

# d19

# 2nd cosmic-ray antideuteron workshop

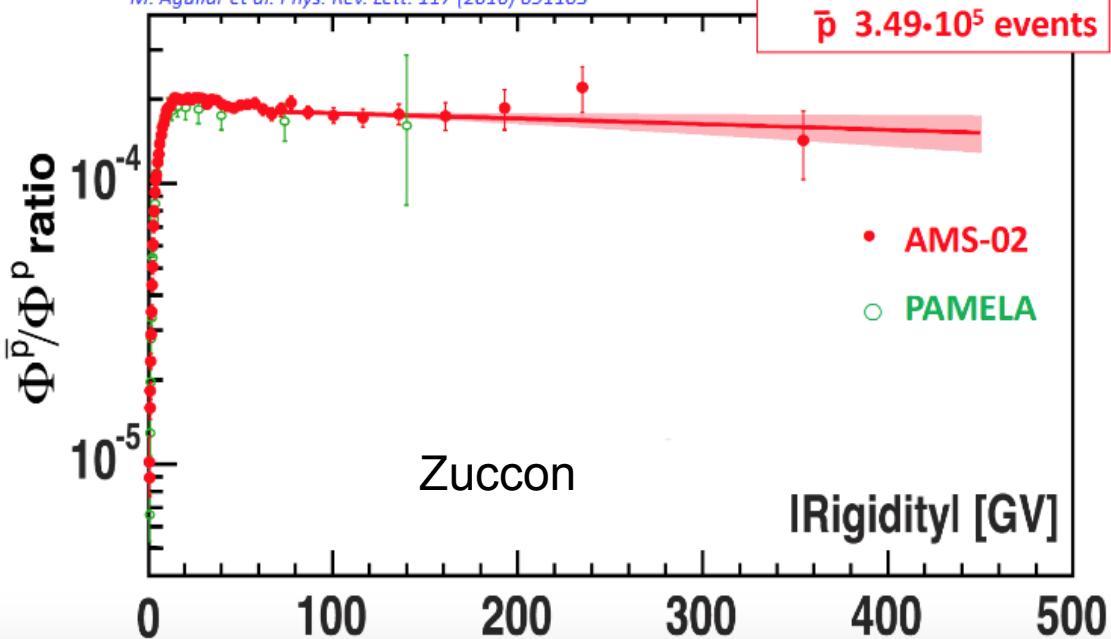


A very incomplete summary...

