INFN BOLOGNA
Istituto Nazionale di Fisica Nucleare
Sezione di Bologna

Meeting with ASI:
Results for Light Ions Analysis
Li, Be, B, C, N & O

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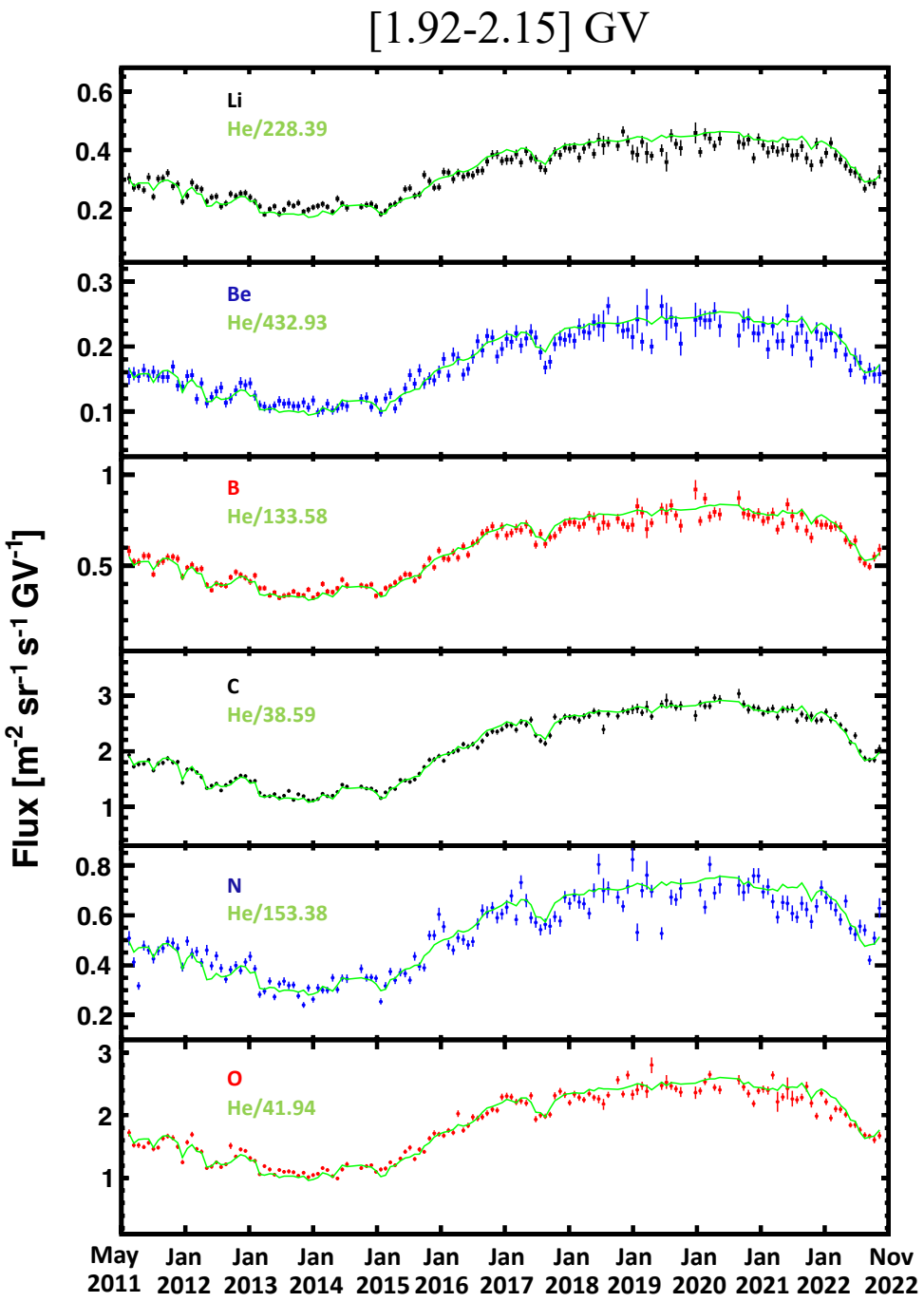
What is new?

