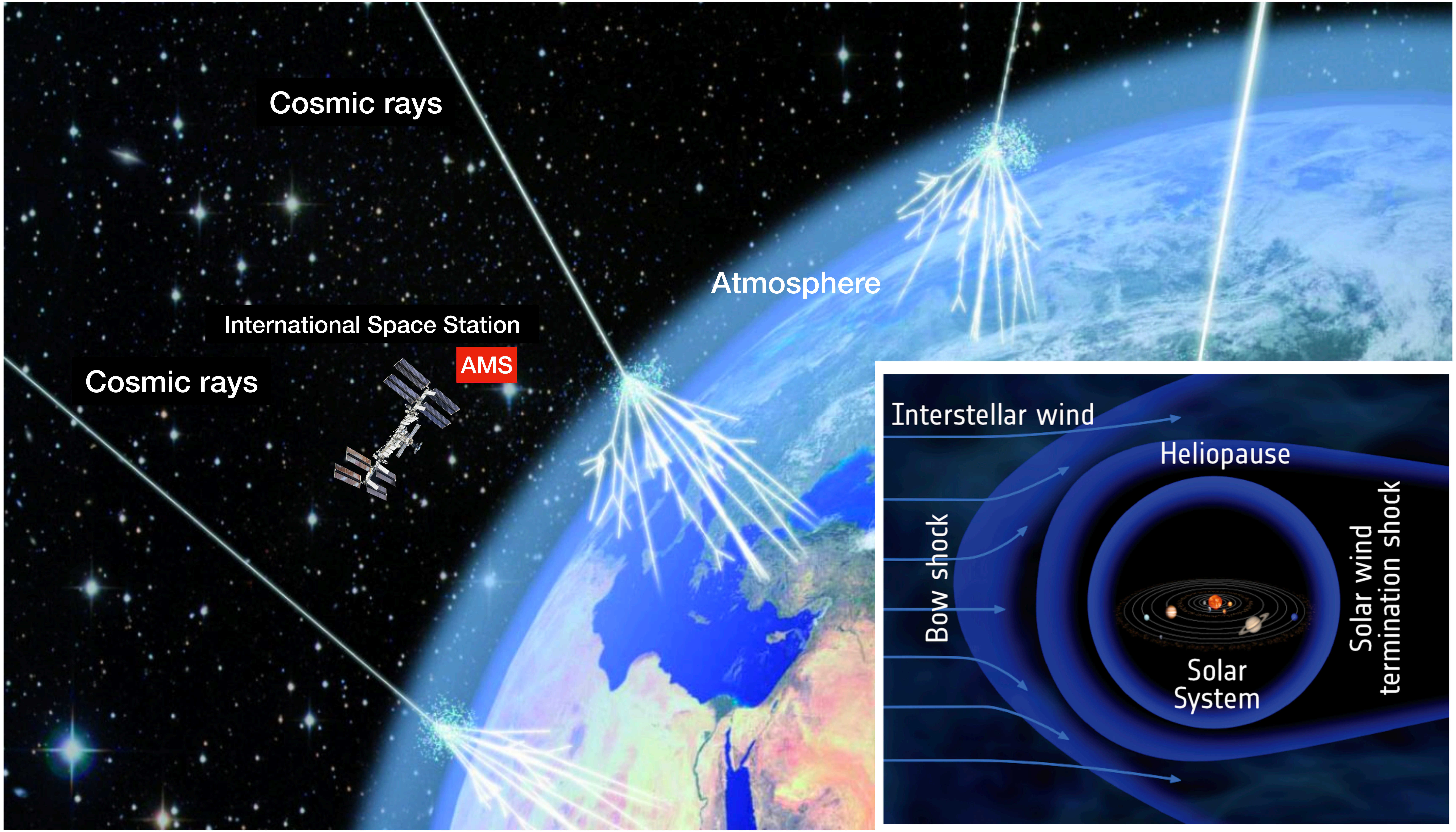
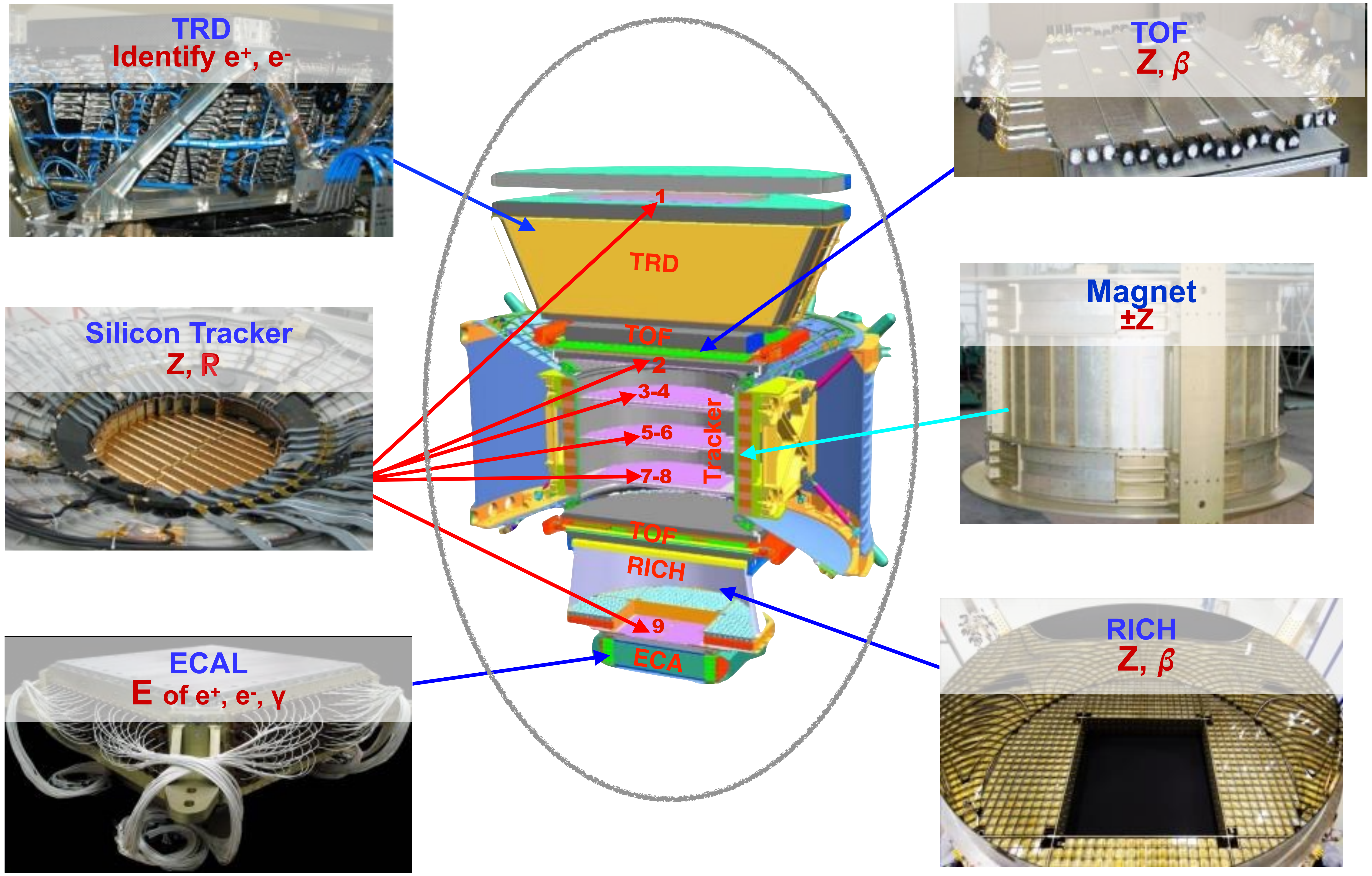
Progress of the monthly flux for light ions (Li, Be, B, C, N, O) at Roma2

Jian Tian, Apr. 23. 2024

Cosmic rays study



AMS SUBDETECTORS



Particles are defined by their charge (**Z**) and energy (**E ~ P**) or rigidity **R=P/Z**

Both quantities are measured redundantly and independently by AMS sub-detectors: Tracker, TOF, TRD, ECAL, RICH

FLUX MEASUREMENT

Isotropic Differential Flux
$(m^2$ sr s GV$)^{-1}$

Number of events
(in rigidity bin i, corrected for bin-to-bin migrations)

$$\phi_i = \frac{\tilde{N}_i}{T_i A_i \Delta R_i}$$

Exposure Time
Duty Cycle and Geomagnetic Cutoff. (s)

Acceptance
(Effective geometrical factor)
Estimated from Monte Carlo simulation (m2 sr) and validated from Data

Rigidity Bin width

Strategy

The goal of this analysis is to get the isotropic differential flux for each ***Bartel Rotation*** **(BR)**, starting from May 2011 up to Nov. 2022 (11.5 years pass8 data, MC B1236, NAIA tuple v1.0.2), with the following formula:

$$\Phi_i^{BR} = \frac{N_i^{BR}}{A_i^{BR}\,\varepsilon_i^{BR}\,T_i^{BR}\,\Delta R_i}$$

1: Reproducing Nuclei integrated fluxes (Lithium to Oxygen).

2: Evaluating Monthly Nuclei fluxes (Lithium to Oxygen).