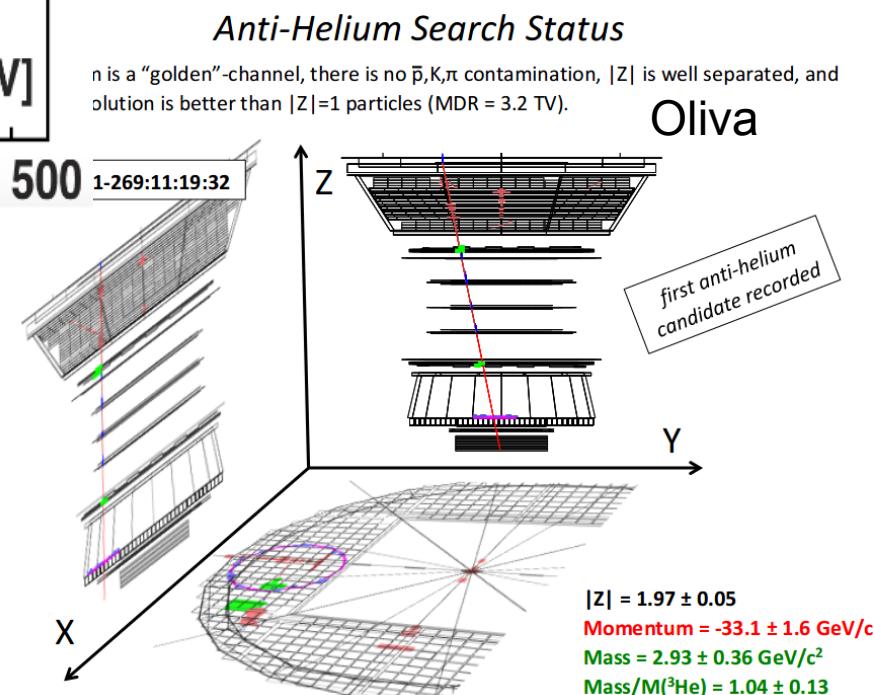
Philip von Doetinchem

# Measurements since 2014

M. Aguilar et al. Phys. Rev. Lett. 117 (2016) 091103

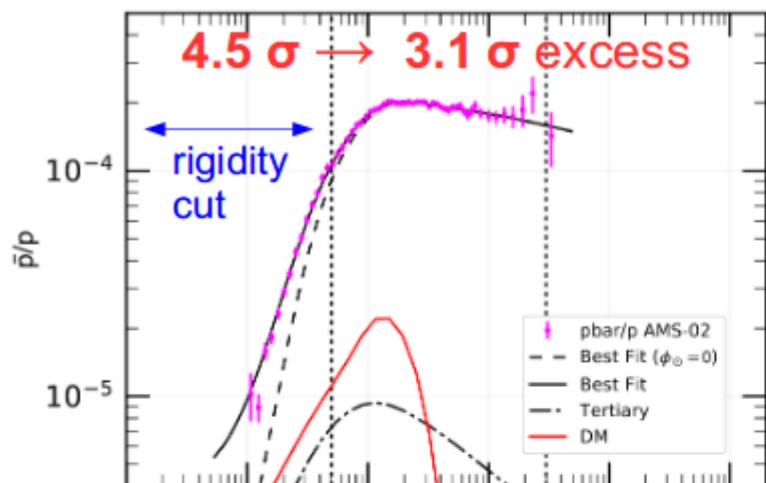


# Antideuteron Antinuclei Workshop

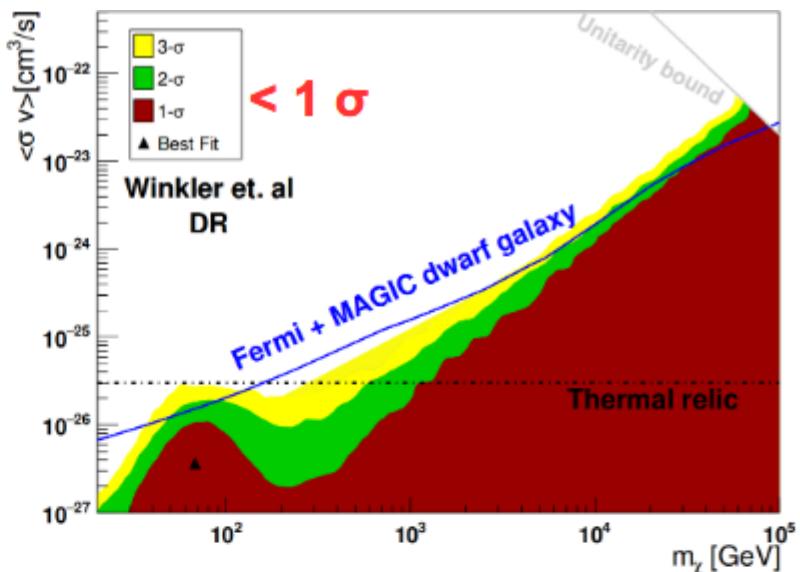


# Dark matter signal in antiprotons?

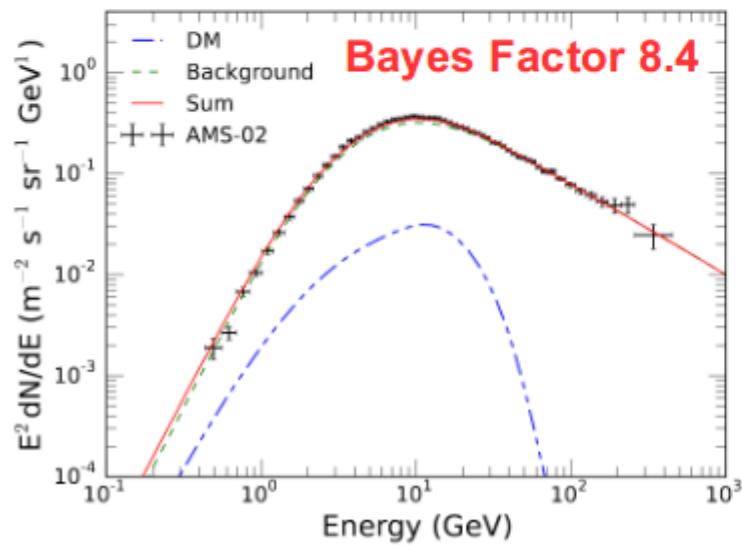
Winkler



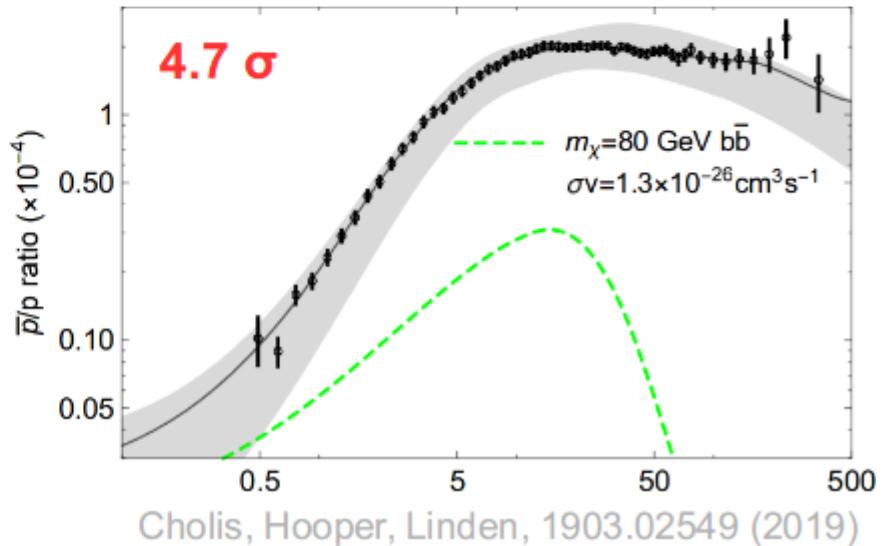
Cuoco et al., arXiv:1903:01472 (2019)



