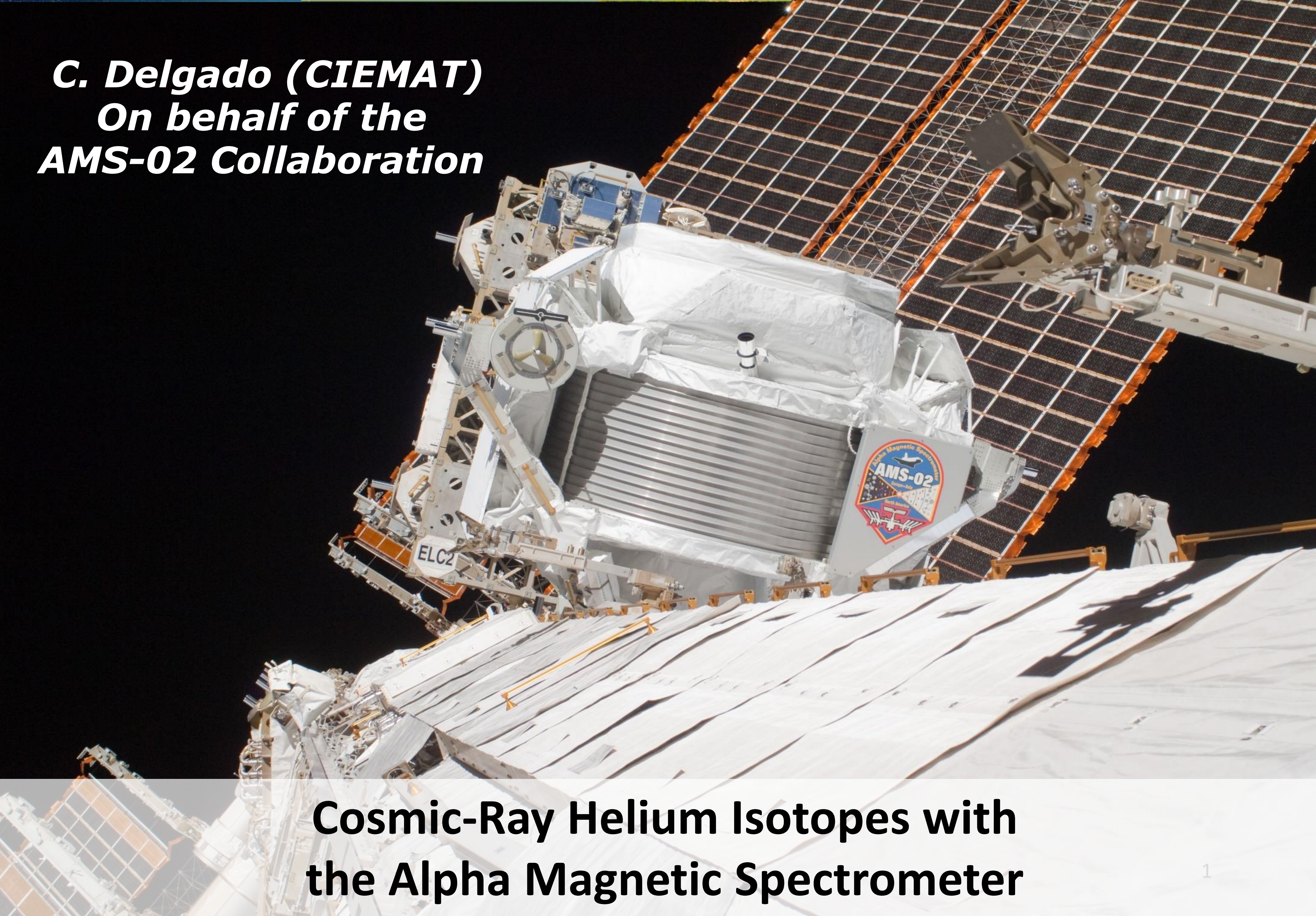
C. Delgado (CIEMAT)
On behalf of the
AMS-02 Collaboration



Cosmic-Ray Helium Isotopes with the Alpha Magnetic Spectrometer

Helium Isotopes in Cosmic Rays

Helium are the second most abundant nuclei in cosmic rays, consisting of the two isotopes, ^{4}He and ^{3}He.

The ^{4}He is thought to be mainly produced and accelerated in astrophysical sources.

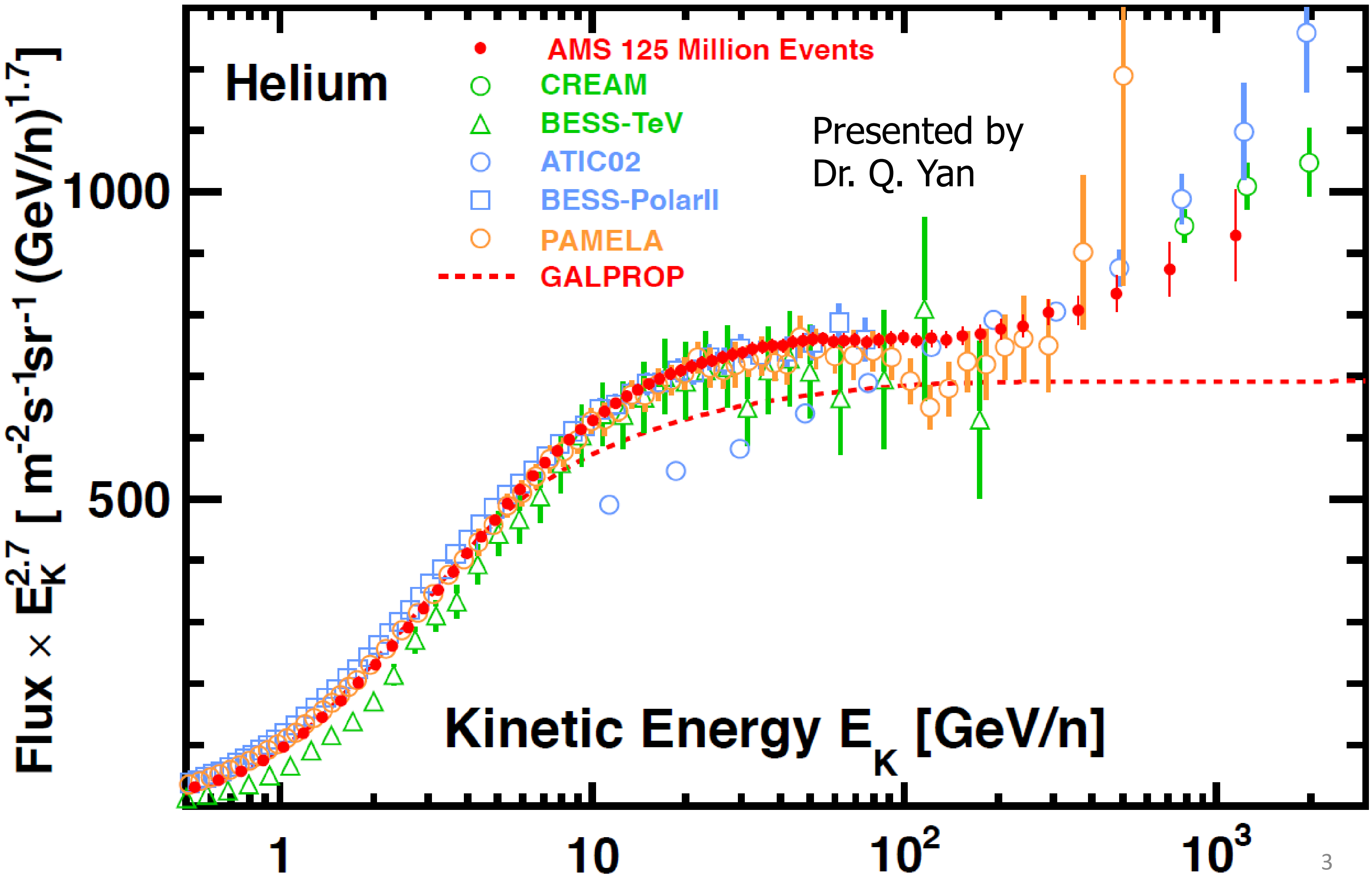
^{3}He is produced by the fragmentation of nuclei in the interstellar medium.