Selected Nuclei Counts

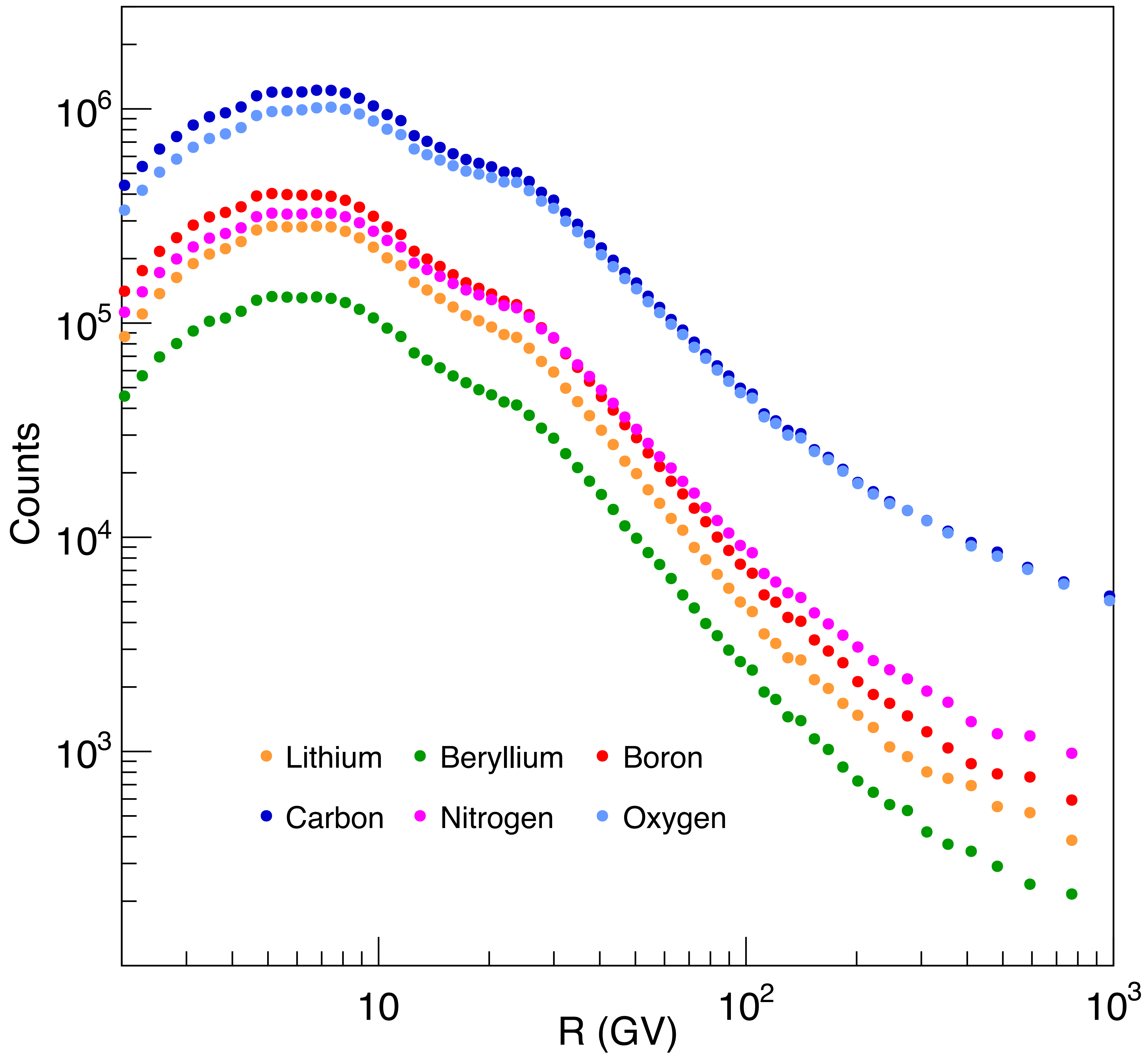
From 11.5 years pass8 data

BASIC
- ❑No SAA
- ❑Live time > 0.5 && Zenith < 40 with
- ❑Physics trigger

TOF
- ❑$\beta > 0$
- ❑Upper Tof charge Q E (Z – 0.75, Z + 0.75)

INNER
- ❑At least one track with Q E (Z – 0.45, Z + 0.45)
- ❑pattern on Y view: L2 && (3 | | 4) && (5 | | 6) && (7 | | 8)
- ❑Chi2Y < 10
- ❑Rigidity_inner > 1.2RC (IGRF)
- ❑σQ/Q < 0.55

INNERL1
- ❑InnerL1 track with Q E (0, Z + 0.8)
- ❑InnerL1 Chi2Y < 10
- ❑L1NormRes < 10
- ❑Rigidity_innerL1 > 1.2RC (IGRF)

