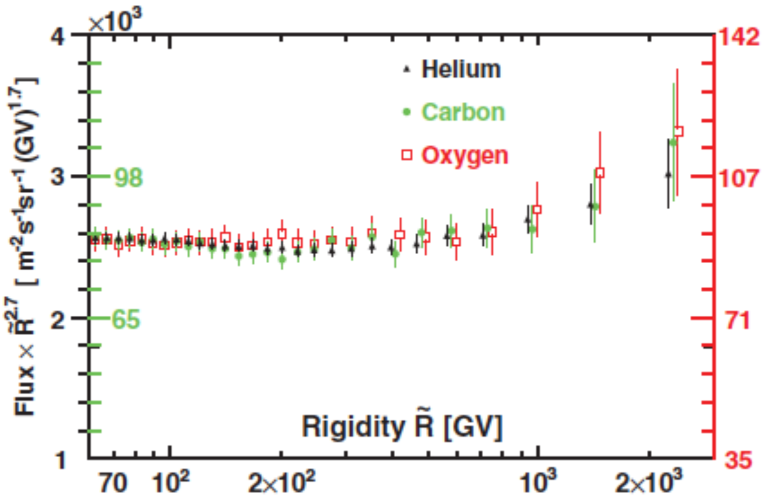
Ions Fluxes

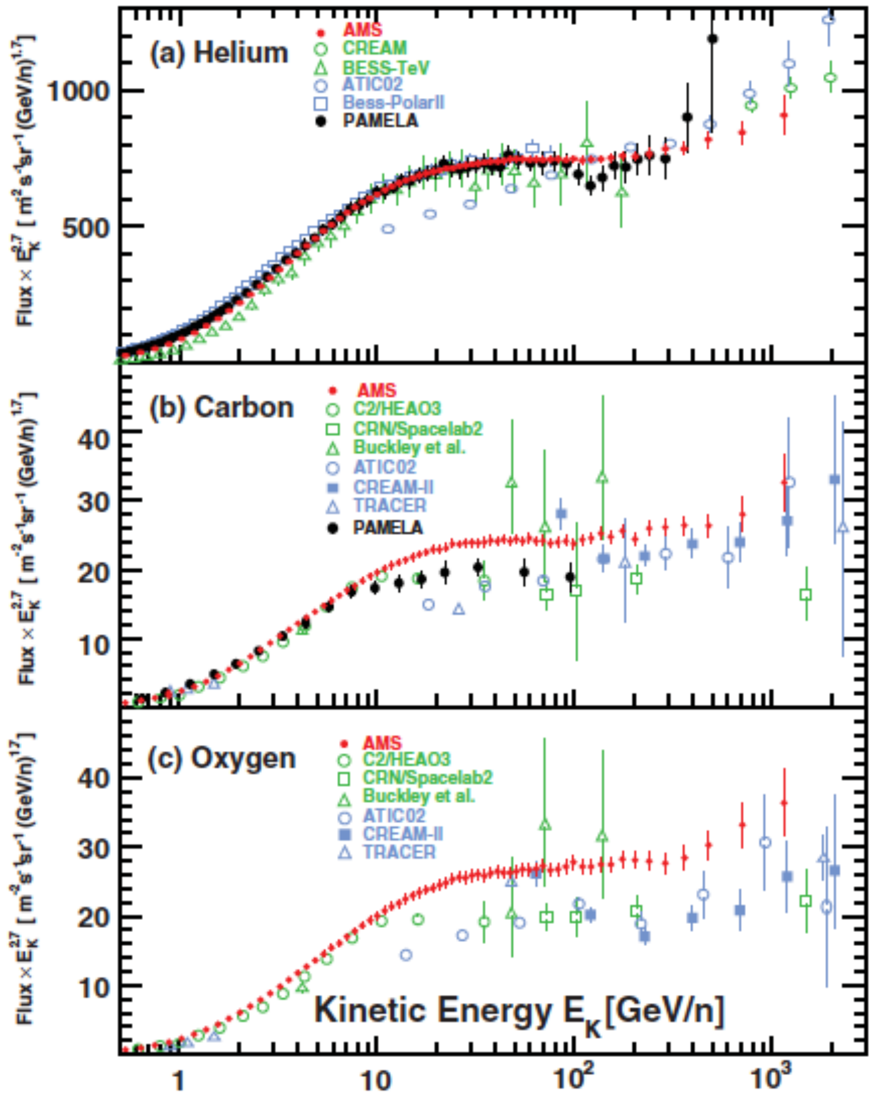


pass6 – 60 months
Flux R^2.7 (m^2 s sr)^-1 GV^1.7
10^2
10
1
10
10^2
10^3
R (GV)
Lithium
Beryllium
Boron
Carbon
Nitrogen
Oxygen