- **Photon Trigger period extension (6 more Bartels added from that period).**
- **Thanks to the new pass8 track reconstruction, the acceptance is higher and an extension of the analysis to lower rigidities is possible.**
- **Interpretations/Results plots.**

Time Variation of Cosmic Light Nuclei

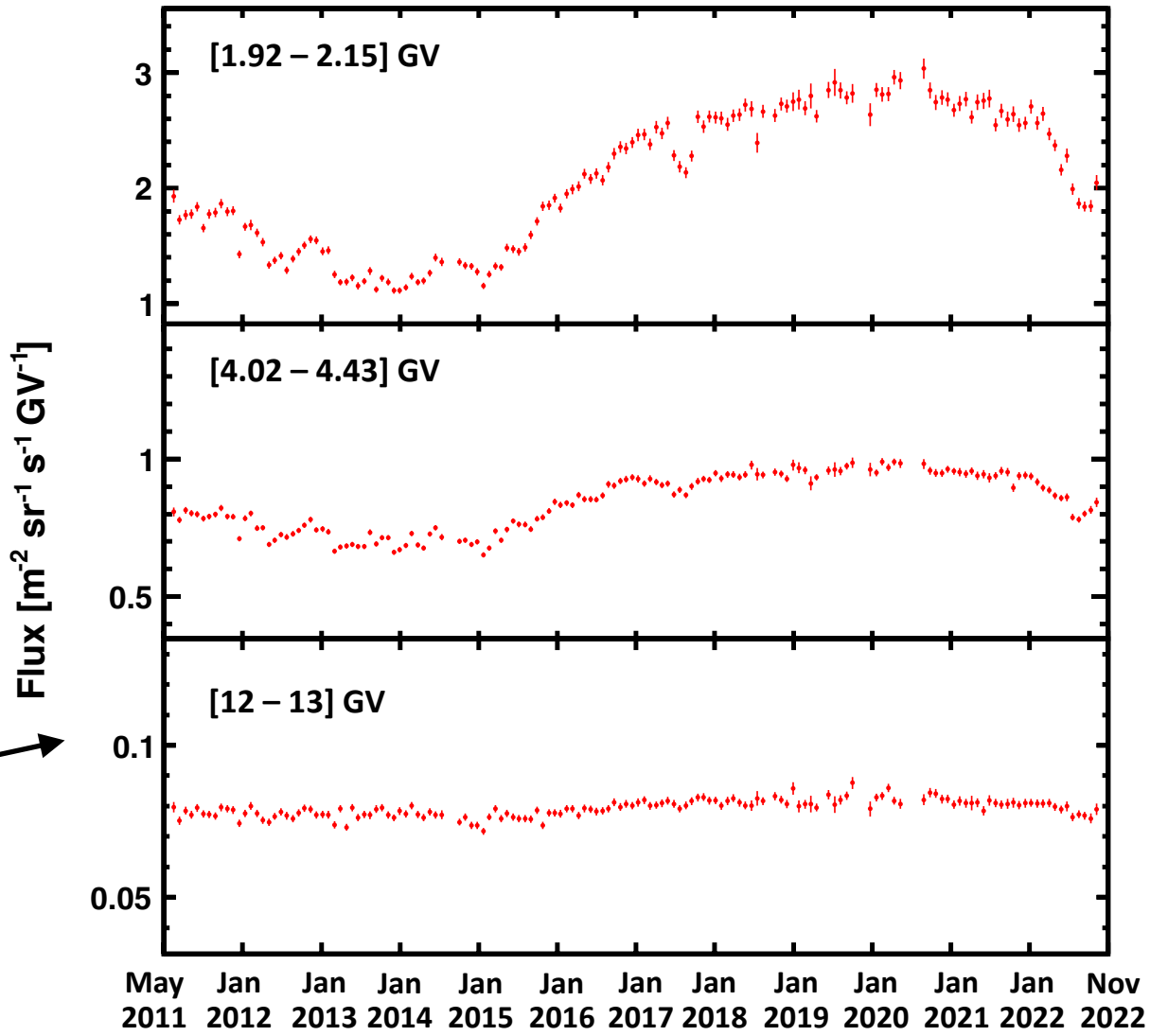
- **Data covers from May 2011 to Nov 2022, from Bartels 2426 to Bartels 2581.**
- **Data covers rigidity from 1.92 to 60 GV.**
- **A total of 5.3M Li, 2.6M Be, 7.8M B, 26.1M C, 6.6M N and 22.1M O.**
- **All fluxes show similar time behavior.**