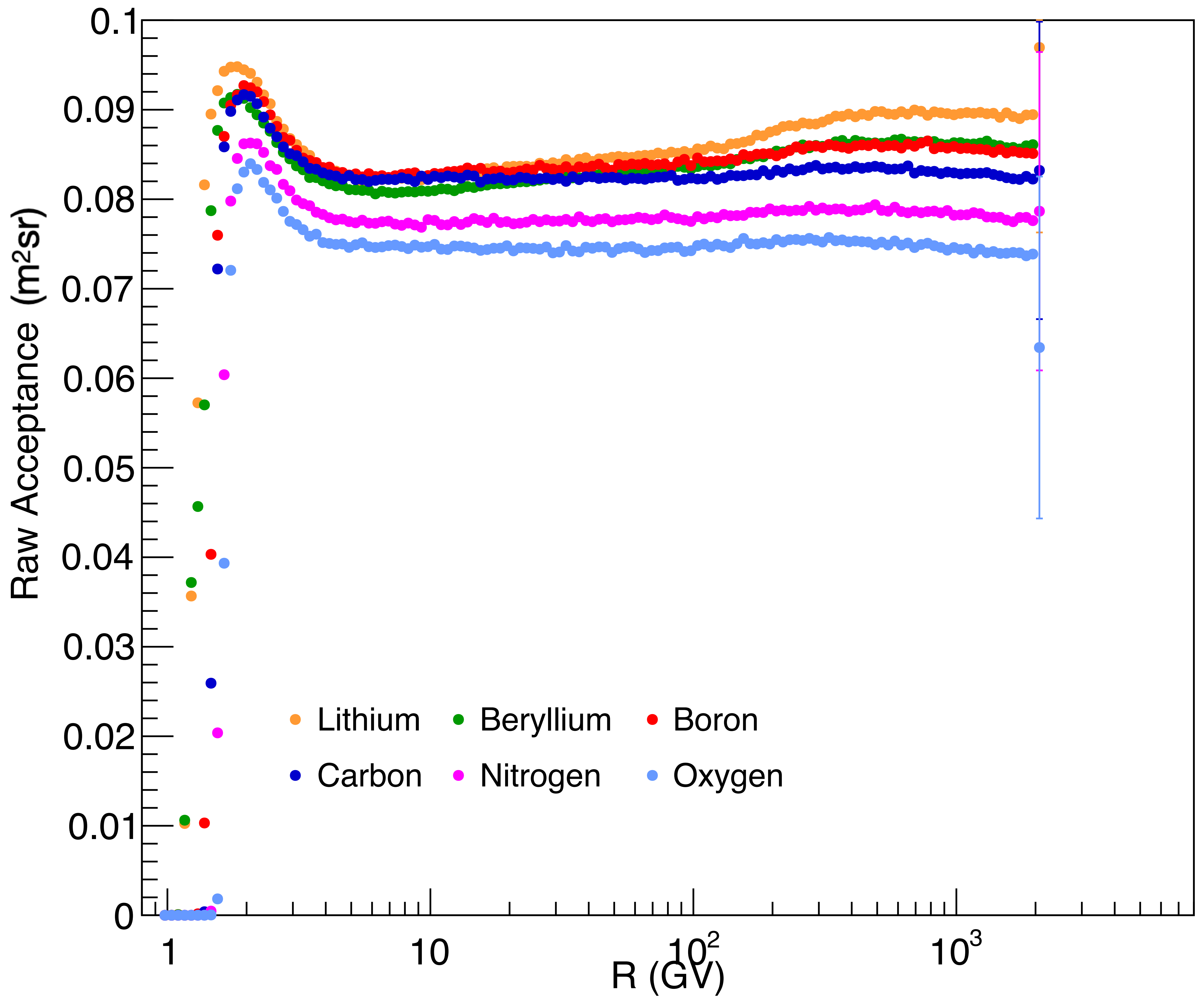


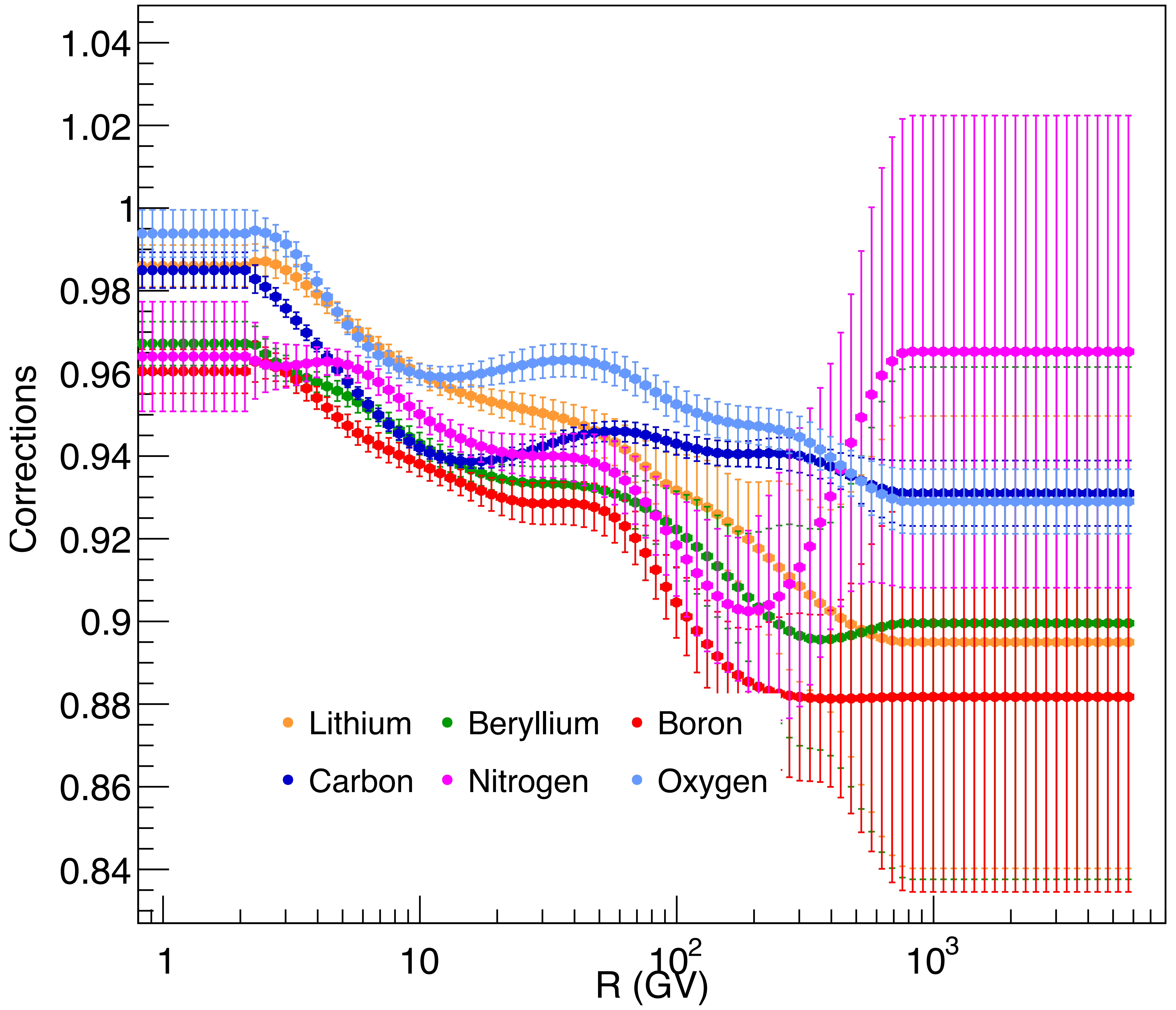
Lithium	5.9 M	Carbon	28.6 M
Beryllium	2.8 M	Nitrogen	7.3 M
Boron	8.5 M	Oxygen	24.1 M

Nuclei Acceptances

Nuclei Raw Acceptance obtained by using PG selections and MC B1236.

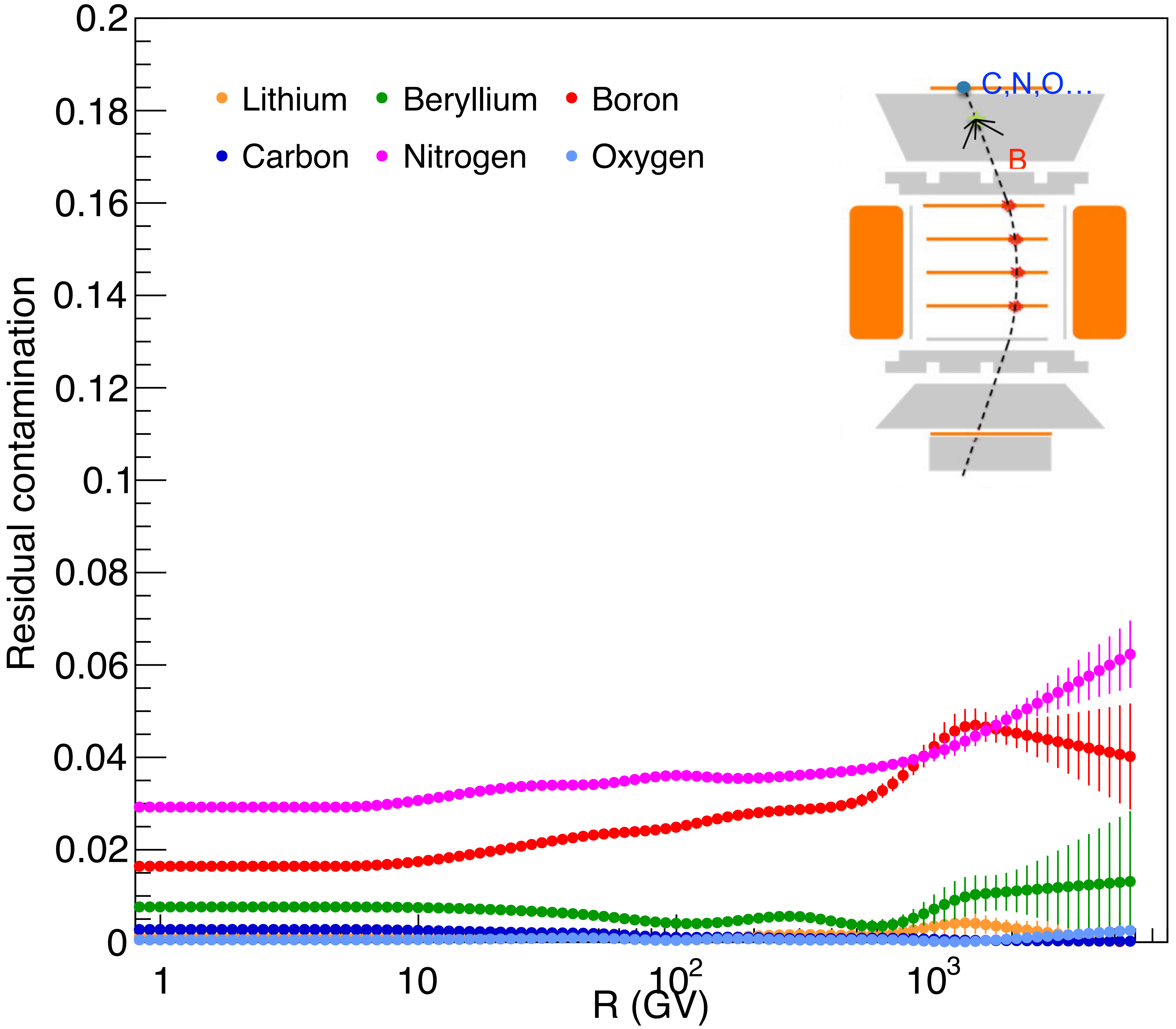
Efficiencies and Data/MC corrections obtained by using 11.5 years of Pass8 Data and MC B1236





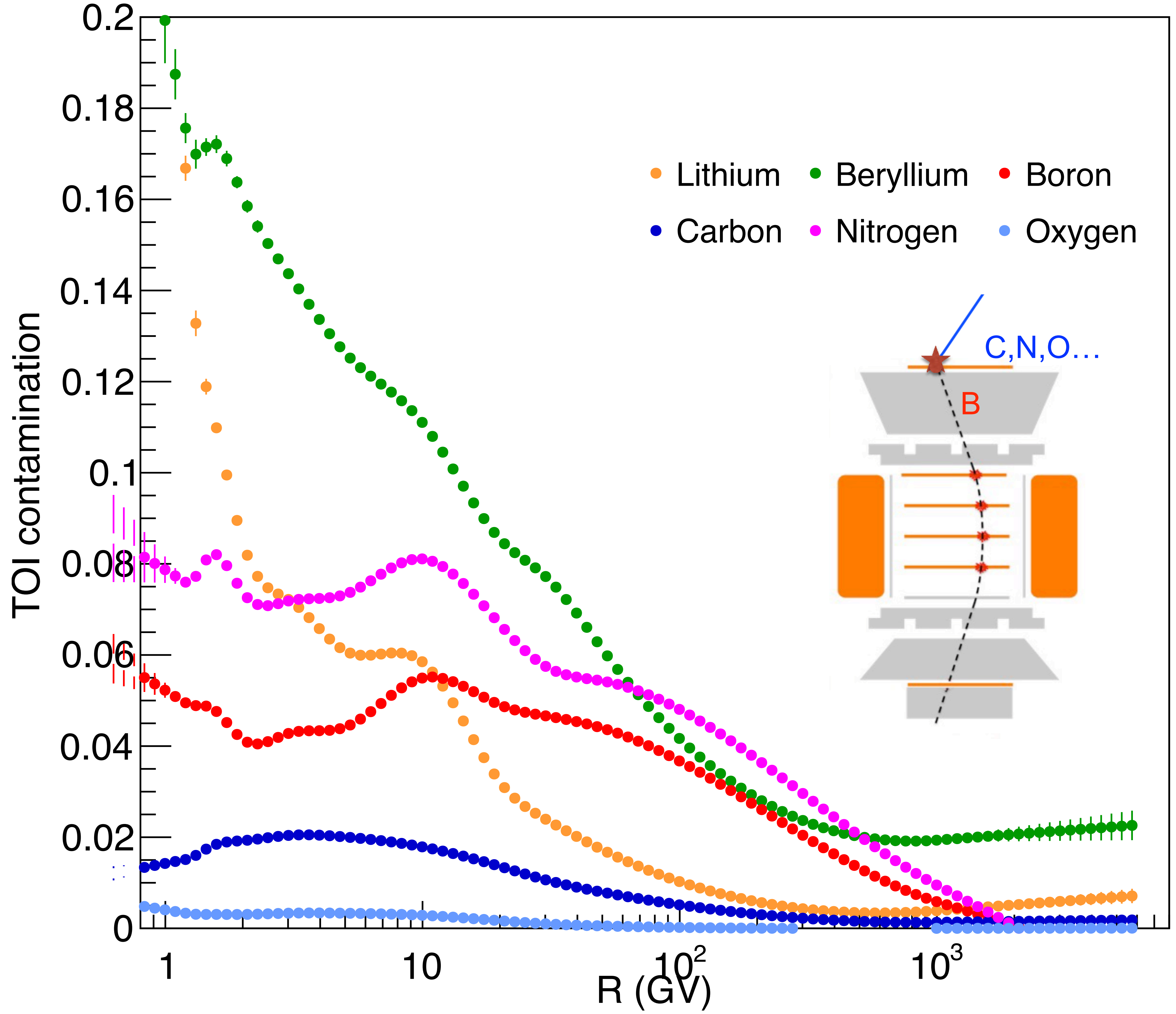
Nuclei Contamination

Contamination below L1 obtained fitting the L1 charge distribution and using L1 templates.