^{3}He is mostly produced by the fragmentation of ^{4}He, allowing a simpler comparison with propagation models than with heavier secondary to primary nuclei ratios.

The small cross section of He with respect to heavier nuclei, allows ^{3}He/^{4}He to probe the properties of diffusion at larger distances than any secondary to primary ratio.

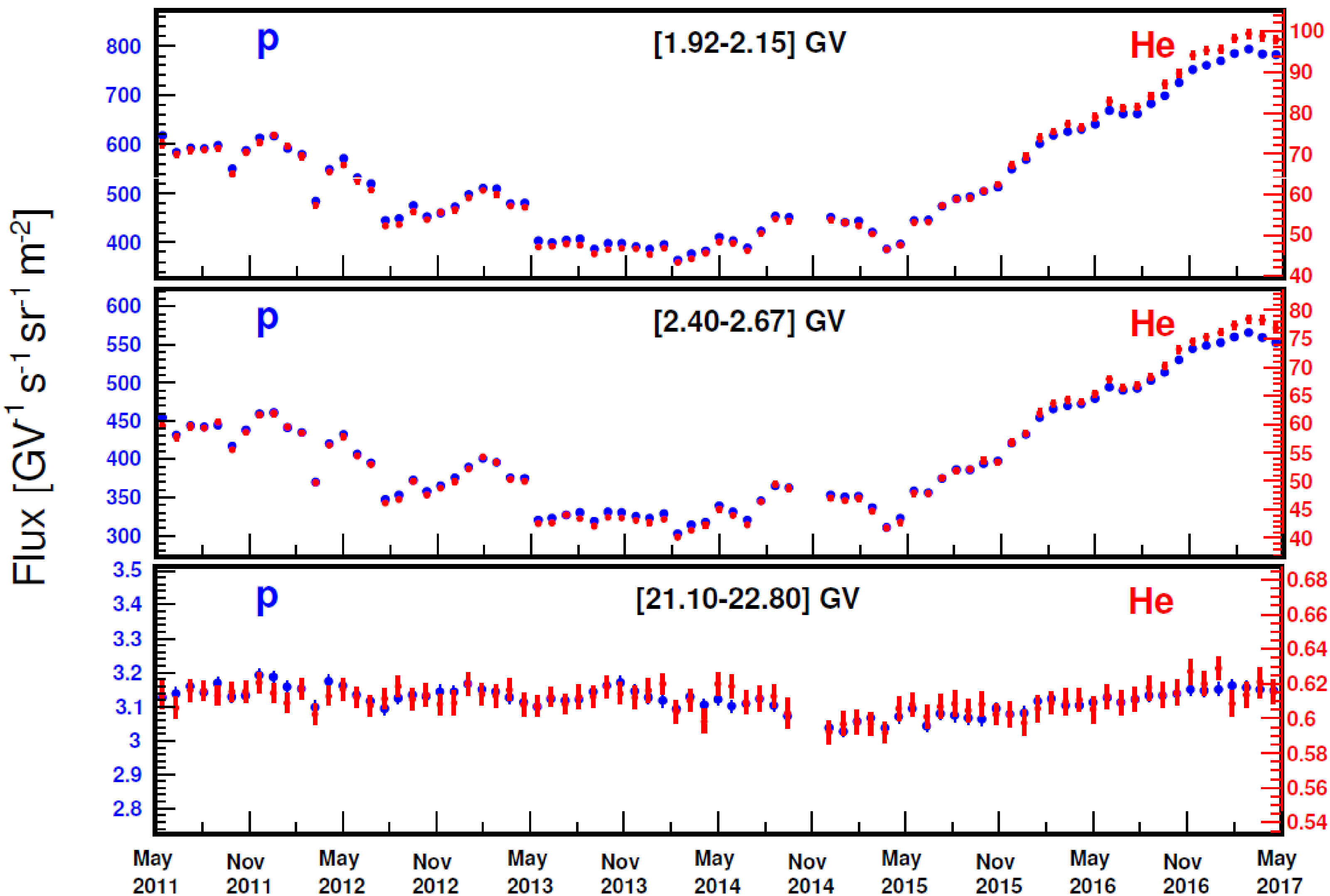
Properties of Cosmic Helium

Helium Flux Measurement



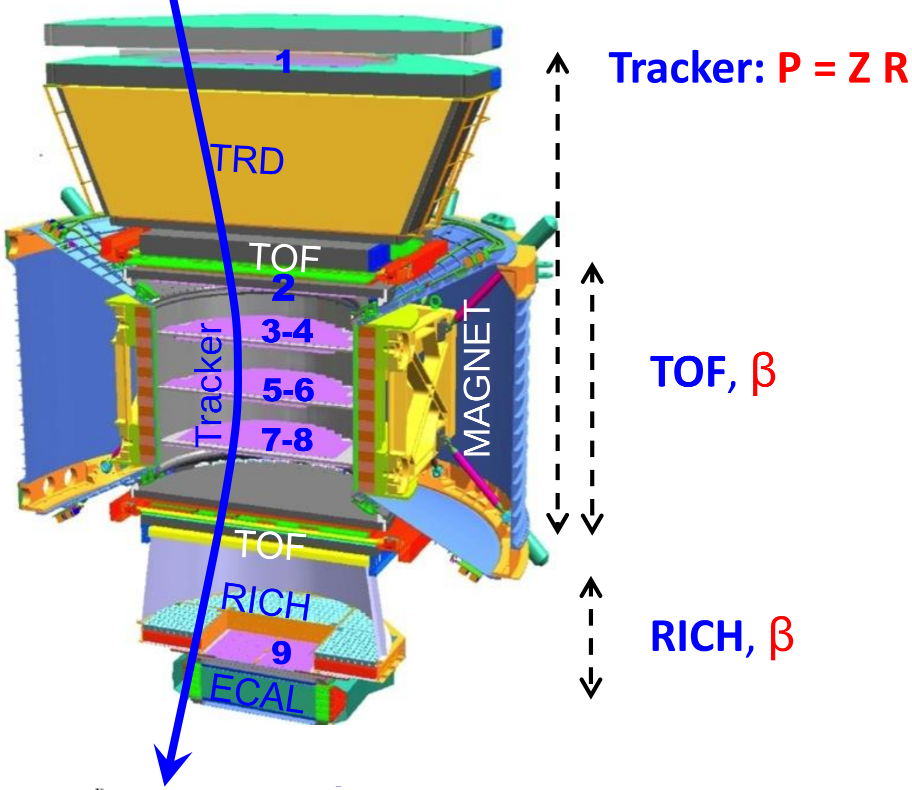
Properties of Cosmic Helium

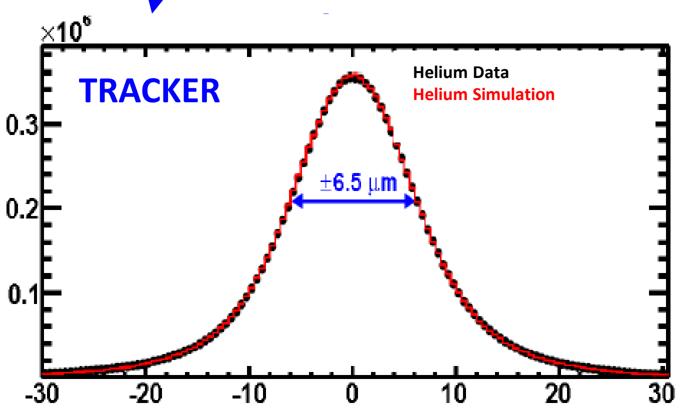
Proton and helium fluxes as function of time.