Summary: Primary CR

PHYSICAL REVIEW LETTERS
119, 251101 (2017)

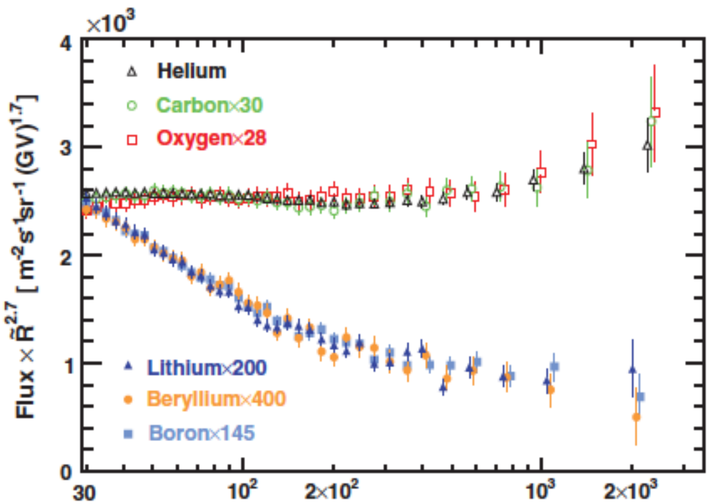


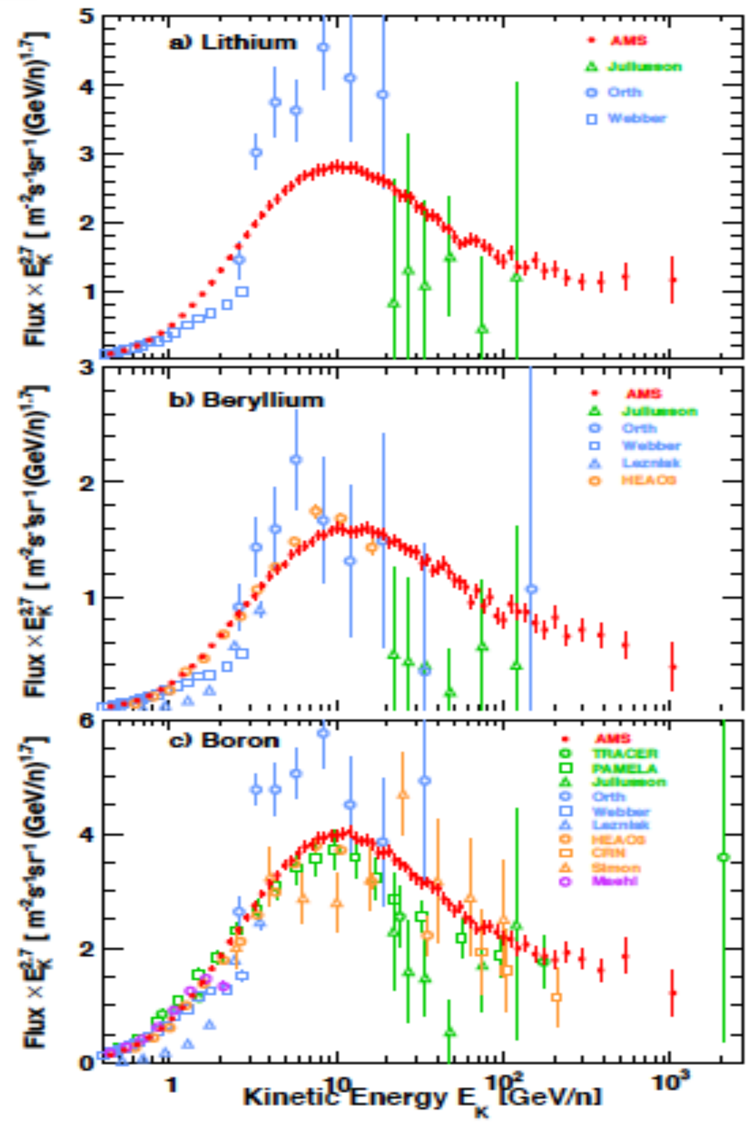


- The fluxes deviate from a single power law with an harden above 200 GV
- *Above 60 GV the fluxes have identical rigidity dependence*

Summary: Secondary CR

PHYSICAL REVIEW LETTERS
120, 021101 (2018)





- ➢ The fluxes deviate from a single power law with an harden above 200 GV
- ➢ Above 30 GV the fluxes have identical rigidity dependence
- ➢ The rigidity dependence is different between Primary and Secondary CR