Lin et al., arXiv:1903.09545 (2019)

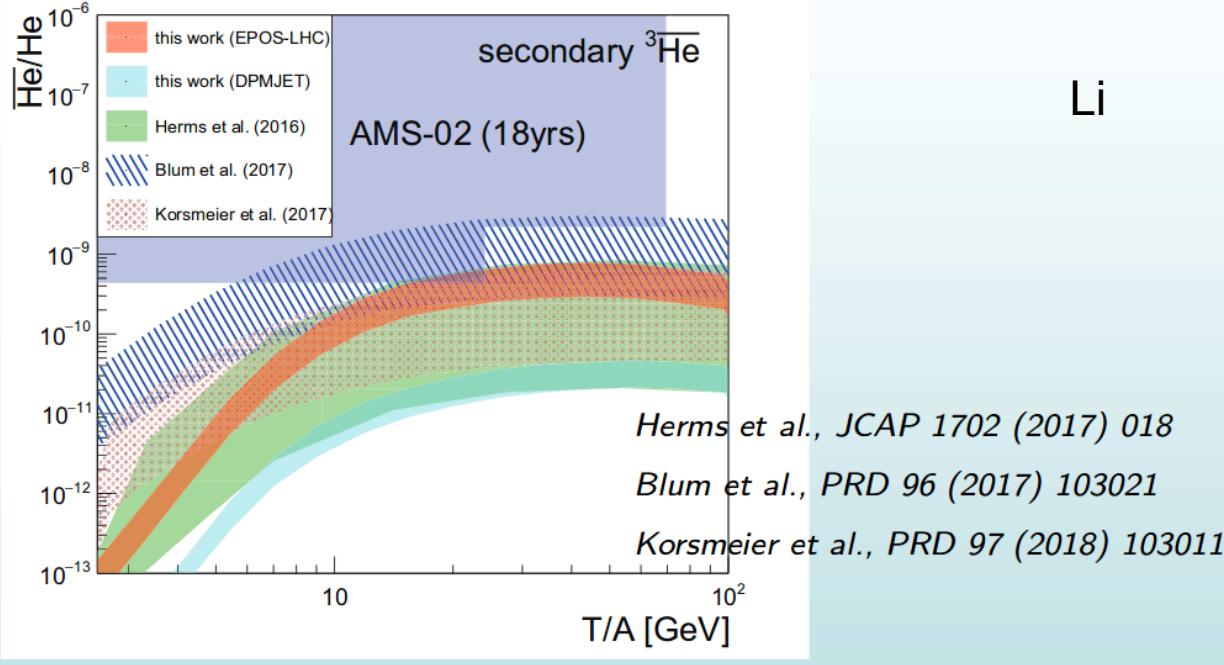


Cui et al., JCAP 1806 (2018)



Cholis, Hooper, Linden, 1903.02549 (2019)