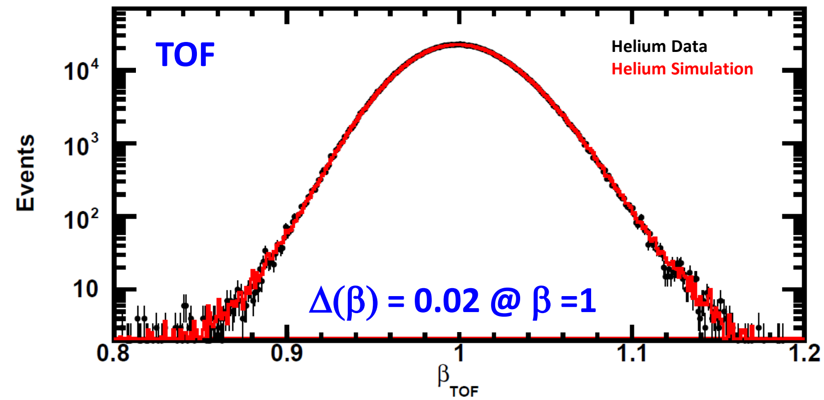


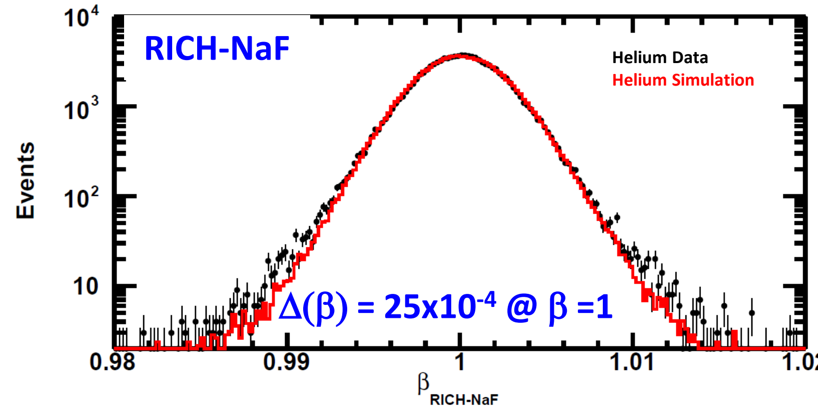
Helium Isotopes identification in AMS

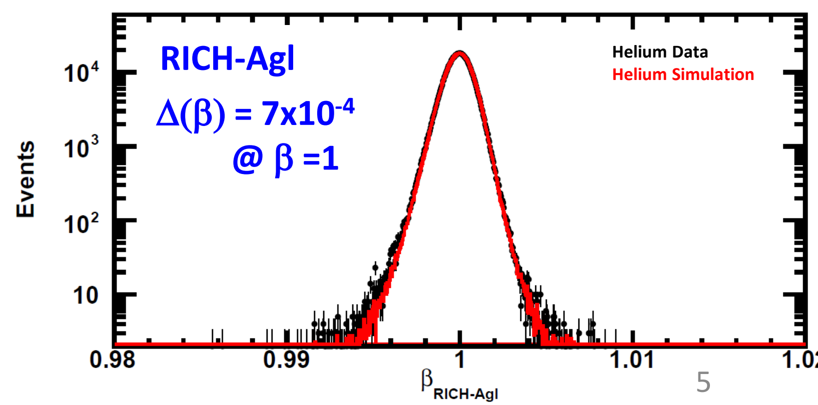
Z = 2









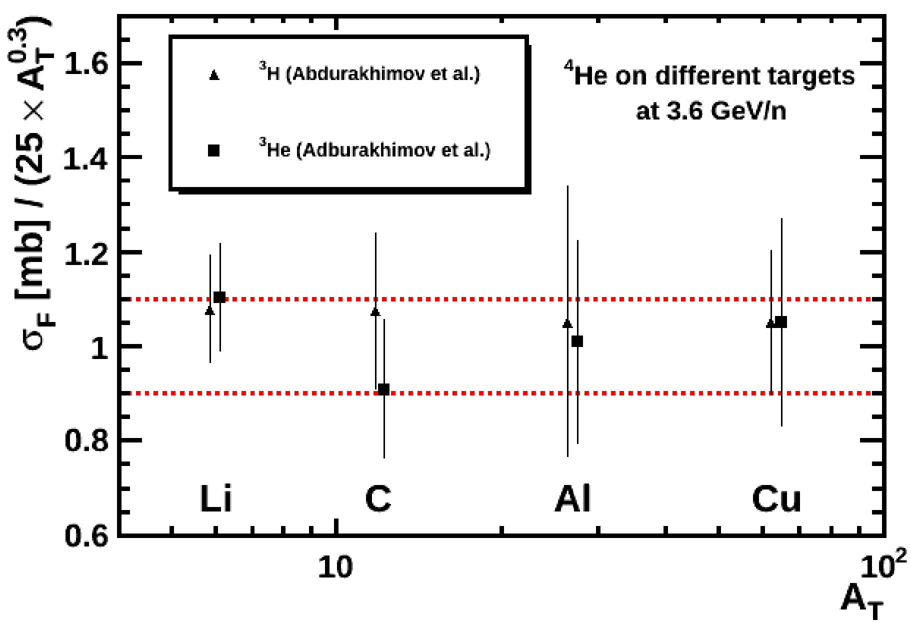


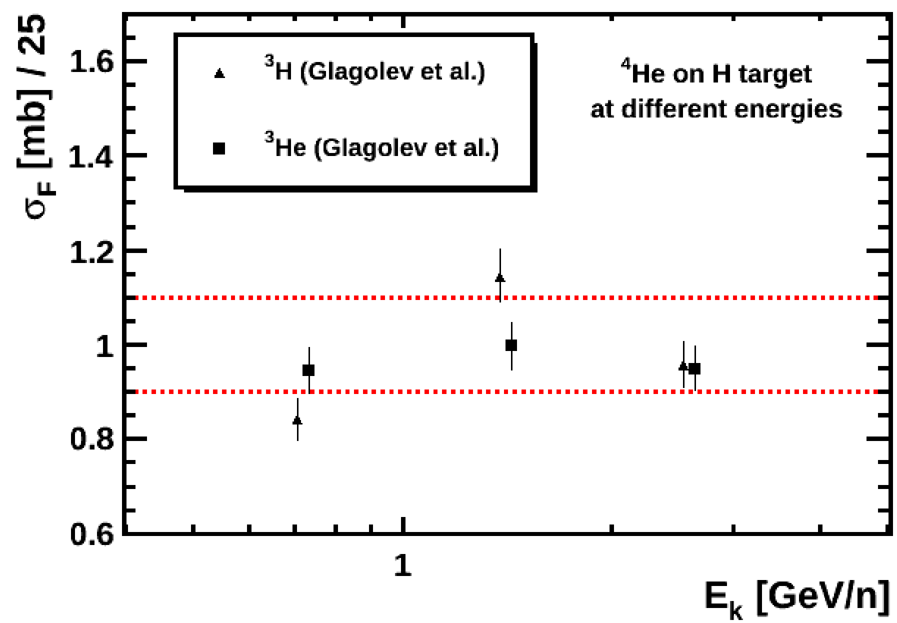
^{3}He contamination from ^{4}He→^{3}He Fragmentation

The ^{4}He → ^{3}He fragmentation is determined from the ^{4}He → ^{3}H direct measurement within AMS

^{4}He Fragmentation Cross Sections

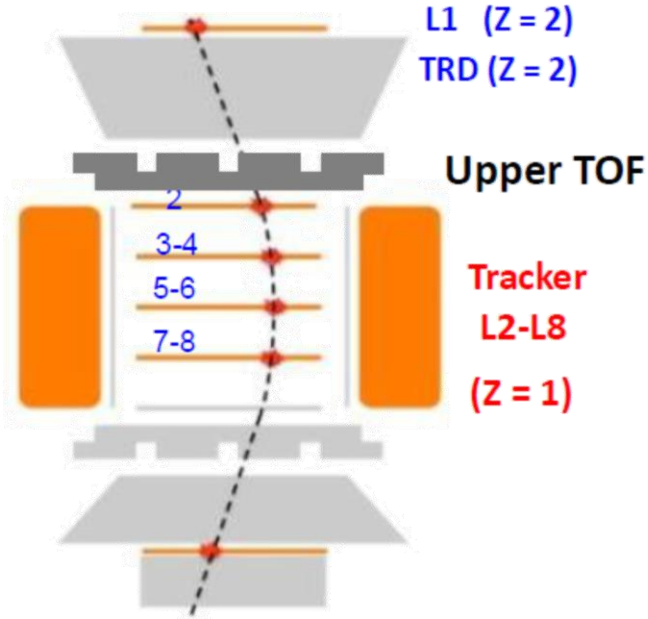
- ^{3}He and ^{3}H production cross sections in ^{4}He interactions are expected to be similar and constant above ~0.2 GeV/n