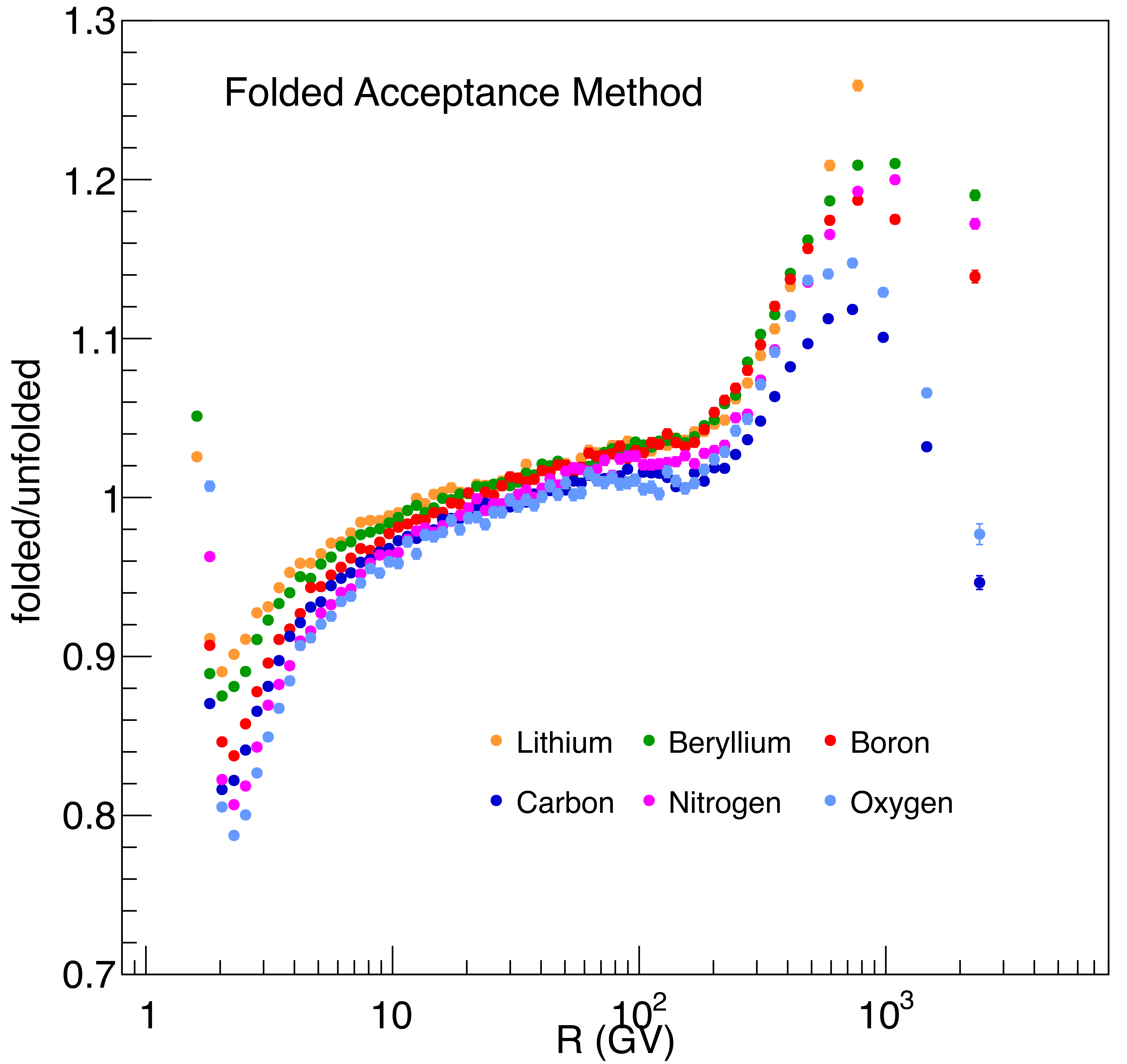


Contamination above L1 (TOI) evaluated from the expected number of events, where

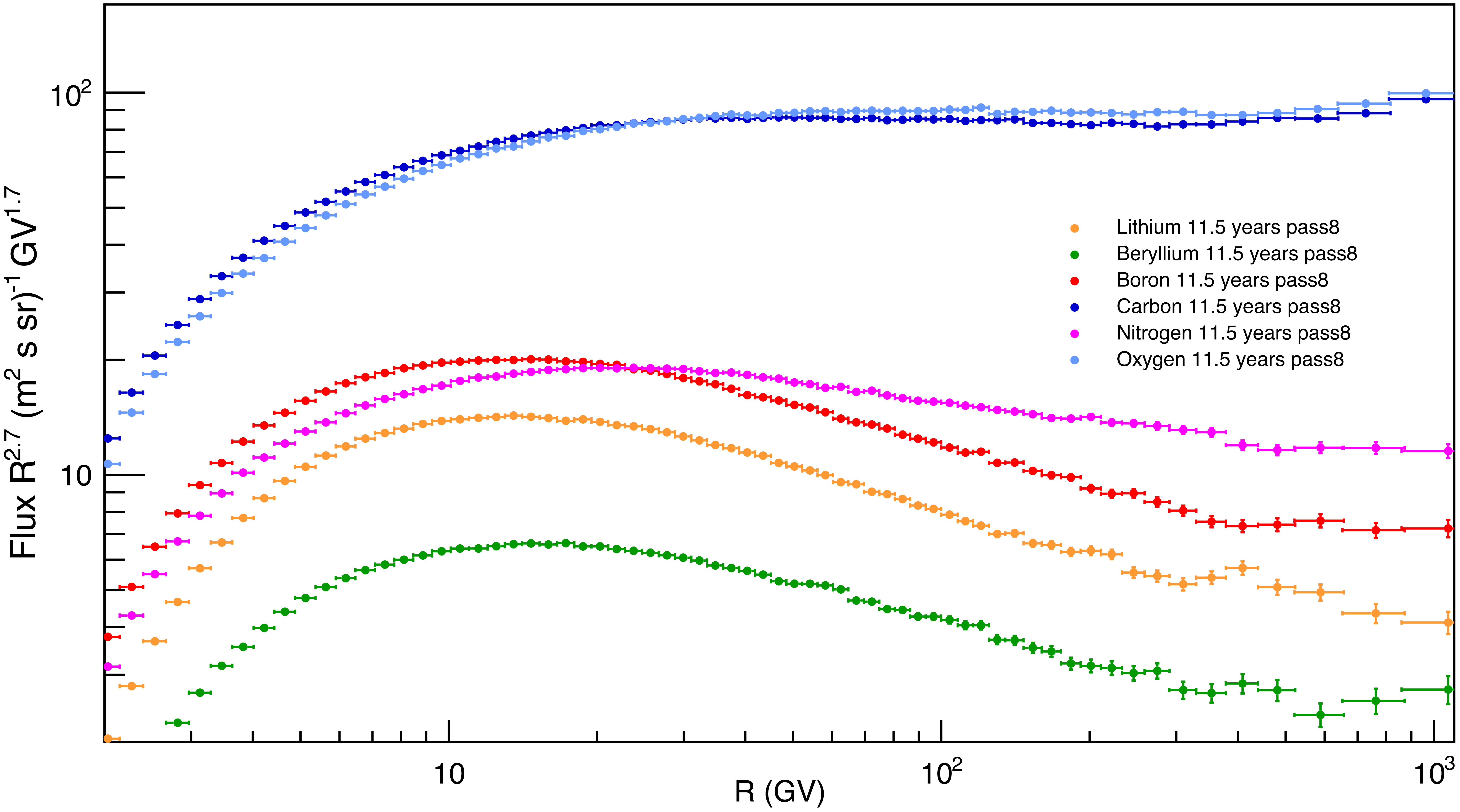
$$N_{i \longrightarrow j}(R) = \Phi_i(R) T(R) A_{i \longrightarrow j}(R) \Delta R$$



