A very incomplete summary…

Philip von Doetinchem
Measurements since 2014

Antideuteron
Antinuclei Workshop

Anti-Helium Search Status

$|Z| = 1.97 \pm 0.05$
Momentum = $-33.1 \pm 1.6$ GeV/c
Mass = $2.93 \pm 0.36$ GeV/c$^2$
$\text{Mass/}\text{M}^4(\text{He}) = 1.04 \pm 0.13$

P. von Doetinchem
Antideuteron 2019
Mar 2019 - p. 2
Dark matter signal in antiprotons?

4.5 $\sigma \rightarrow 3.1 \sigma$ excess

rigidity cut


Bayes Factor 8.4

Cui et al., JCAP 1806 (2018)

< 1 $\sigma$

Winkler et al.

DR

Fermi + MAGIC dwarf galaxy

Unitarity bound

Thermal relic


4.7 $\sigma$

$m_\chi = 80$ GeV $\bar{b}b$

$\sigma v = 1.3 \times 10^{-26}$ cm$^3$s$^{-1}$

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 $\overline{p}$ 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.

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.
Antideuterons

Korsmeier

[Sakai, Donato, Fornengo; 2018]

Flux ($m^2$sr$^{-1}$GeV$^{-1}$n$^{-1}$)

Kineatic energy (GeV/n)

P. von Doetinchem
Antideuteron 2019
Mar 2019 - p.5
A big uncertainty that breaks the degeneracy with antiprotons is the antinuclei formation process.

More cross sections needed for all types of antinuclei: NA61/SHINE, COMPASS, LHCb, ALICE, etc.
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.
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.
Thanks a lot to the UCLA team:

Rene Ong
Ralph Bird
Sean Quinn
Jamie Ryan
Takeru Hayashi
Thanks a lot!