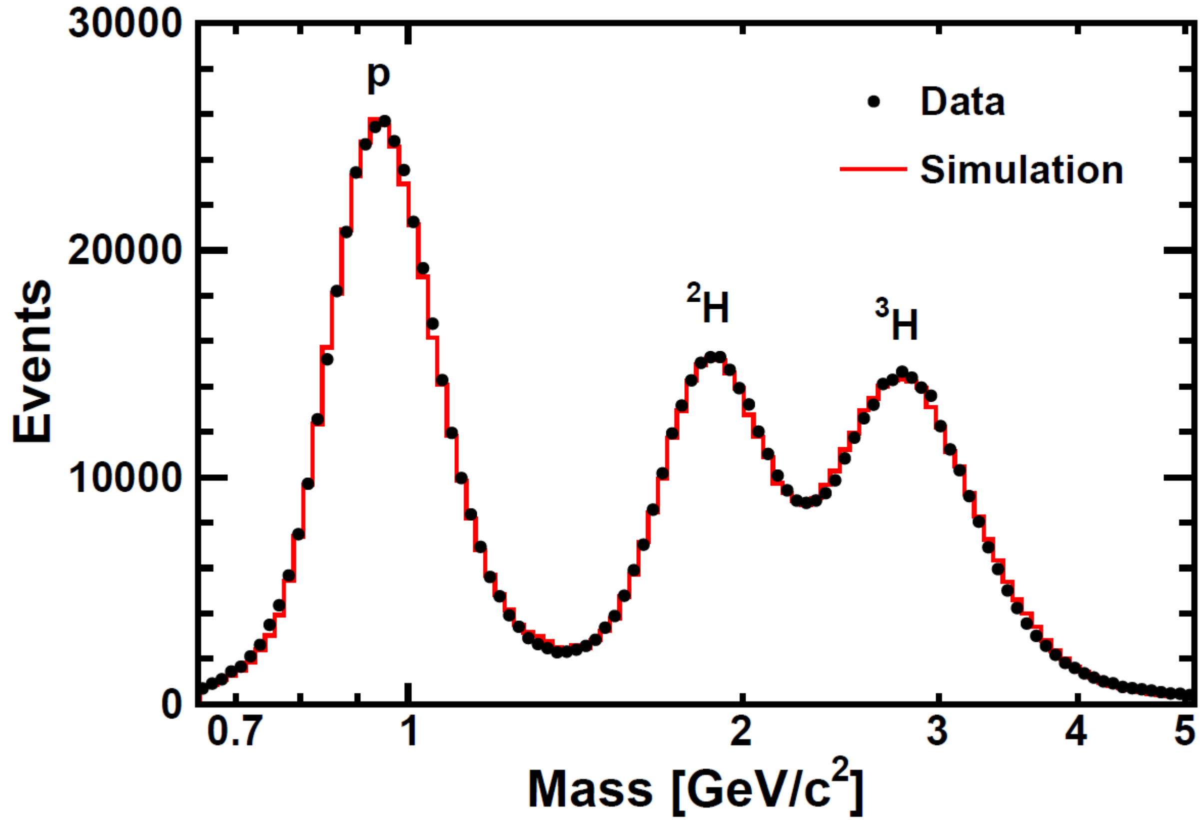




^{3}He contamination from ^{4}He$\rightarrow$^{3}He Fragmentation

He $\rightarrow$ p, ^{2}H, ^{3}H direct measurement within AMS





Helium Isotopes measurement

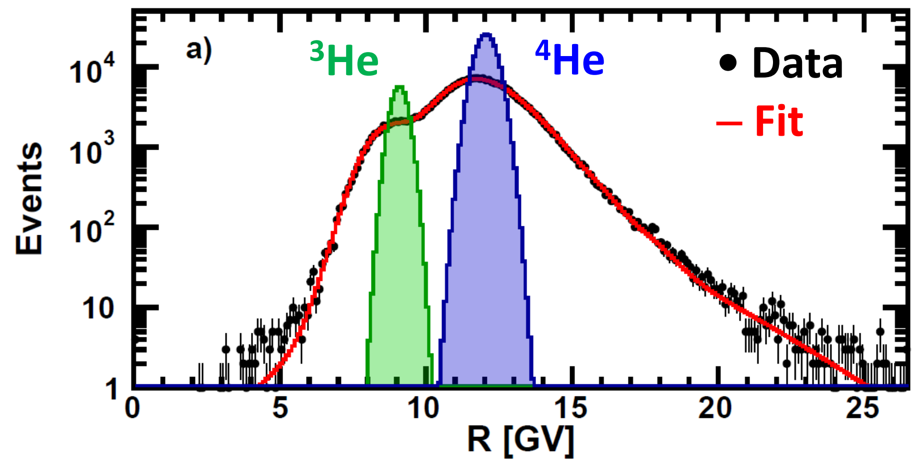
Select data for fine bins on β

Unfold the Rigidity distribution using the Tracker Resolution Function to obtain the ^{3}He and ^{4}He on top of AMS

Fit the data with the folded-back result