# Antihelium events?



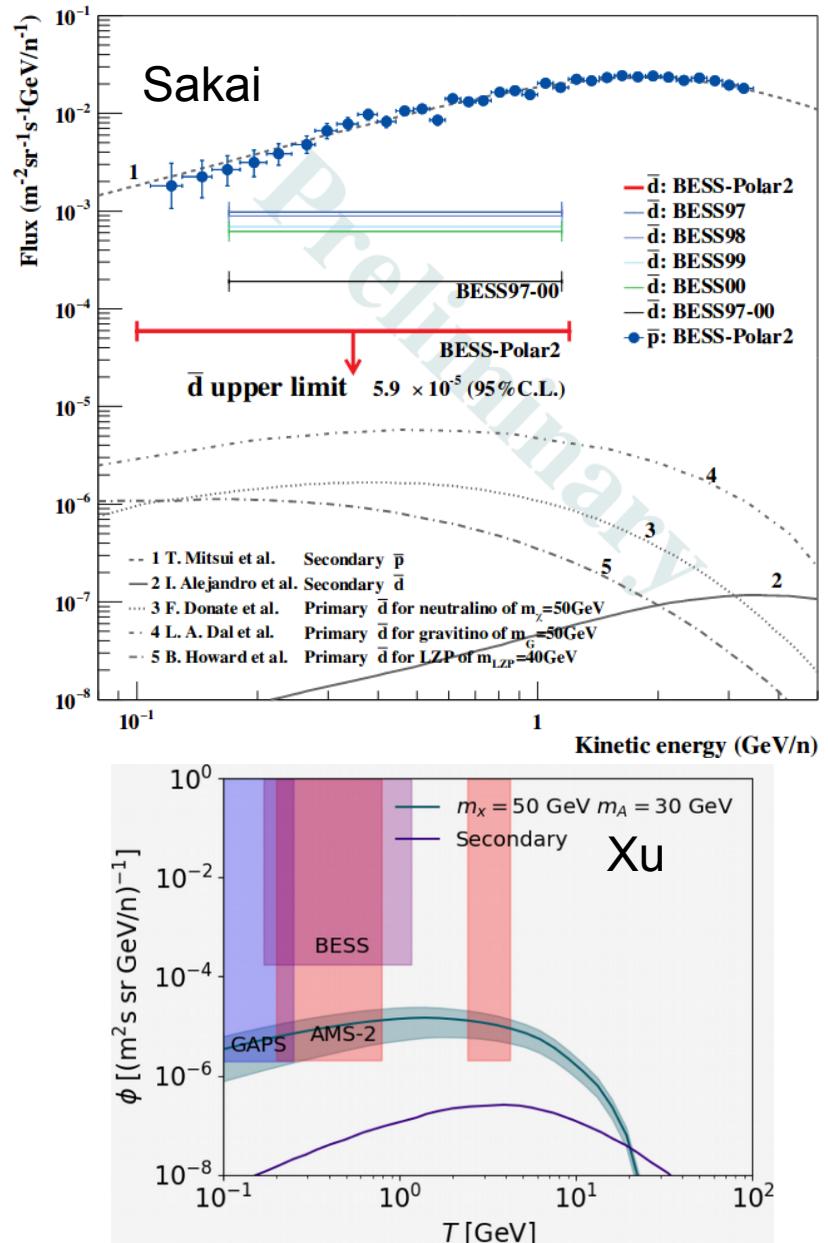
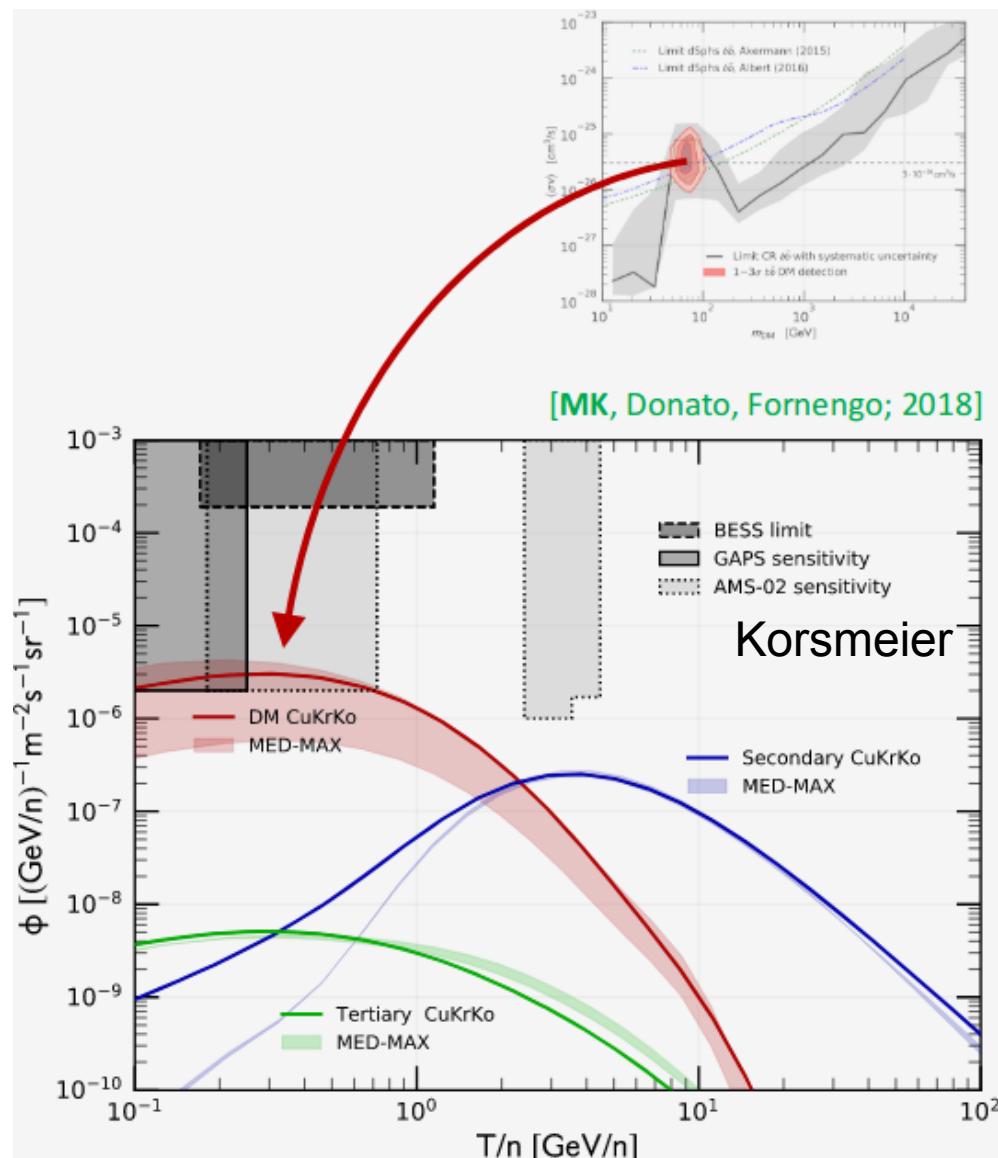
- ${}^3\text{He}$  events  
AMS-02 should **not** see secondary CR  ${}^3\overline{\text{He}}$ .  
If  $\overline{\text{He}}$  events are produced by DM, a large  $\bar{p}$  excess is expected.  
Apart from a possible anomaly, no such excess is seen.
- ${}^4\overline{\text{He}}$  events  
There is **absolutely no hope** to detect a single event.