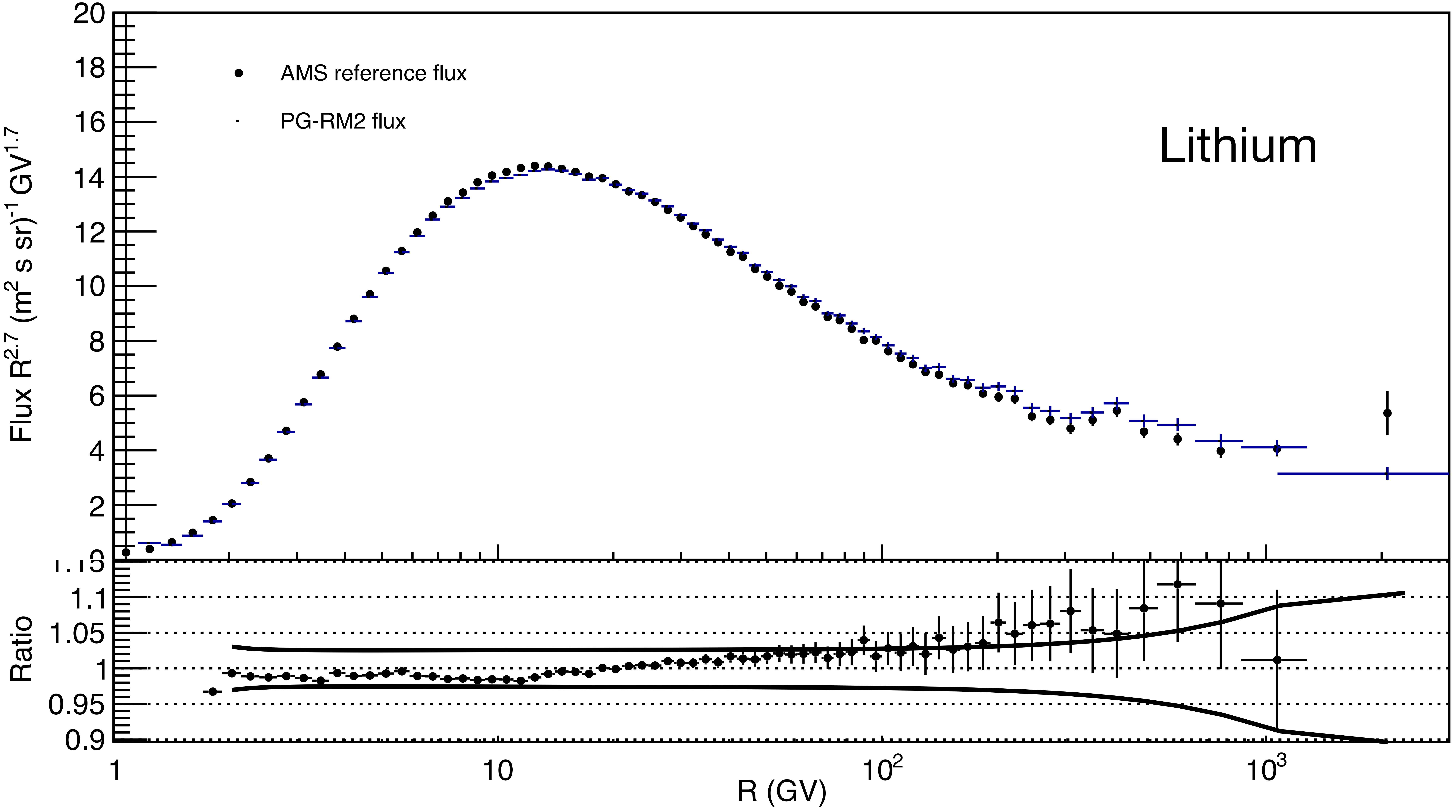
Nuclei Unfolding Factors



Integrated Nuclei Fluxes



Nuclei Fluxes comparison



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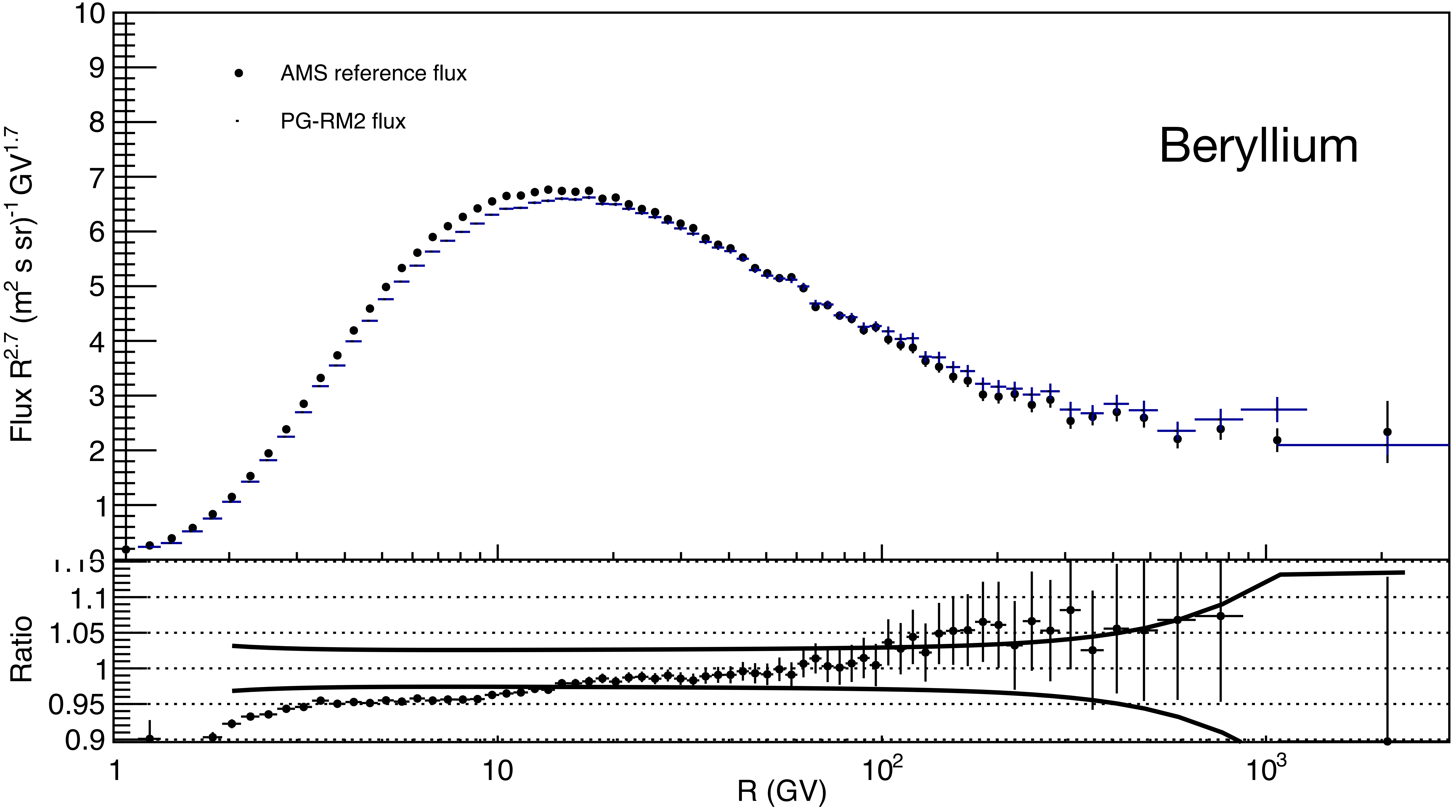

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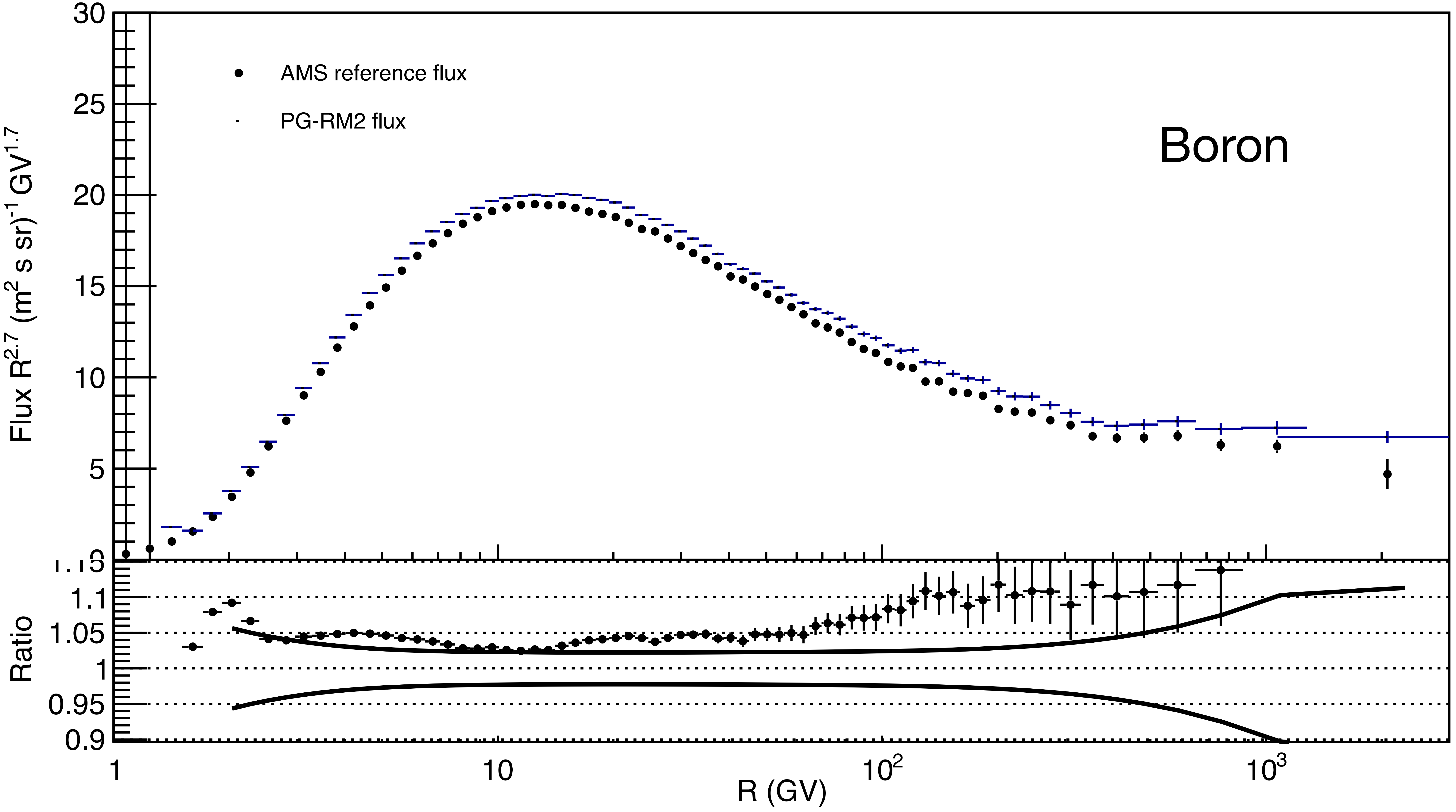