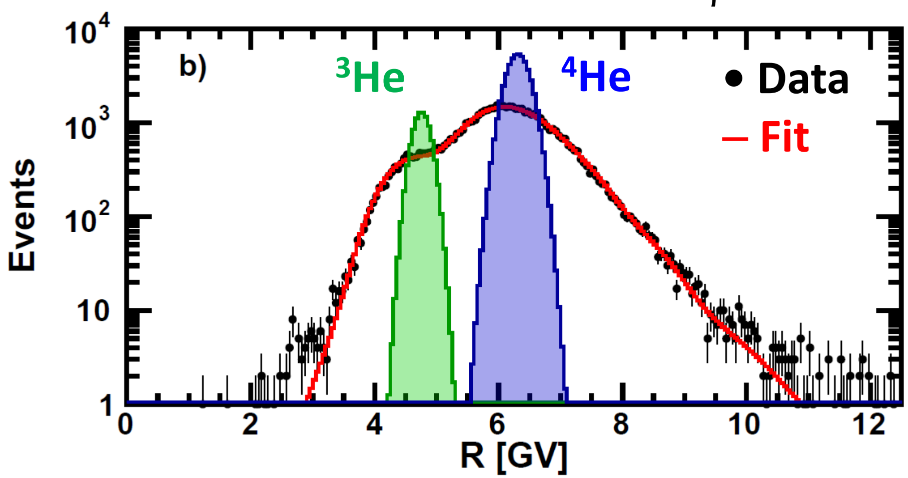
RICH-AgI

$0.9863 < \beta < 0.9864$



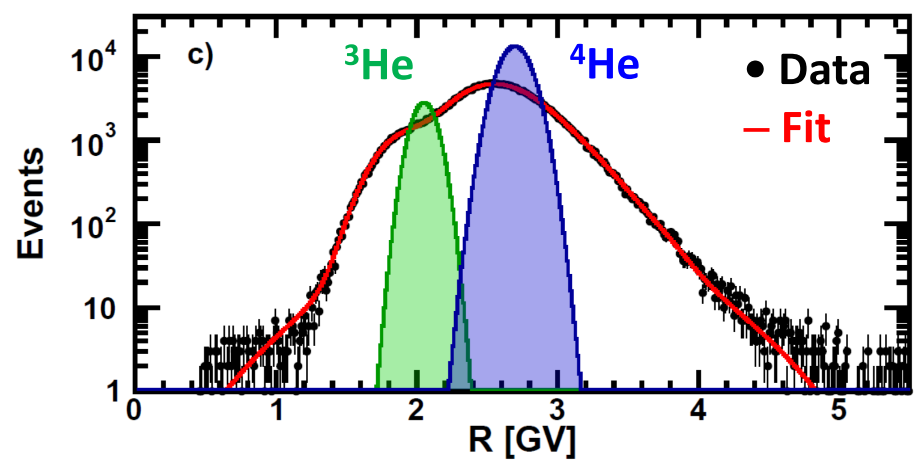
RICH-NaF

$0.9532 < \beta < 0.9537$



TOF

$0.8149 < \beta < 0.8160$



Helium Isotopes measurement

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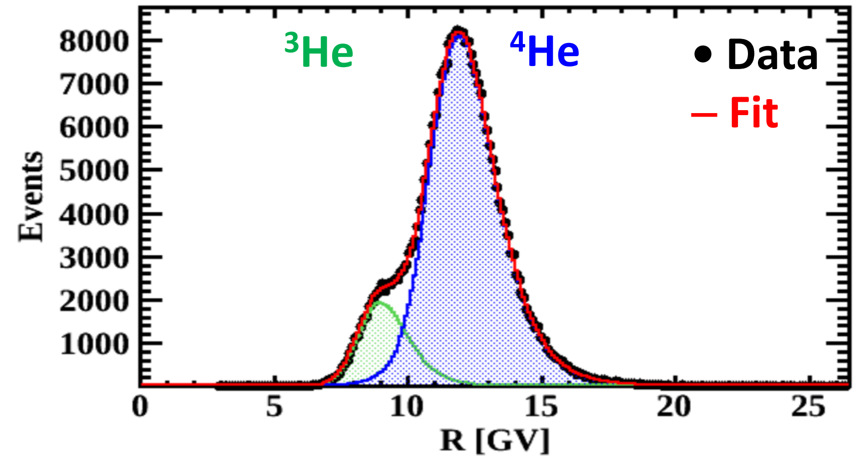

RICH-NaF

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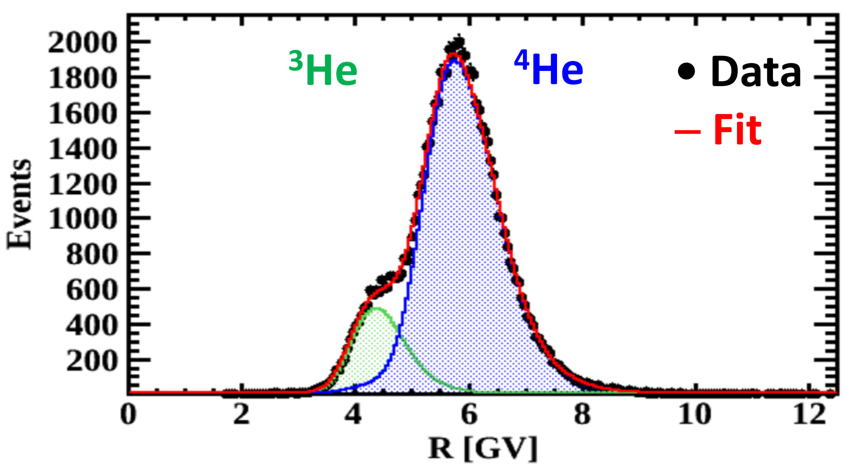