Time Variation of Cosmic Light Nuclei

- **Data covers from May 2011 to Nov 2022, from Bartels 2426 to Bartels 2581.**
- **Data covers rigidity from 1.92 (2.15) to 60 GV.**
- **A total of 5.3M Li, 2.6M Be, 7.8M B, 26.1M C, 6.6M N and 22.1M O.**
- **All fluxes show similar time behavior.**
- **The amplitude of the the time structures decrease with increasing rigidity.**

Carbon flux vs time for 3 rigidity bins.



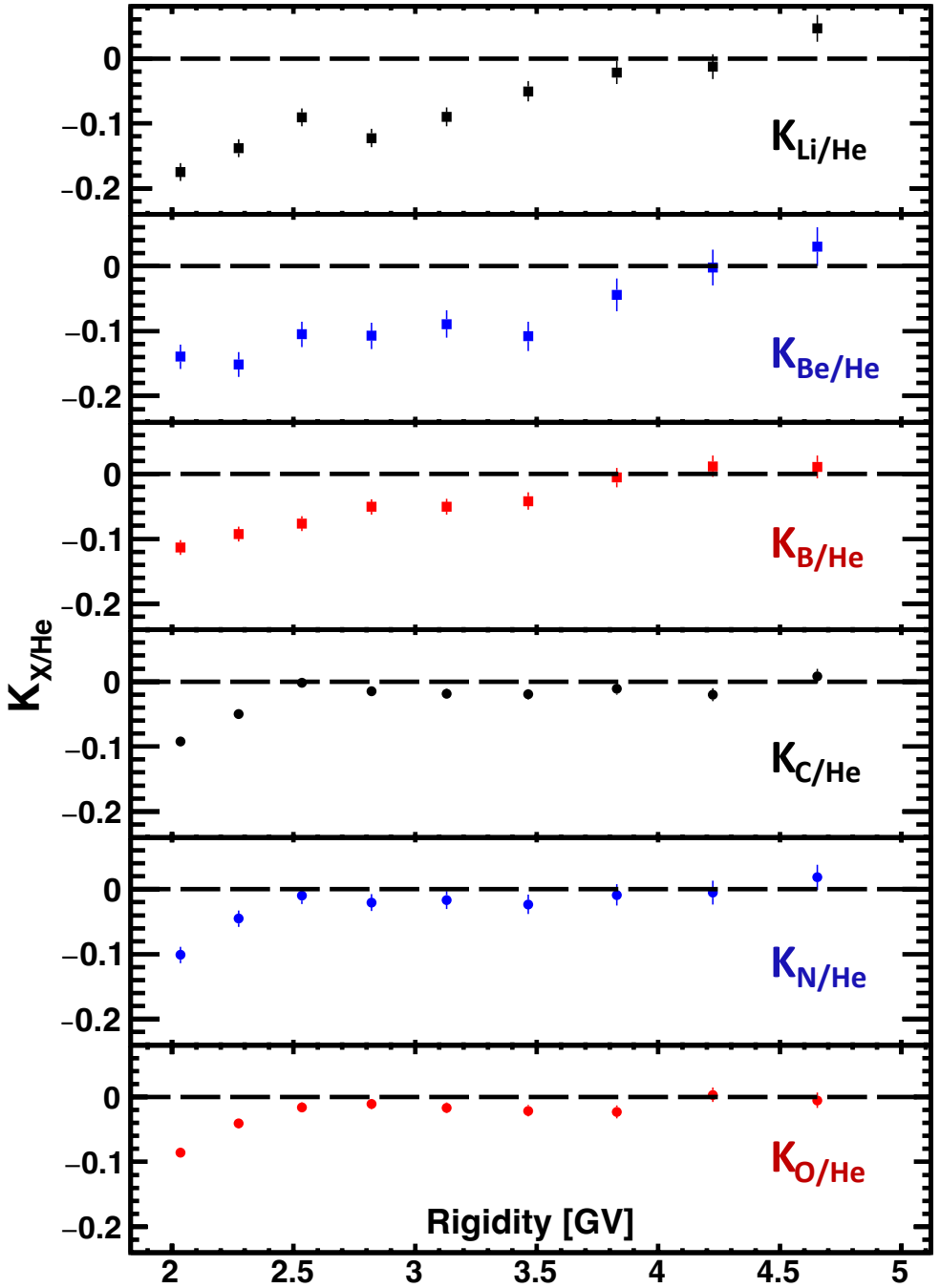
Differences in solar modulation for light nuclei