Salati

- Depending on the (unknown) acceleration mechanism, it is conceivable that **a single near-by ( $\sim 1\text{pc}$ ) anti-star** contributes to the AMS-02 observation.

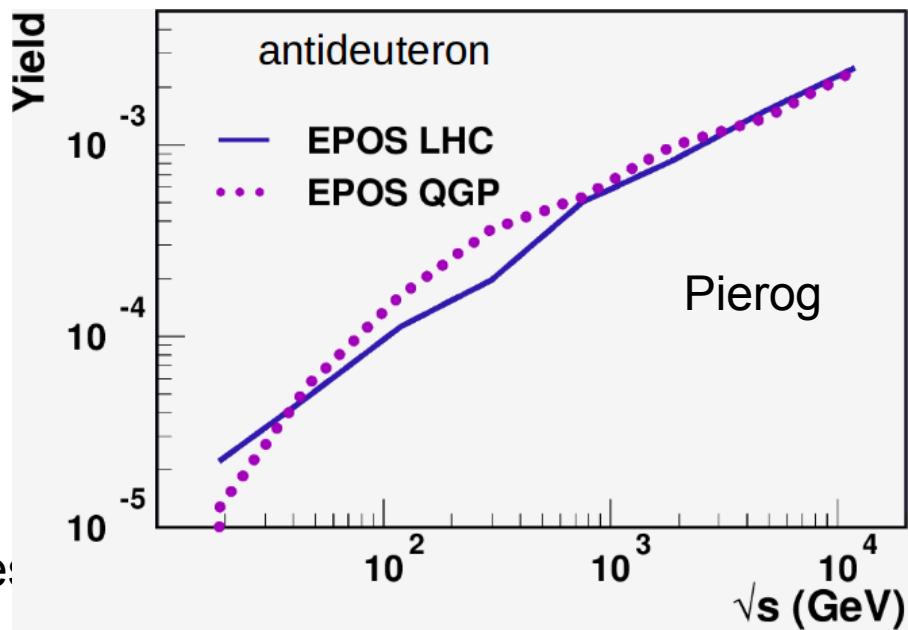
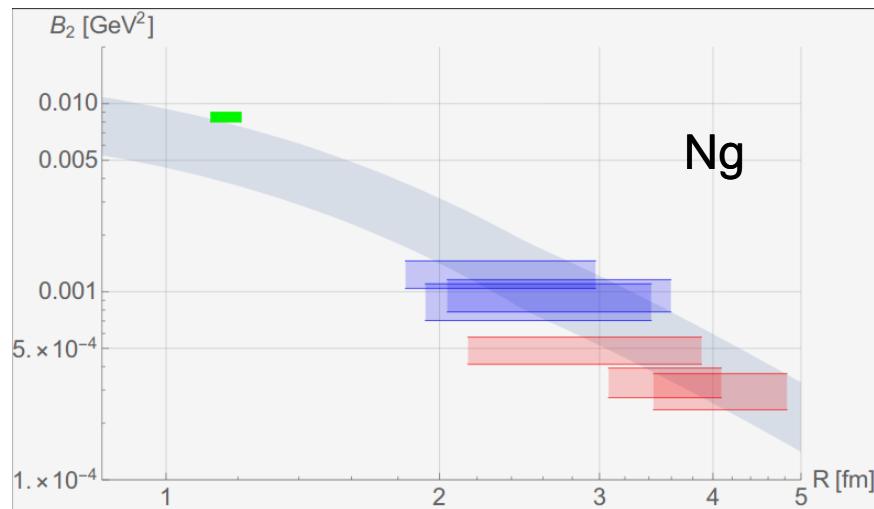
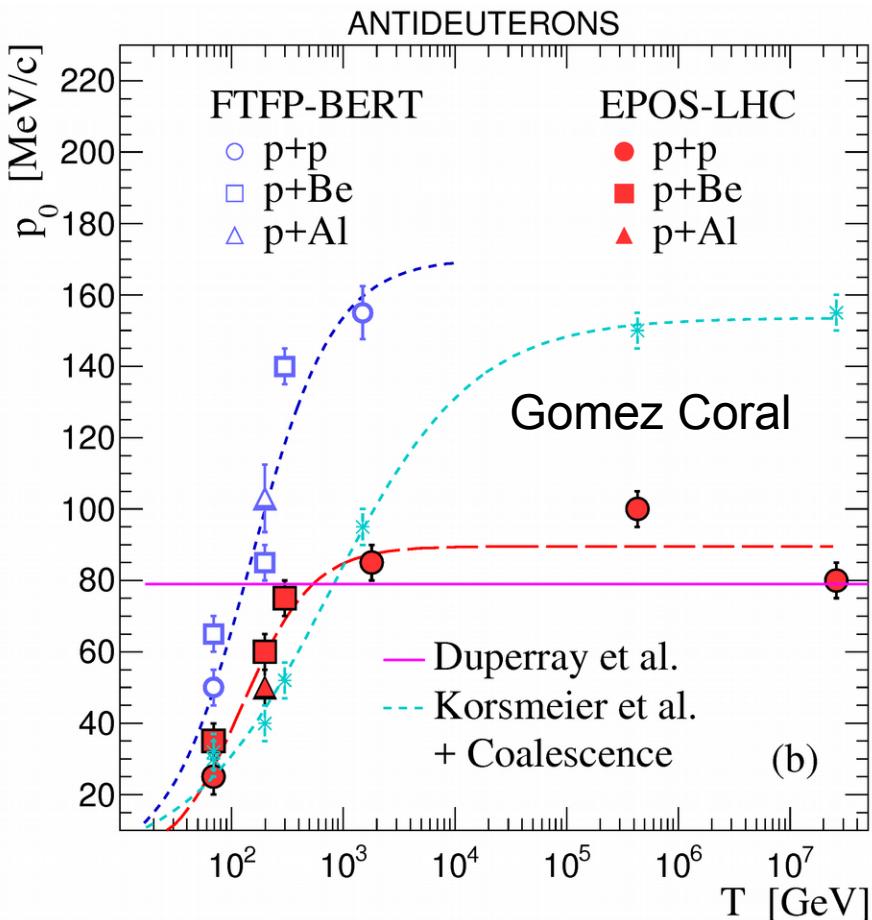
Poulin