TOF

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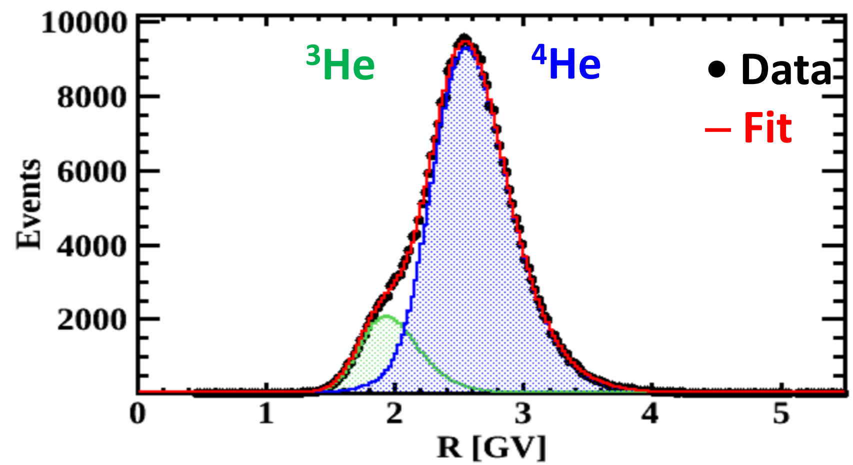
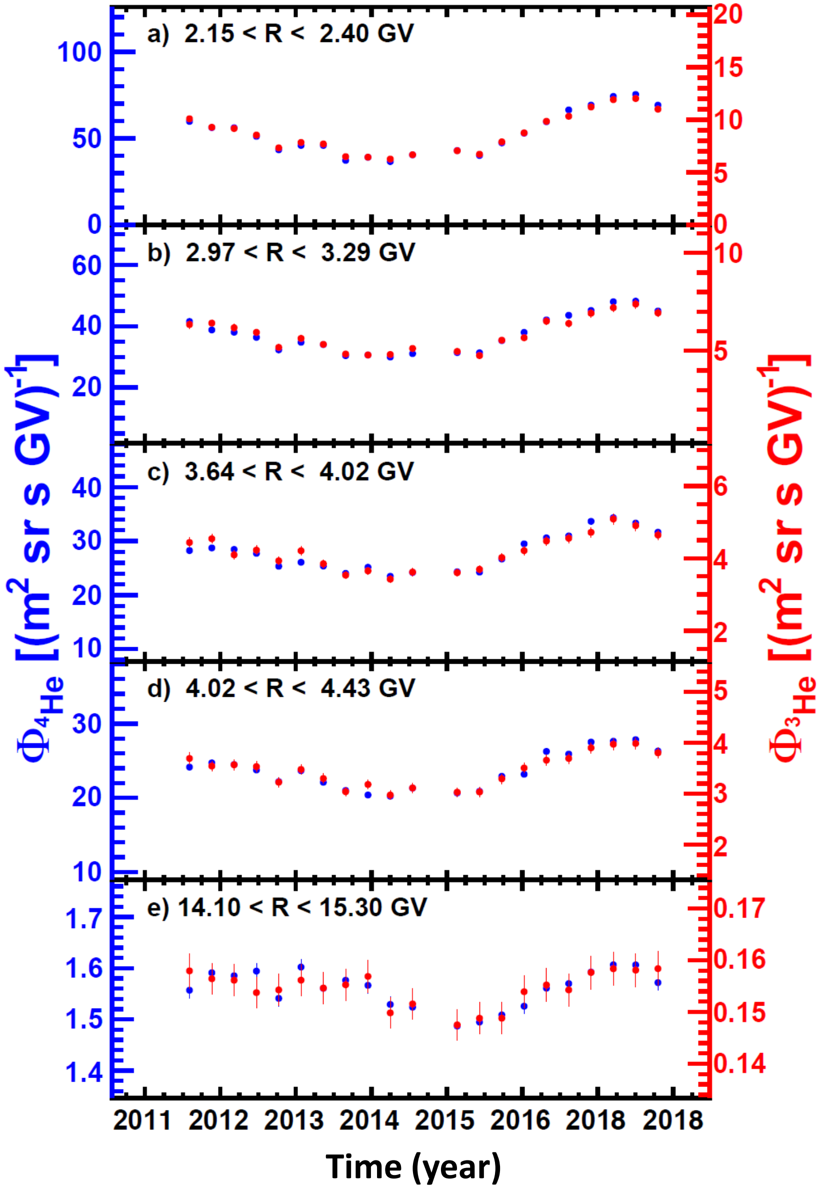
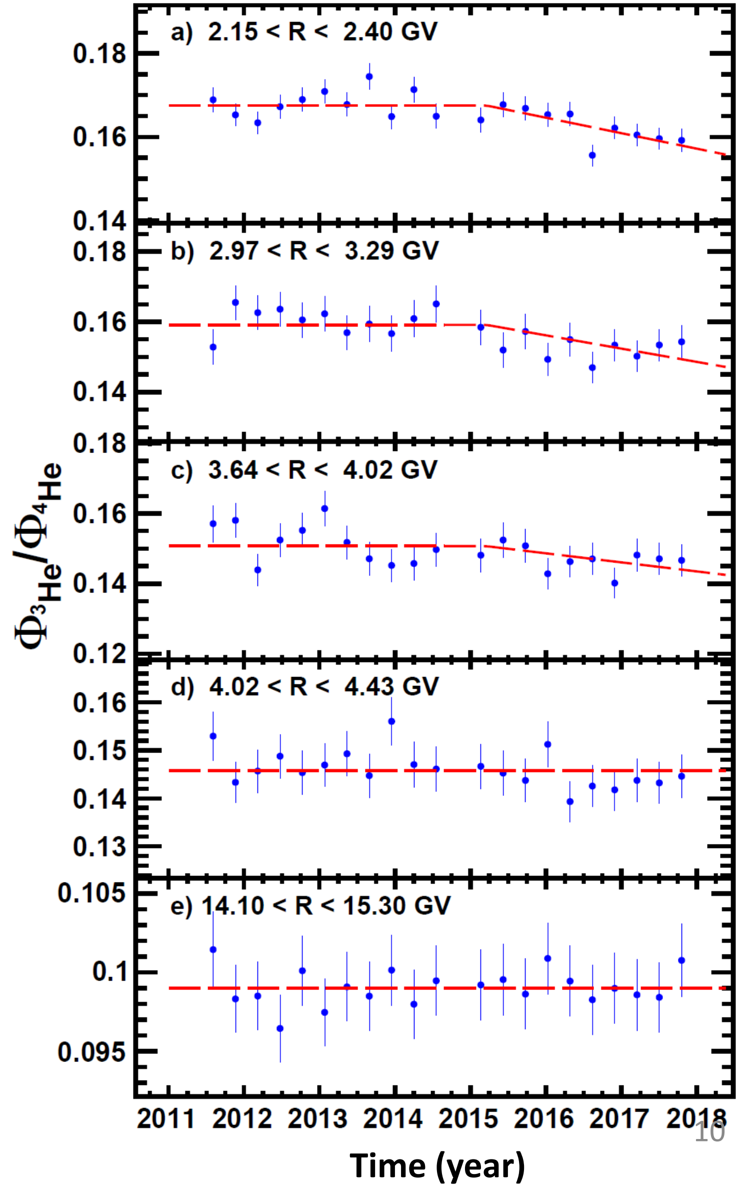