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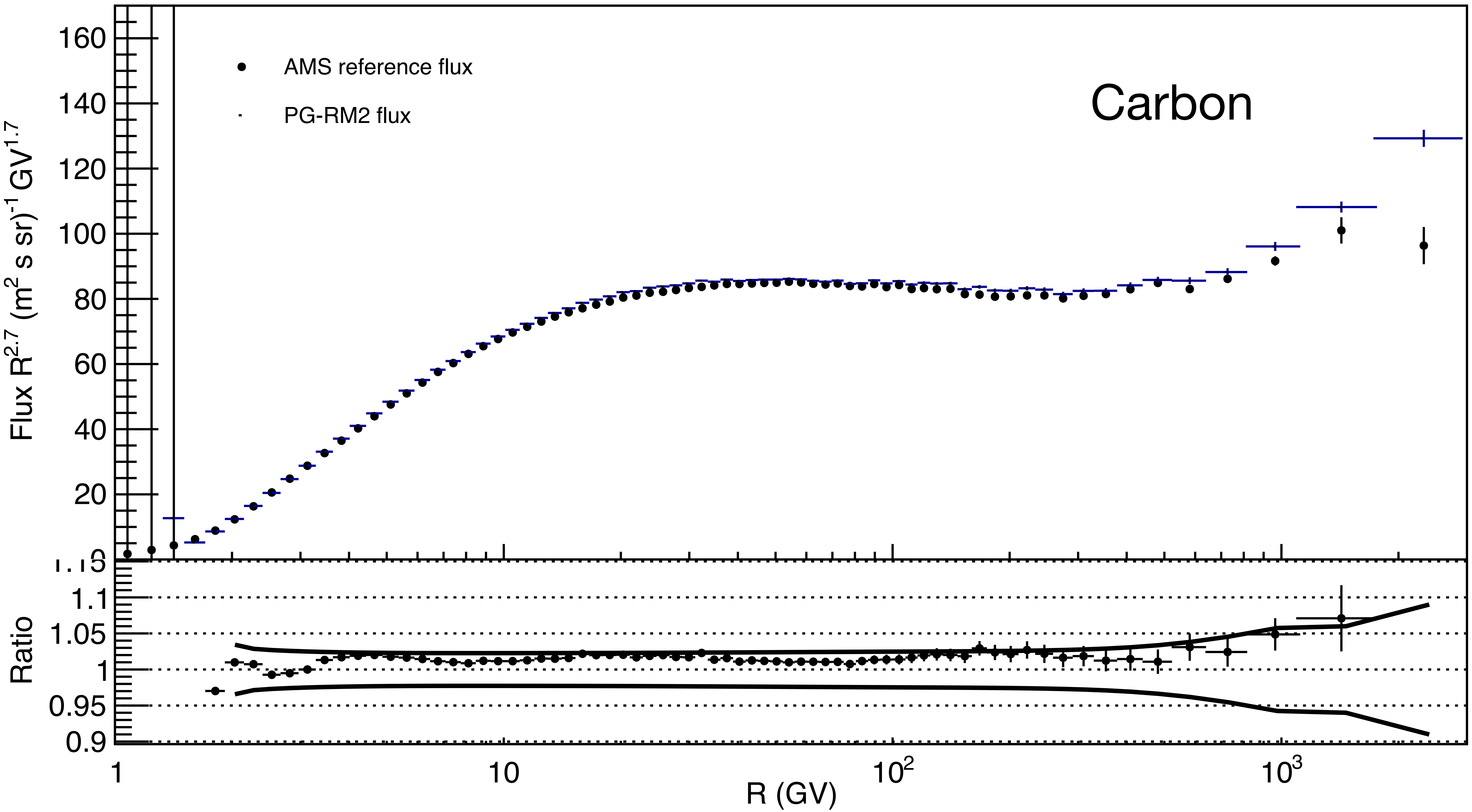

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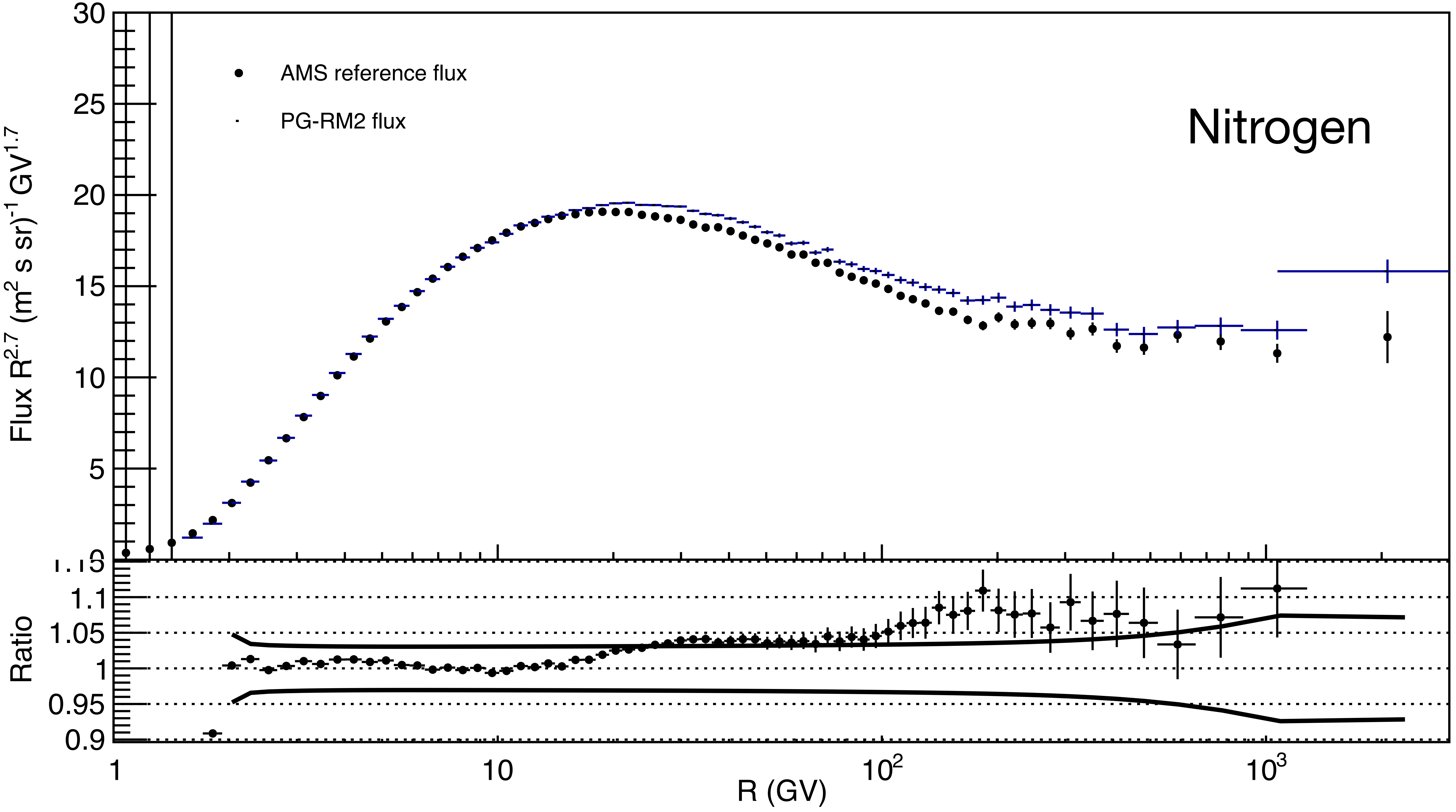