# Antideuterons



# Antinuclei formation

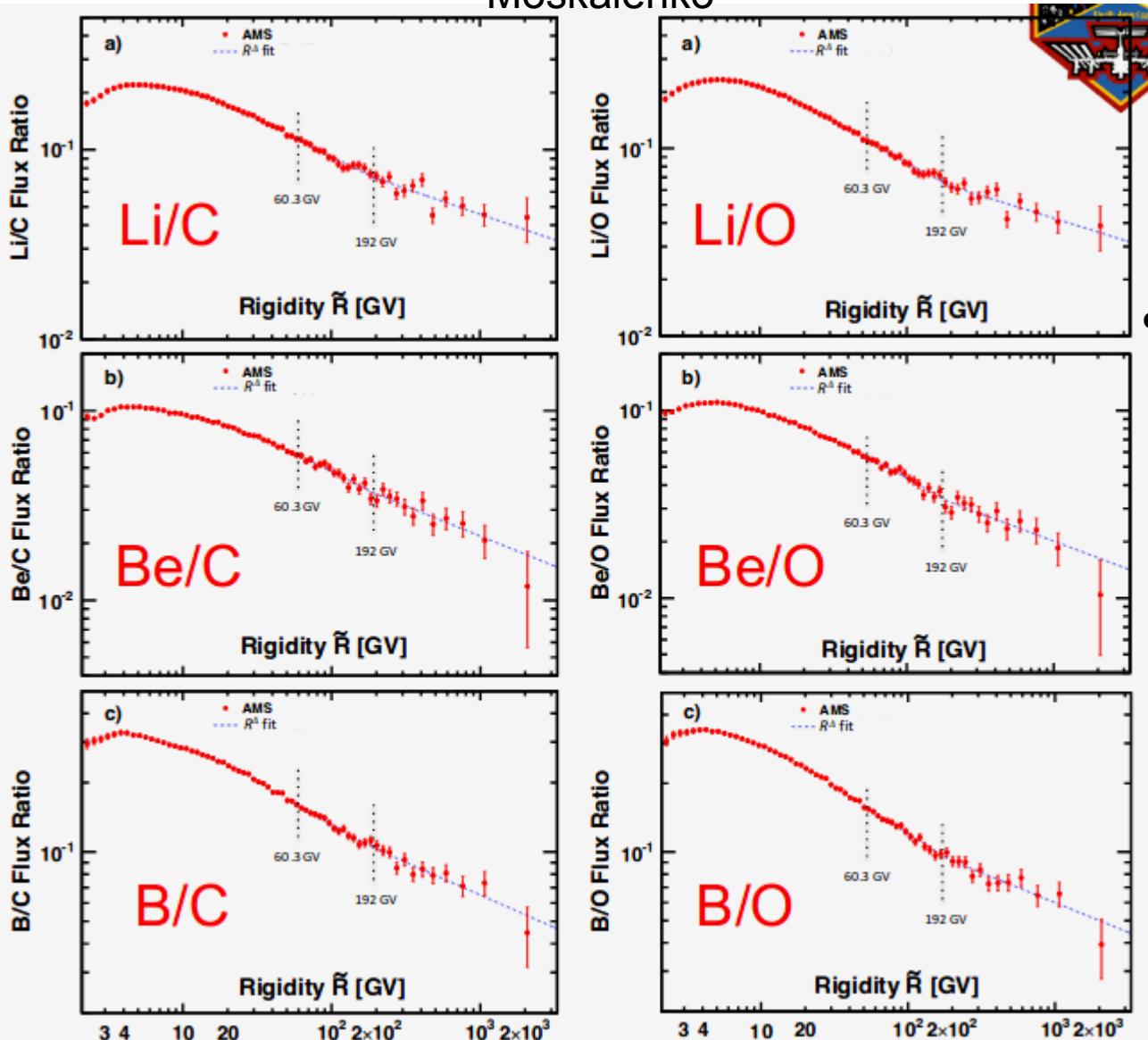
Lea: "Snowballs in hell"