AMS ^3He and ^4He fluxes

Data collected from May 2011 to Nov 2017 (6.5 y)

Measurements in 21 time periods of 4 Bartels rotations (108 days) each



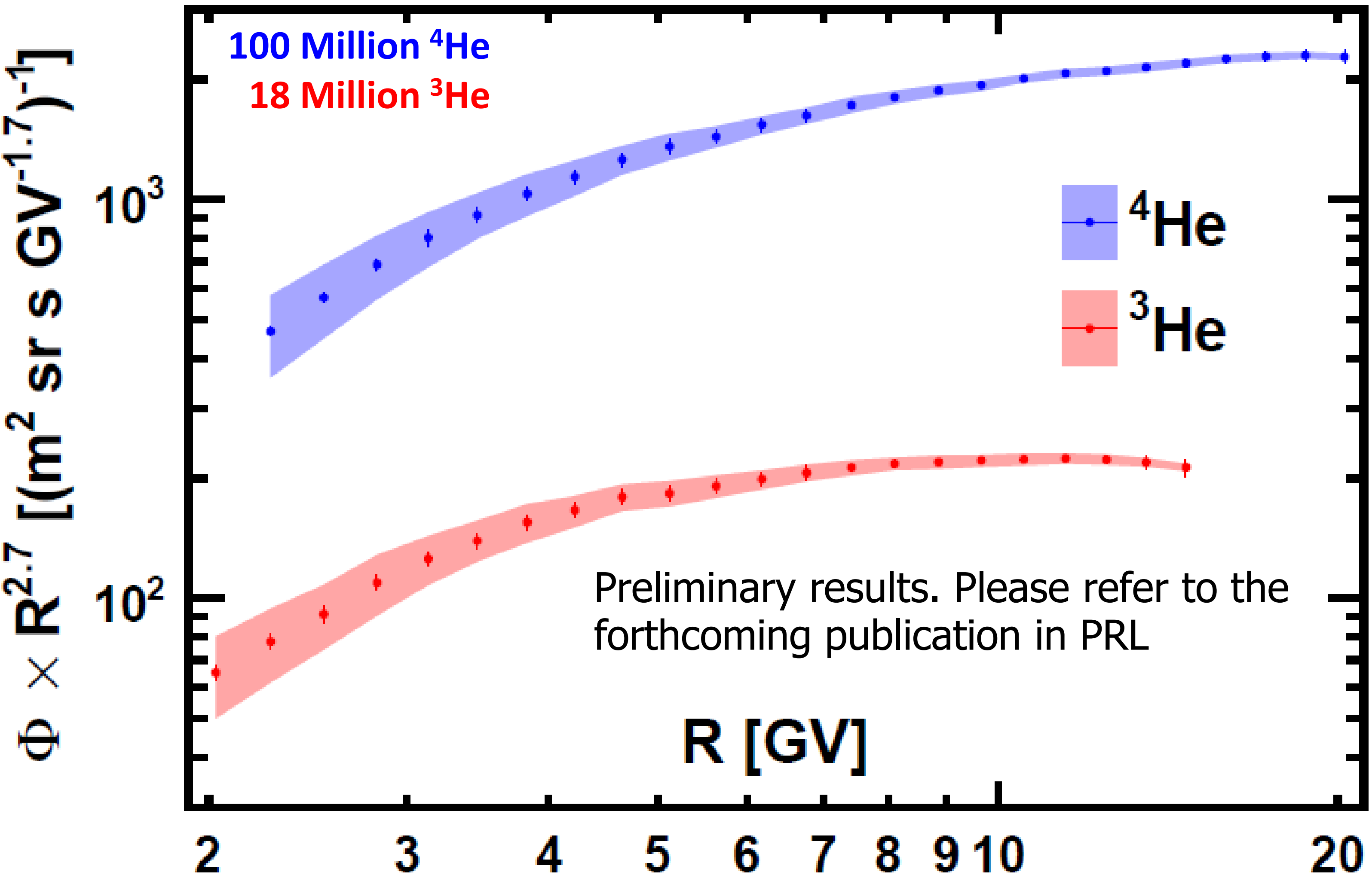


AMS ^{3}He and ^{4}He fluxes

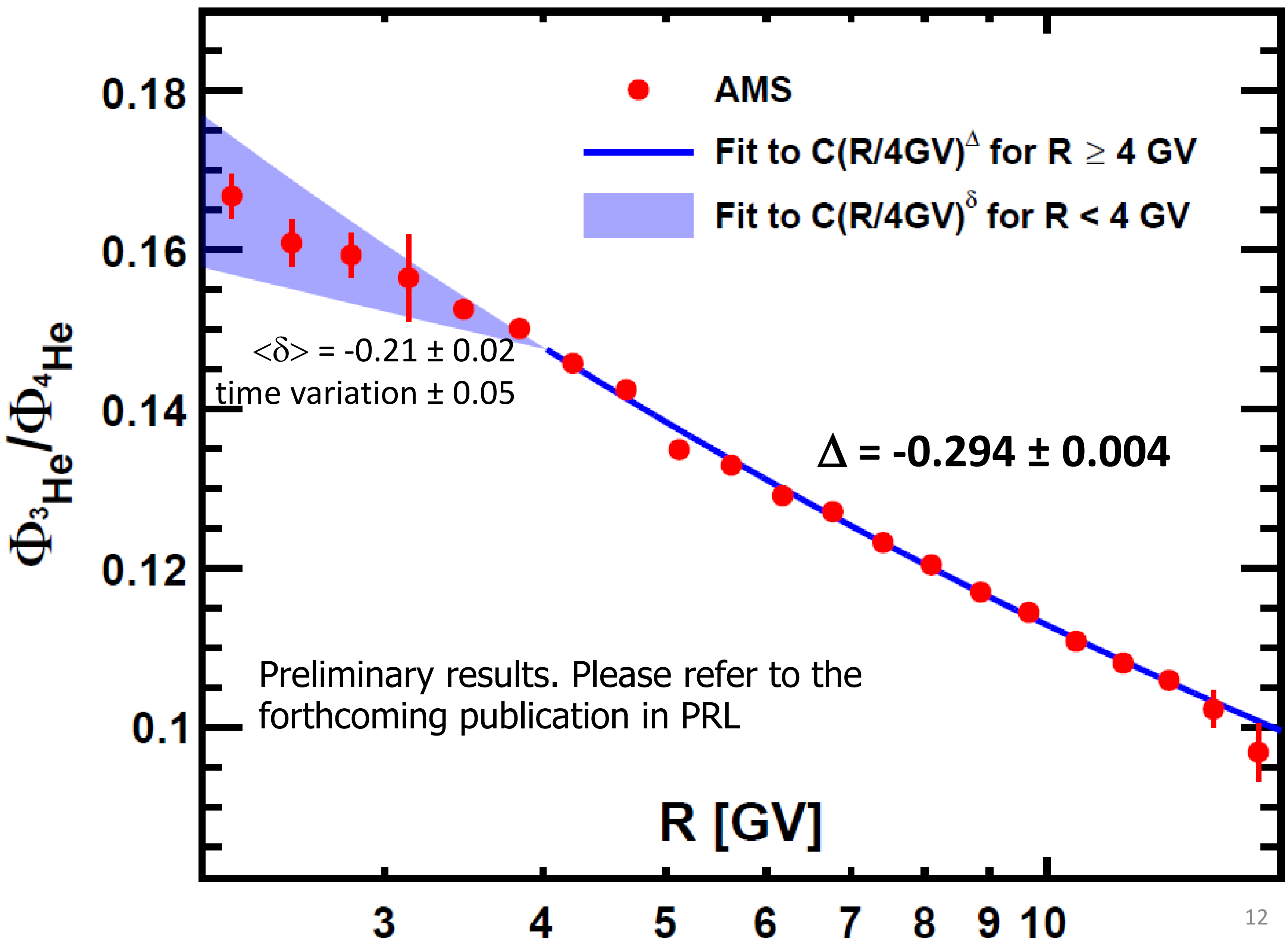
Data collected from May 2011 to Nov 2017 (6.5 y)