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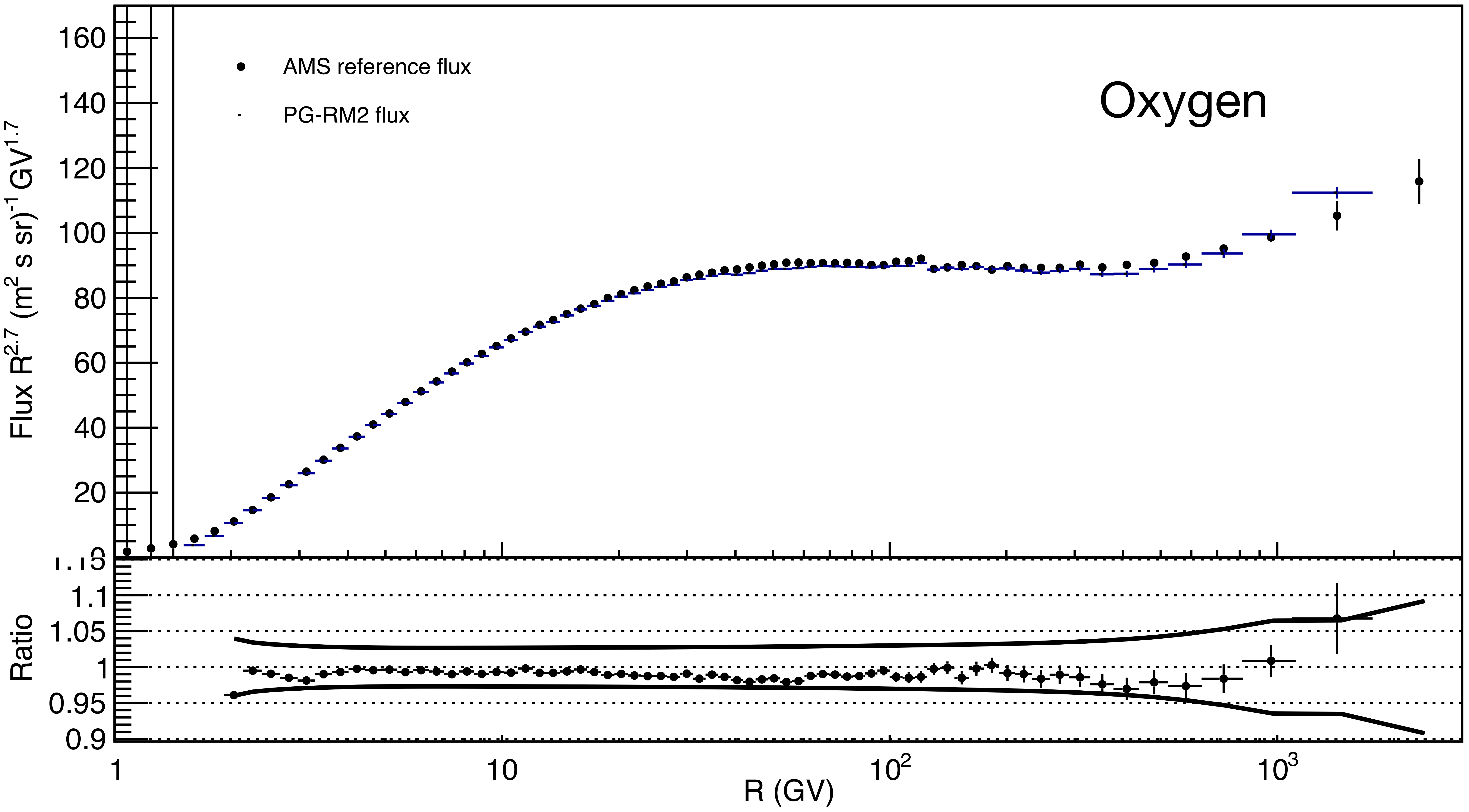


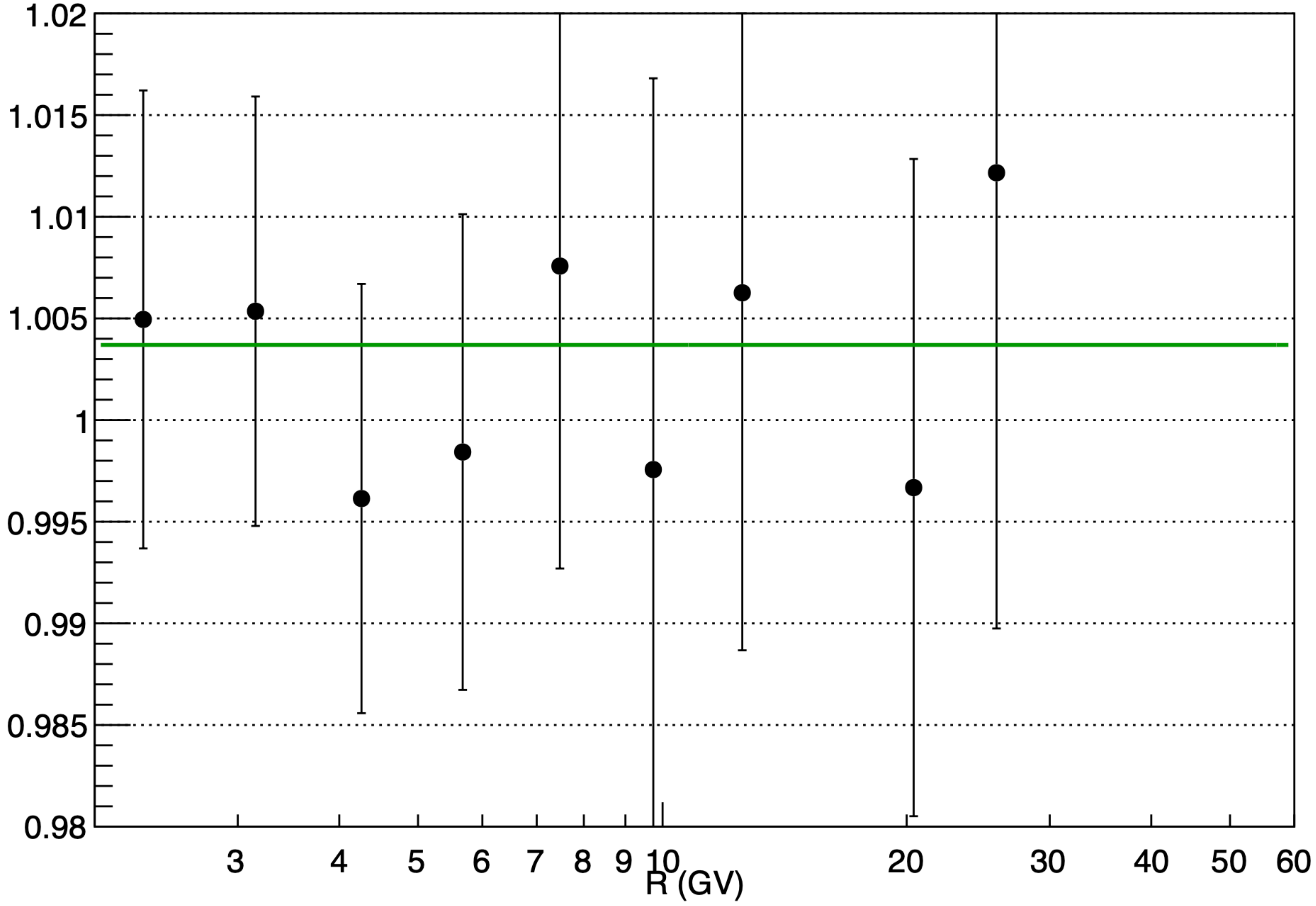
Time dependent Corrections procedure

Step1: evaluating in each BR the Amplitude of the Data/MC variation with respect the one in the overall period (11.5 years)

$$A^{\mathrm{BR}} = \frac{(\varepsilon_{\mathrm{Data}}/\varepsilon_{\mathrm{MC}})^{\mathrm{BR}}}{(\varepsilon_{\mathrm{Data}}/\varepsilon_{\mathrm{MC}})_{\text{All time}}}$$

Step2: building the Amplitude as a function of Time to obtain a time dependent correction $f_A(t)$

Step3: evaluating the correction for each BR starting from the integrated one



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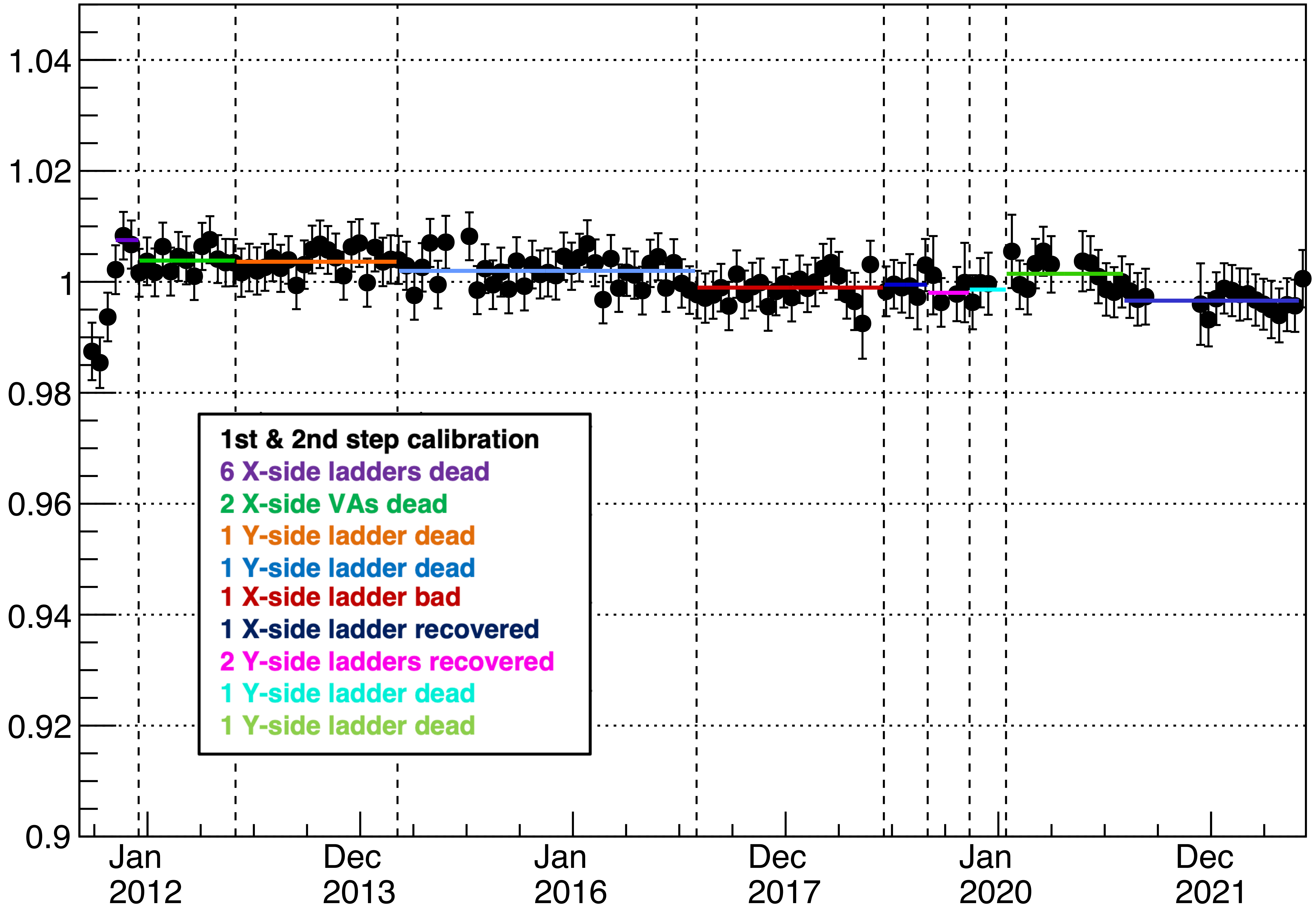

