

Properties of cosmic Deuterons and <sup>3</sup>He C. Delgado (CIEMAT) On behalf of the AMS-02 Collaboration

### Deuterium and Helium Isotopes in Cosmic Rays

Helium nuclei are the second most abundant nuclei in cosmic rays.

<sup>2</sup>H and <sup>3</sup>He are mostly produced by the fragmentation of <sup>4</sup>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 <sup>2</sup>H/<sup>4</sup>He and <sup>3</sup>He/<sup>4</sup>He to probe the properties of diffusion at larger distances than any secondary to primary ratio.

In addition the difference A/Z ratios of <sup>2</sup>H and <sup>3</sup>He allow to disentangle kinetic energy and rigidity dependence of propagation.

### Datasample

From May 2011 to May 2021

Total exposure time 2.2e8 seconds

Z=1

Selected events	Above cutoff	Protons	Deuterons
8.7 10 <sup>9</sup>	5.0 10 <sup>9</sup>	4.8 10 <sup>9</sup>	1.0 10 <sup>8</sup>

#### Z=2

Selected events	Above cutoff	<sup>4</sup> He	<sup>3</sup> He
1.2 10 <sup>9</sup>	7.2 10 <sup>8</sup>	6.6 10 <sup>8</sup>	6.9 10 <sup>7</sup>

### He & H Isotopes identification in AMS



# He & H Isotopes identification in AMS Whole data samples



# He & H Isotopes identification in AMS Analysis methodology

Global fit of R vs  $\beta$  for each datasample with a common



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# He & H Isotopes identification in AMS **Separation results**

#### **RICH aerogel data**

#### **RICH NaF data**

#### **TOF** data



### <sup>3</sup>He Flux



# <sup>2</sup>H Flux



### Time evolution RMS of data compared with total error

Time evolution is not compatible with systematics below ~5 GV



Preliminary results. Please refer to the forthcoming publication in PRL

### **Flux ratios**



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### Evolution with time (R<5 GV)



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# Summary

AMS-02 measured the <sup>3</sup>He and <sup>2</sup>H fluxes using 10 years of data in the rigidity range from 2GV to 20 GV.

Below ~5GV solar modulation induces a time evolution of the the measured fluxes larger than the systematics of the measurement.

Above ~5GV the ratio of <sup>3</sup>He and <sup>2</sup>H to <sup>4</sup>He are compatible with a power law function. The spectral indexe seem to be different for the two species.

Below ~5GV the fluxex time evolution are qualitatively similar to those of <sup>4</sup>He. However we observe a slighly different relative amplitude of the two species.

# The end