We study the dependences of light nuclei using as references He, B and C.

$$\frac{\Phi_X^i/\Phi_Y^i - \langle \Phi_X^i/\Phi_Y^i \rangle}{\langle \Phi_X^i/\Phi_Y^i \rangle} = K_{X/Y}^i \frac{\Phi_Y^i - \langle \Phi_Y^i \rangle}{\langle \Phi_Y^i \rangle}$$

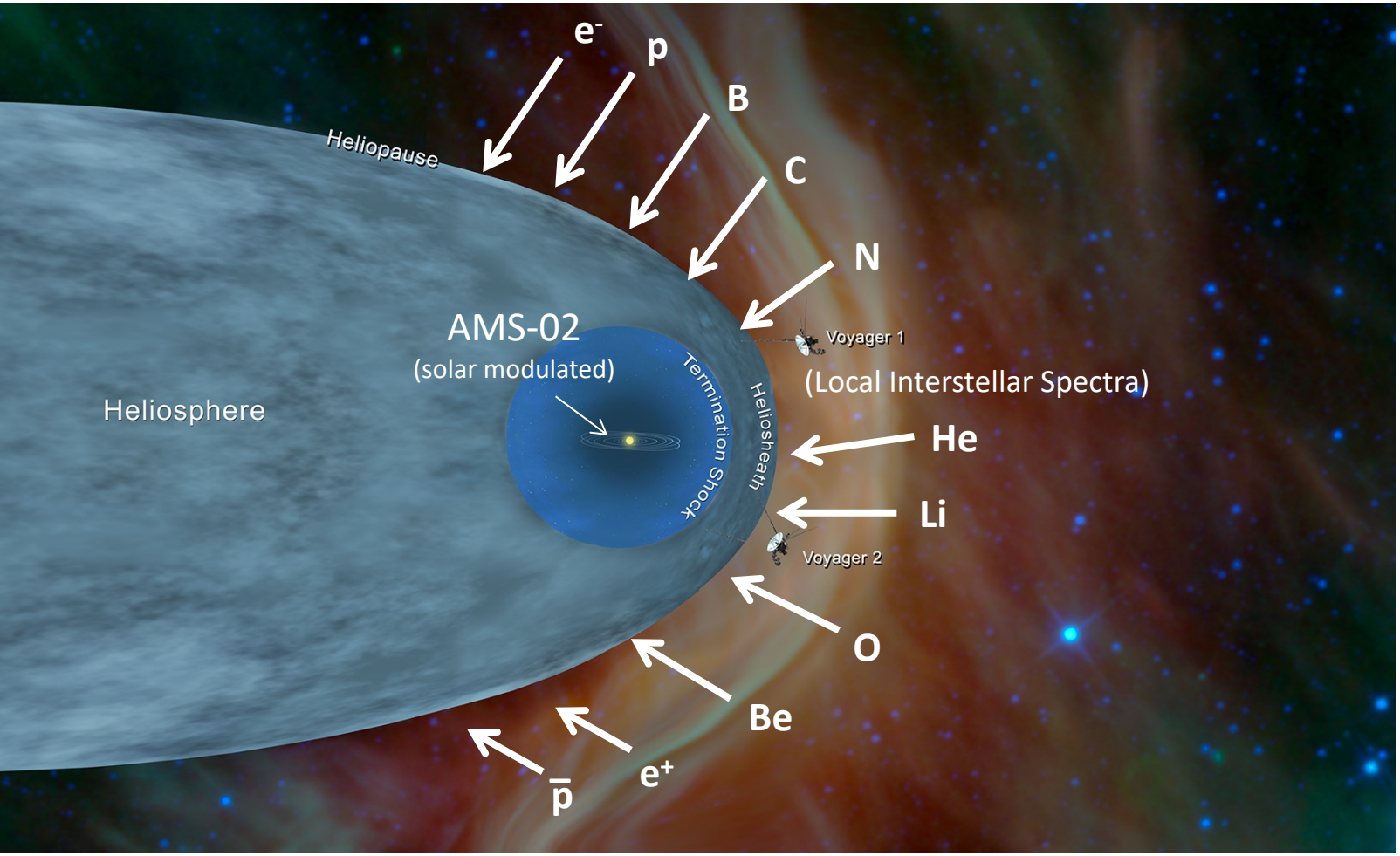
where X is the a selected nuclei from Li to O, and Y is the nuclei used as a reference.