- A big uncertainty that break the degeneracy with antiprotons is the the antinuclei formation process
- More cross sections needed for all types of antinuclei: NA61/SHINE, COMPASS, LHCb, ALICE, etc.

# Propagation

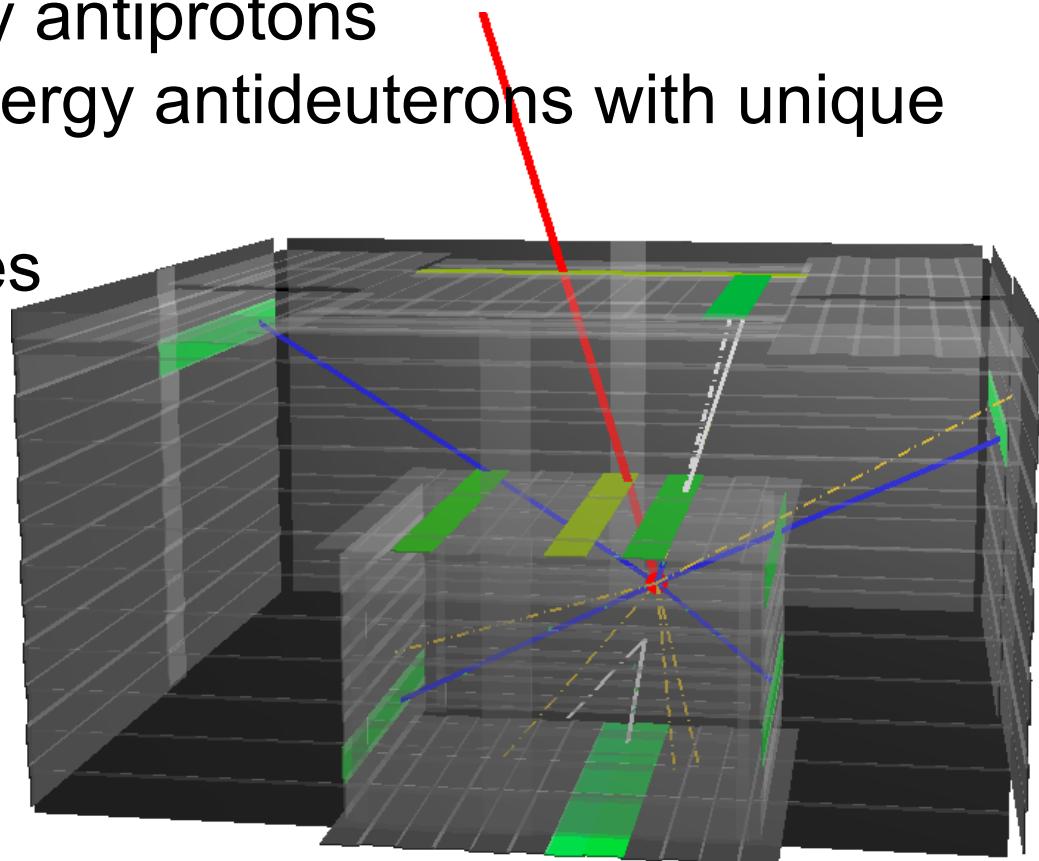
Moskalenko



- Evoli: Makes no sense to discuss antiprotons before propagation is better understood?

# Future

- It is planned that AMS-02 will continue taking data until the end of the ISS → antideuteron studies ongoing
- First GAPS launch 2020 or 2021
  - precision low-energy antiprotons
  - optimized for low-energy antideuterons with unique signature
  - antihelium capabilities
- New ideas:
  - ADHD
  - GRAMS
  - AMS-100



**Yes, I am aware that this  
mini summary is leaving  
out a lot of hard work  
that was presented.**

# Summary paper

Should we write a status paper like we did for 2014?

- I suggest a condensed update that compares where we stand in a coherent way.