^{3}He: 1.9 – 15 GV

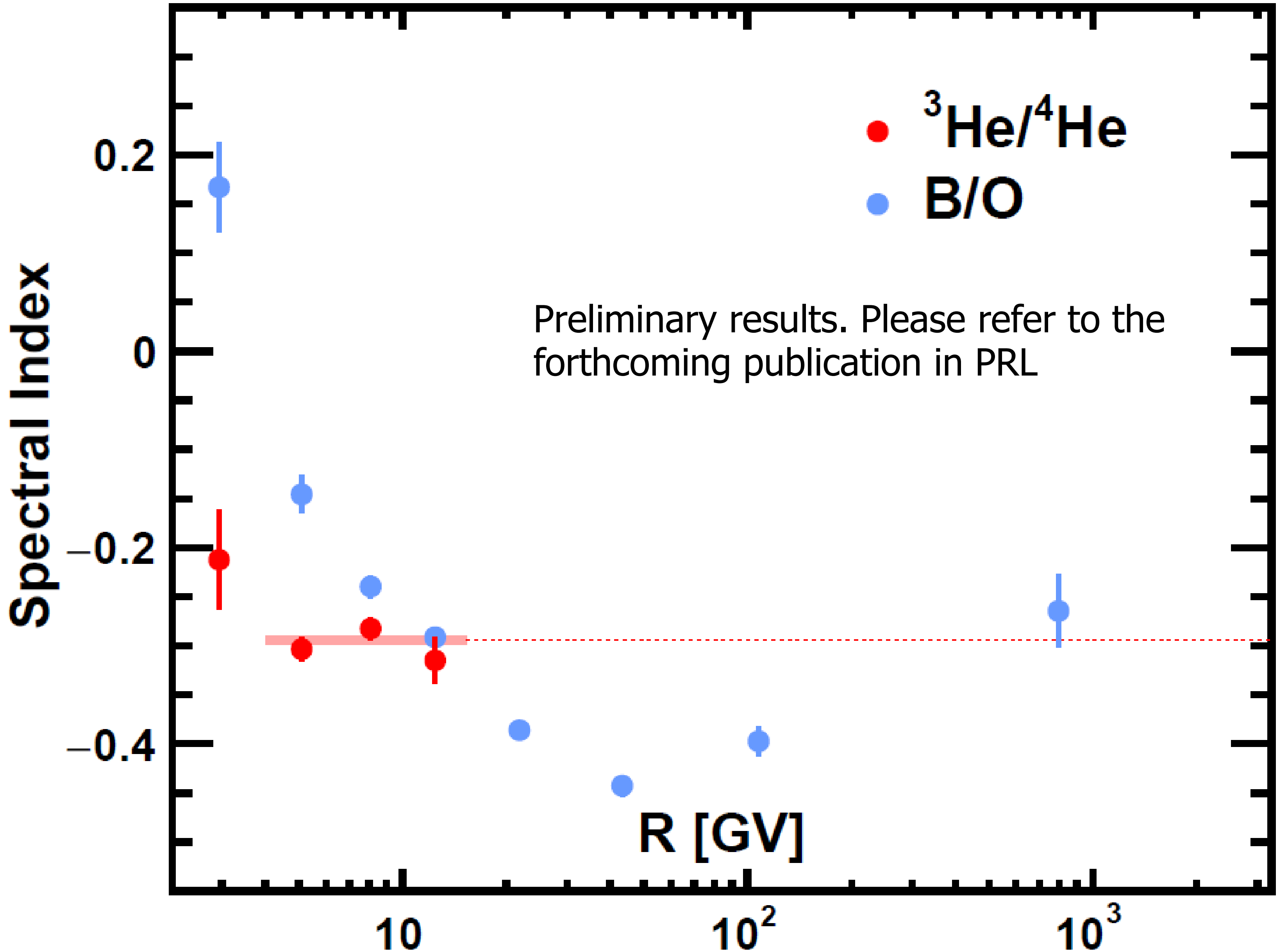
^{4}He: 2.1 – 21 GV



AMS $^3He/^4He$ flux ratio



AMS $^3He/^4He$ Spectral Index



SUMMARY

AMS has performed a precision measurements of the cosmic-ray ^{3}He and ^{4}He isotope fluxes and their ratio with rigidity from 1.9 GV to 15 GV for ^{3}He, from 2.1 GV to 21 GV for ^{4}He and from 2.1 GV to 15 GV for ^{3}He/^{4}He, based on 100 million ^{4}He and 18 million ^{3}He nuclei.

Below 4 GV the ^{3}He/^{4}He flux ratio shows a long-term time dependence.

^{3}He/^{4}He flux ratio was found being always decreasing with rigidity below 4 GV as R^{δ} with $<\delta>= 0.21 \pm 0.02$ and a time dependence of ± 0.05.

Above 4 GV the ^{3}He/^{4}He flux ratio was found to be time independent and its rigidity dependence is well described by a single power law ($C R^{\Delta}$) with $\Delta = 0.294 \pm 0.004$.

The measured ^{3}He/^{4}He flux ratio power law spectral index, is in agreement with the one measures at high rigidity for the B/O ratio.