- **Li, Be and B are significantly less modulated than He up to 3.6 GV.**
- **C, N and O are significantly less modulated than He up to 2.4 GV.**



Galactic Cosmic Rays Propagation in the Heliosphere

GCRs entering the heliosphere are subject to diffusion, convection, adiabatic energy losses and magnetic drift.
This is commonly known as Solar Modulation.



Differences in solar modulation among different nuclei can be attributed to:

- Differences in the spectral (LIS) shape of cosmic rays entering the heliosphere.
- Differences arising from the velocity dependence of the solar modulation (for the same rigidity different species have different velocities depending on the A/Z ratio).

Measuring the rigidity dependences of solar modulation on elements with **different spectral shape** (primary/secondary) and/or **different A/Z** (as ex. 2 for C, 2.167 ± 0.033 for Li) provides information of the propagation of CRs in the heliosphere.

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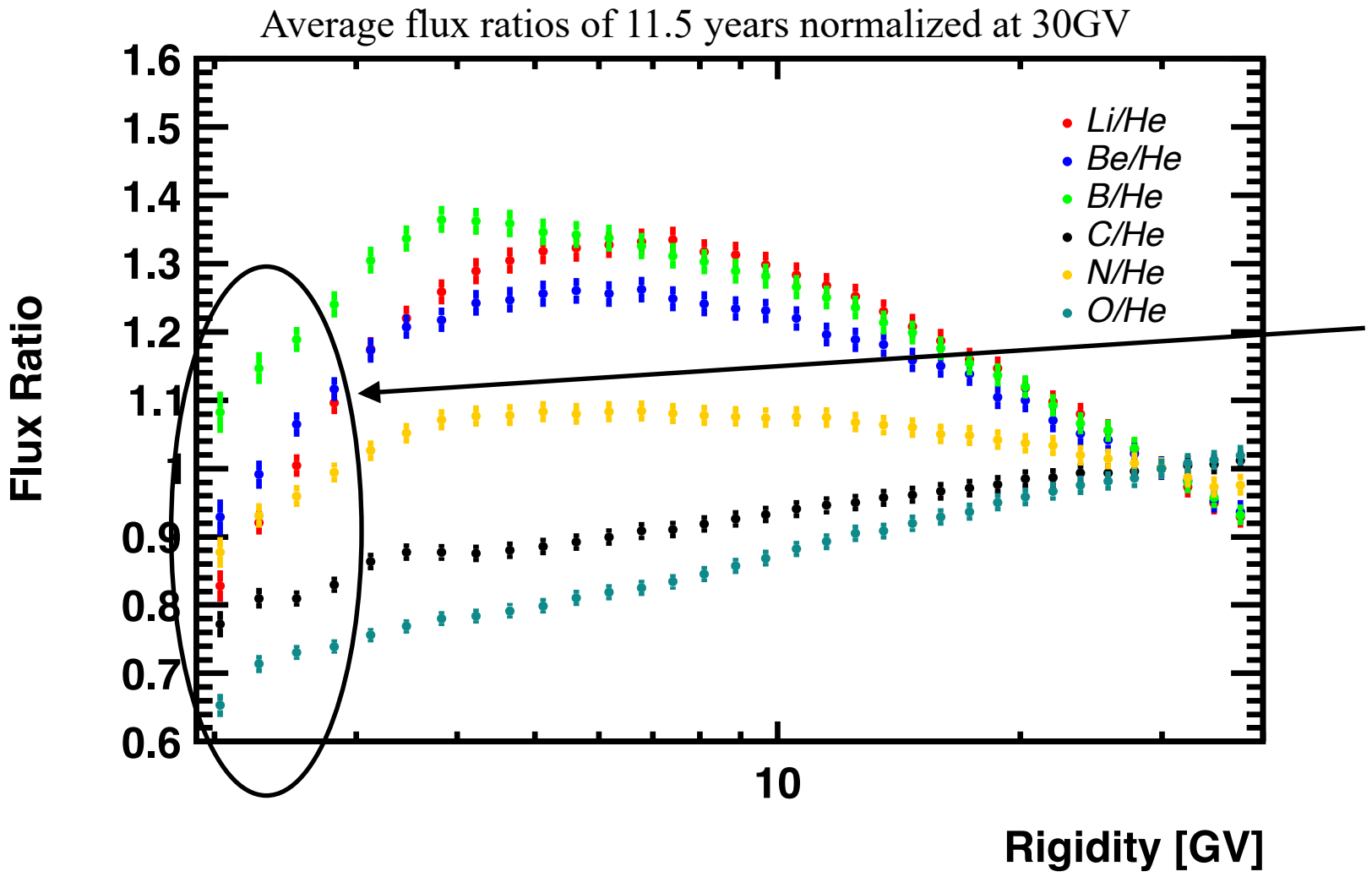
Galactic Cosmic Rays Propagation in the Heliosphere



Differences in solar modulation among different nuclei can be attributed to:

- Differences in the spectral (LIS) dependence of cosmic rays entering the heliosphere.
- Differences arising from the velocity dependence of the solar modulation (for the same rigidity different species have different velocities depending on the A/Z ratio).

The A/Z are 2.17 ± 0.03 for Lithium, **2.00 ± 0.03 for Beryllium**, 2.14 ± 0.02 for Boron, 2 for Carbon, 2.07 ± 0.03 for N, and 2 for O. (From AMS publications)