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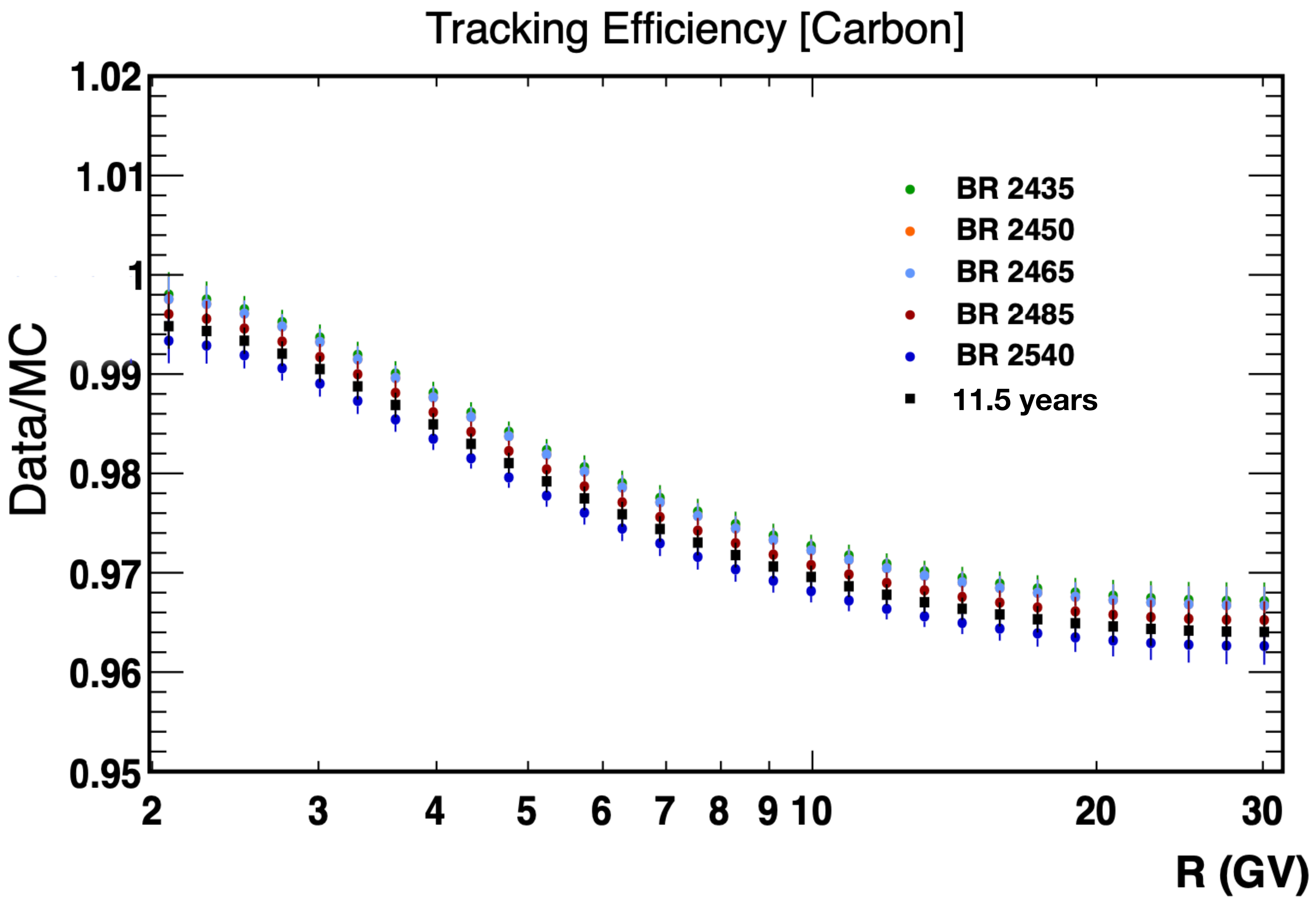
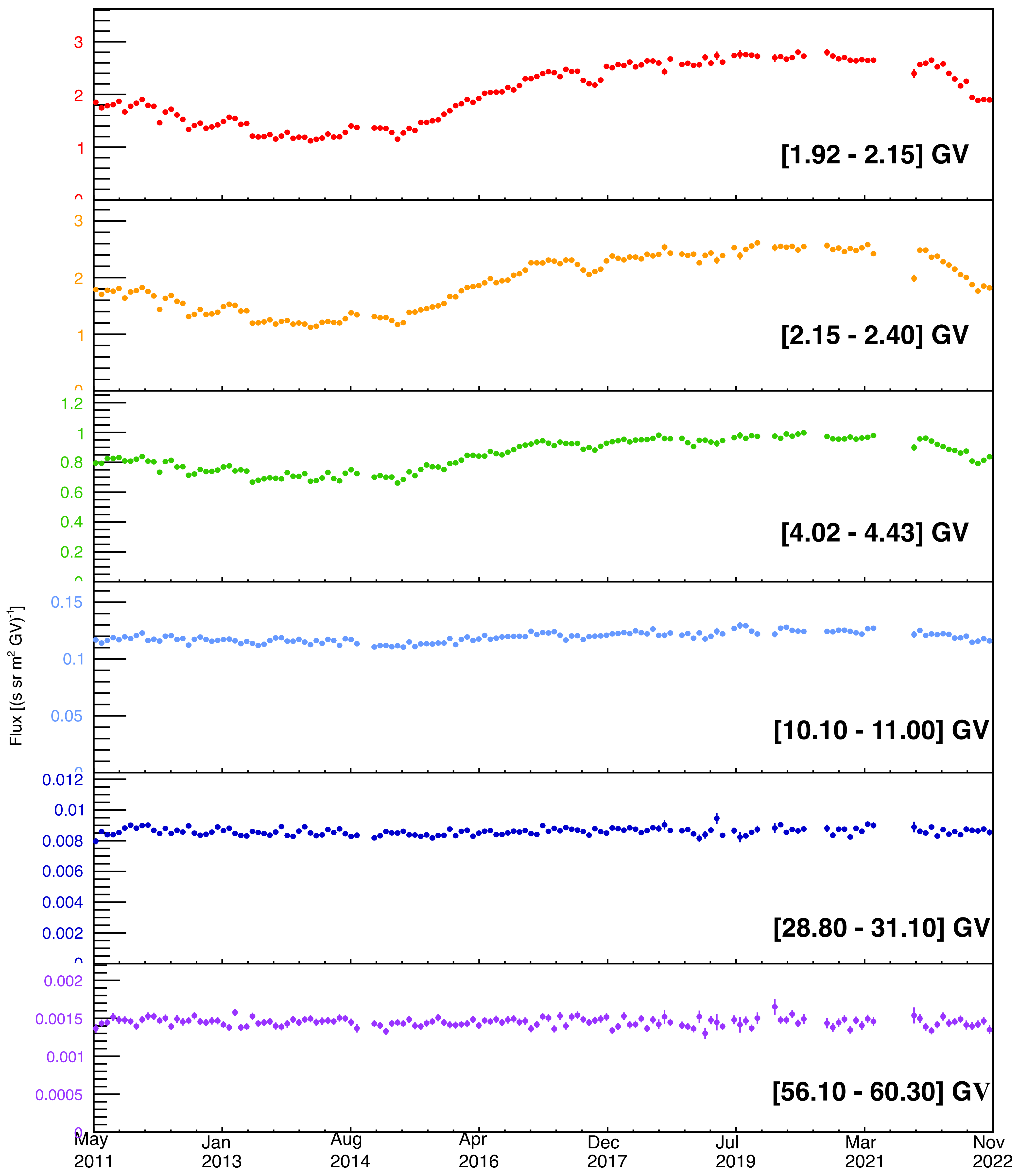


Monthly Nuclei Fluxes

$$\Phi_i^{BR} = \frac{N_i^{BR}}{A_i^{BR}\,\varepsilon_i^{BR}\,T_i^{BR}\,\Delta R_i}$$

Monthly nuclei fluxes exhibit long-term and short-term time variation

The amplitude of these variation decreases increasing the rigidity and become not observable after few tens of GV



Carbon

Conclusions

Nuclei integrated fluxes (Lithium to Oxygen) using 11.5 years pass8 data have been presented

- Nuclei fluxes generally in agreement with MIT 11.5 years fluxes
- Few issues are still under investigation: differences for Beryllium, Boron, and Nitrogen. (mainly for secondary nuclei).

Monthly Nuclei fluxes (Carbon) using 11.5 years pass8 data have been presented

- The flux shows a long-term and short-term time variation

TODO:

- Check Beryllium, Boron, Nitrogen integrated fluxes
- Monthly Nuclei fluxes for other nuclei
- Systematics error evaluation