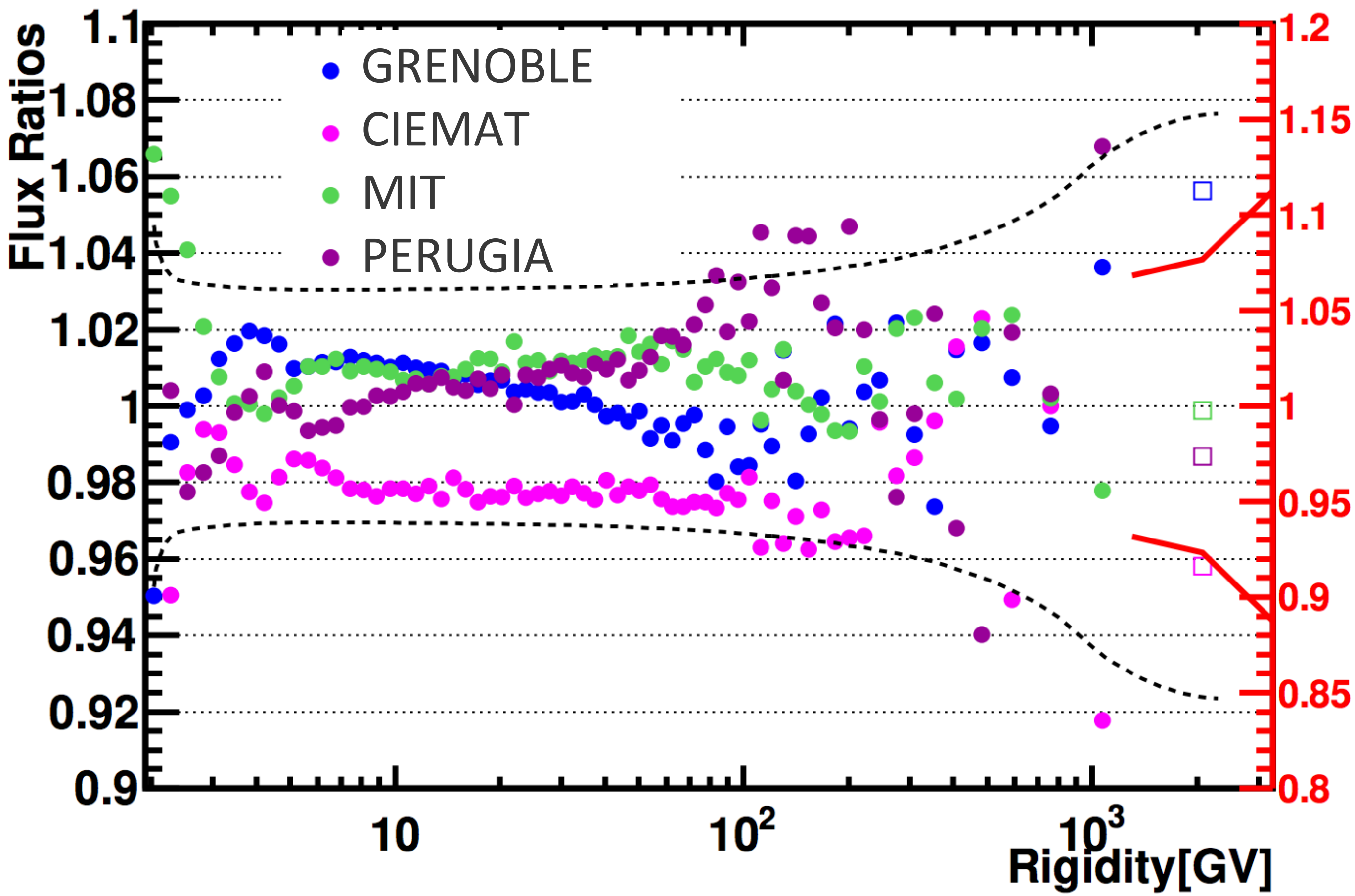
Ongoing Analysis: Nitrogen Flux

Observation of Primary and Secondary Components in the Cosmic Ray Nitrogen Flux by the Alpha Magnetic Spectrometer (AMS) on the International Space Station