Physics Reports 618 (2016) 1–37



Contents lists available at ScienceDirect

Physics Reports

journal homepage: [www.elsevier.com/locate/physrep](http://www.elsevier.com/locate/physrep)



Review of the theoretical and experimental status of dark matter identification with cosmic-ray antideuterons



T. Aramaki<sup>a,b</sup>, S. Boggs<sup>c</sup>, S. Bufalino<sup>d</sup>, L. Dal<sup>e</sup>, P. von Doetinchem<sup>f,\*</sup>,  
F. Donato<sup>d,g</sup>, N. Fornengo<sup>d,g</sup>, H. Fukue<sup>h</sup>, M. Grefe<sup>i</sup>, C. Hailey<sup>a</sup>, B. Hamilton<sup>j</sup>,  
A. Ibarra<sup>k</sup>, J. Mitchell<sup>l</sup>, I. Mojet<sup>m</sup>, R.A. Ong<sup>m</sup>, R. Pereira<sup>f</sup>, K. Perez<sup>n</sup>,  
A. Putze<sup>o,p</sup>, A. Raklev<sup>e</sup>, P. Salati<sup>o</sup>, M. Sasaki<sup>l</sup>, G. Tarle<sup>q</sup>, A. Urbano<sup>r</sup>,  
A. Vittino<sup>d,g</sup>, S. Wild<sup>k</sup>, W. Xue<sup>s</sup>, K. Yoshimura<sup>t</sup>

**Thanks a lot to the UCLA team:**

**Rene Ong**

**Ralph Bird**

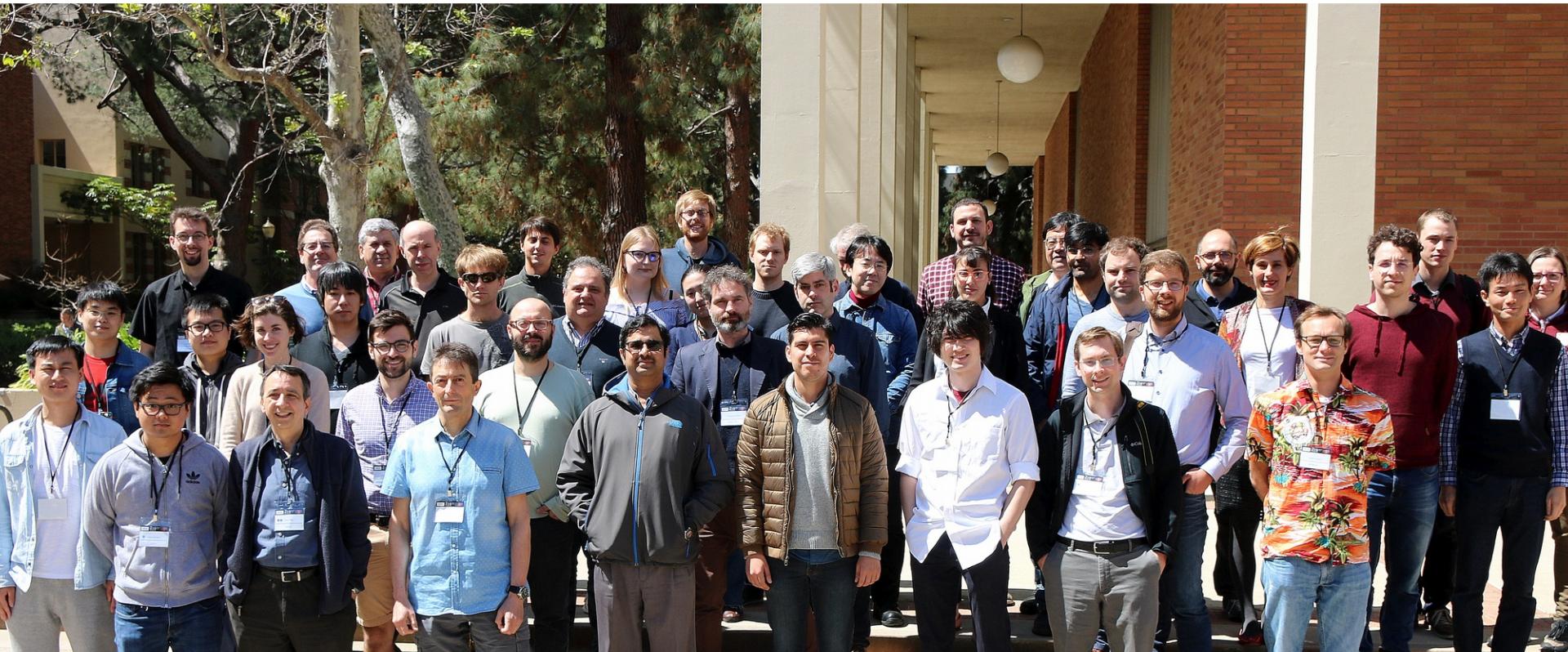
**Sean Quinn**

**Jamie Ryan**

**Takeru Hayashi**

# d19

# 2nd cosmic-ray antideuteron workshop



# Thanks a lot!