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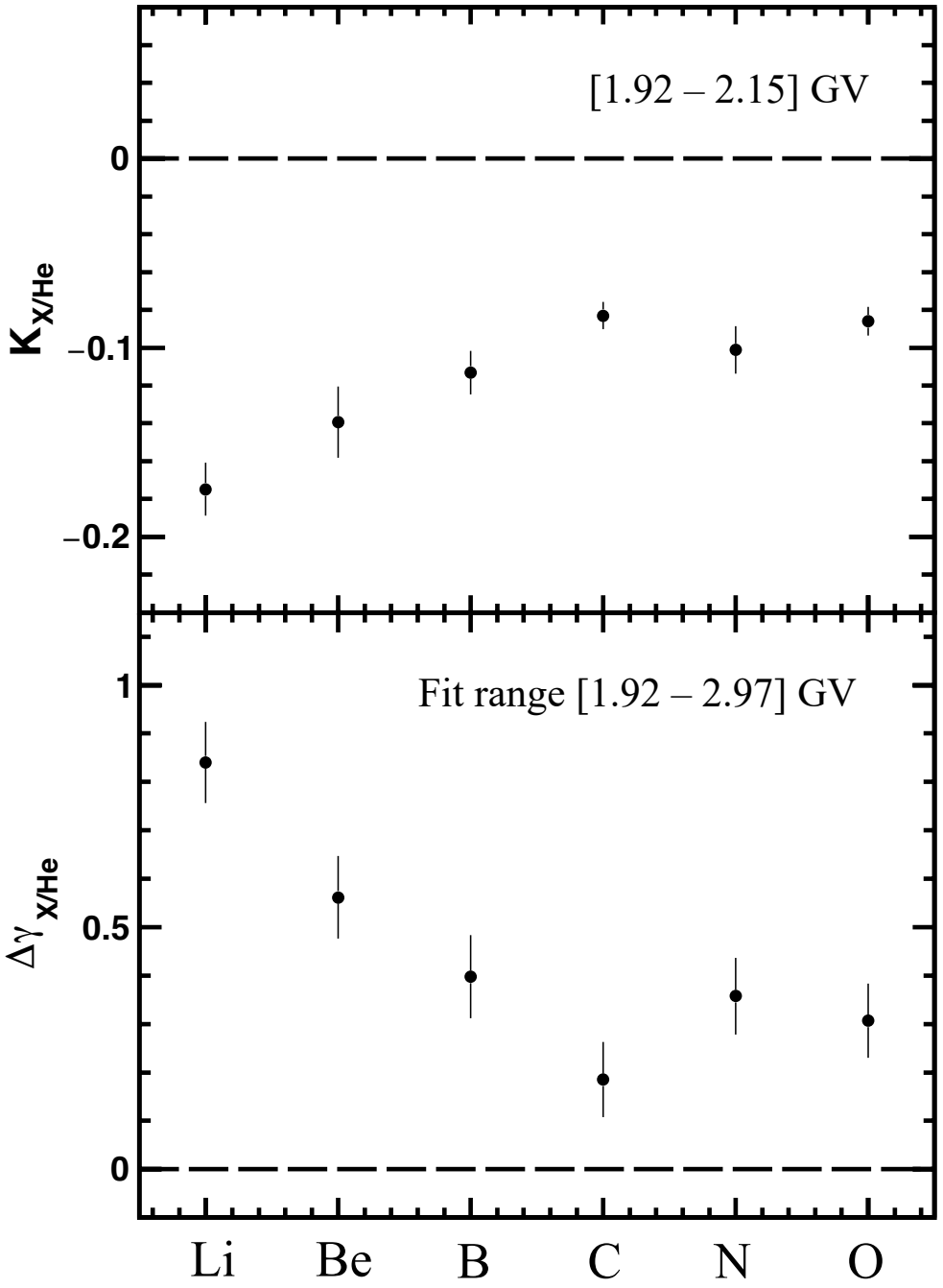
Spectral Index and K-parameter correlation

- When comparing the $\mathbf{K_{X/He}}$ for the first two rigidity bins vs the $\boldsymbol{\Delta\gamma_{X/He}}$,for the fit over the first 4 rigidity bins, an anti-correlation is observed.
- Nuclei with higher $\boldsymbol{\Delta\gamma_{X/He}}$ suffer less modulation.
- This is the first time this effect has been measured directly from data, independently of any model.



Conclusions

- **The Bartels fluxes from Lithium to Oxygen for the first 11.5 years of AMS data taking (Bartels 2426 to Bartels 2581), have been present.**

- **Thanks to the new reconstruction implemented in pass8, an extension to lower rigidities is possible.**

- **Another point at [1.92-2.15] GV has been added for both nitrogen and oxygen, allowing to a more fair comparison between all the nuclei.**

- **The discussed plots within the collaboration have been updated and are ready for a publication.**