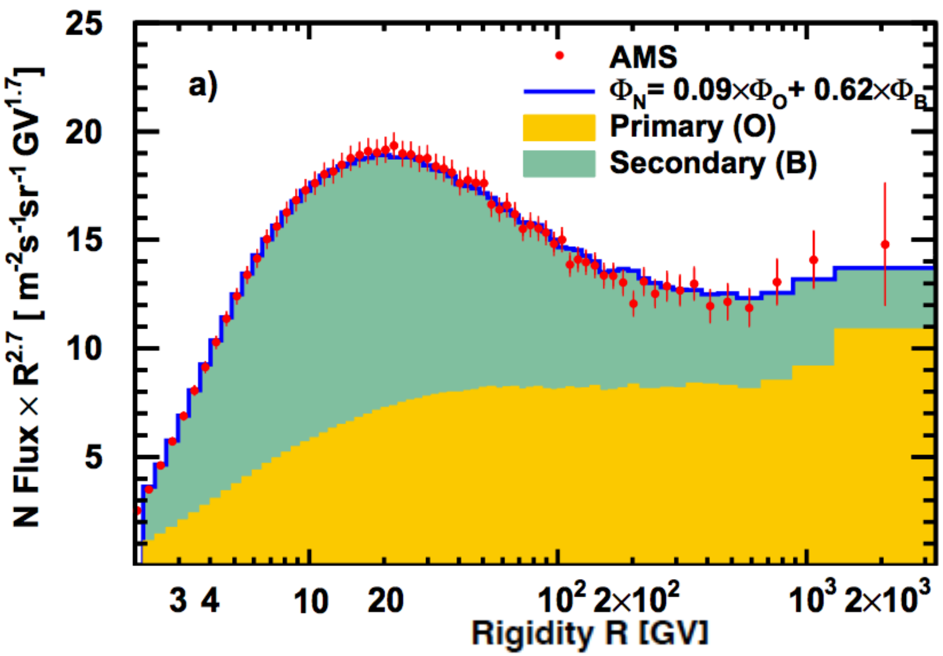
Abstract

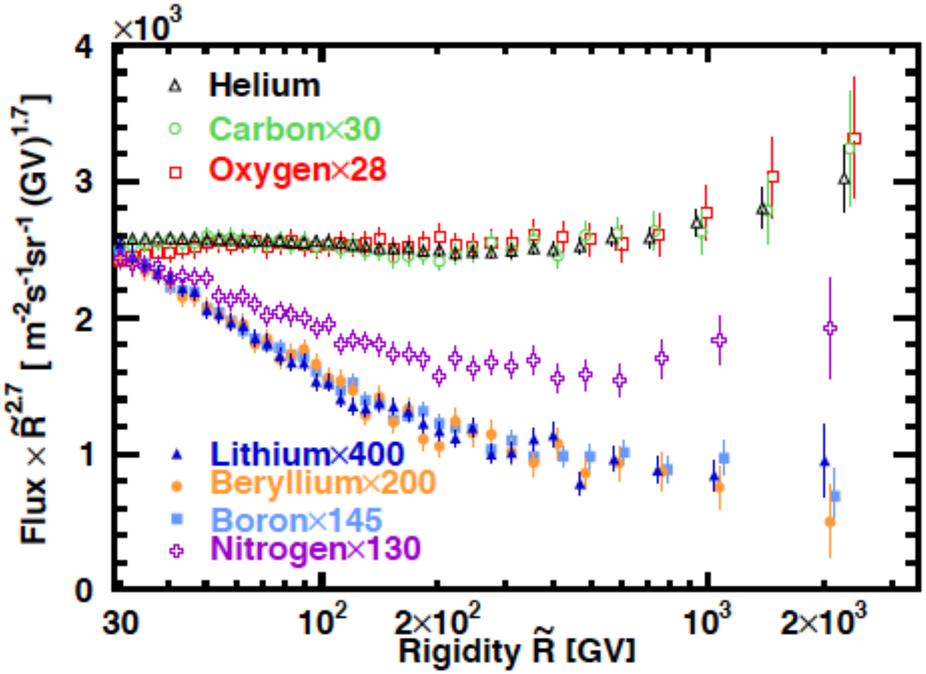
The nitrogen flux in cosmic rays is expected to contain both primary and secondary components, so the knowledge of its rigidity dependence is important in understanding the origin, acceleration, and propagation of cosmic rays. A precise measurement of the nitrogen flux with rigidity (momentum/charge) from 2.2 GV to 3.3 TV based on 2.2×10^6 events is presented. The detailed variation with rigidity of the nitrogen flux spectral index is presented for the first time. The spectral index progressively hardens at high rigidities and becomes identical to the spectral indices of primary He, C, and O cosmic rays above ~700 GV. Remarkably, the nitrogen flux Φ_N is well described by the weighted sum of a primary flux and a secondary flux, $\Phi_N = (0.090 \pm 0.002) \times \Phi_O + (0.62 \pm 0.02) \times \Phi_B$, where Φ_O is the oxygen flux and Φ_B the boron flux. This corresponds to a change of of the secondary component in the nitrogen flux from 70% at a few GV to < 30% above 1 TV.

Ongoing Analysis: Nitrogen Flux



Ongoing Analysis: Nitrogen Flux





- The flux deviates from a single power law with an harden above 100 GV
- The rigidity dependence is different from the behavior of Primary and Secondary CR
- The flux could be described by the weighted sum of a primary flux and of a secondary flux

Conclusions

- Analysis with 60 (58 excluding TTCS-Off) months of pass6 data and latest MC productions
- Analysis of Li, Be, B have been published on PRL
- Analysis of He C, O have been published on PRL
- Currently working on the Nitrogen Analysis