

# A Detectable Antihelium Flux from Dark Matter Annihilation

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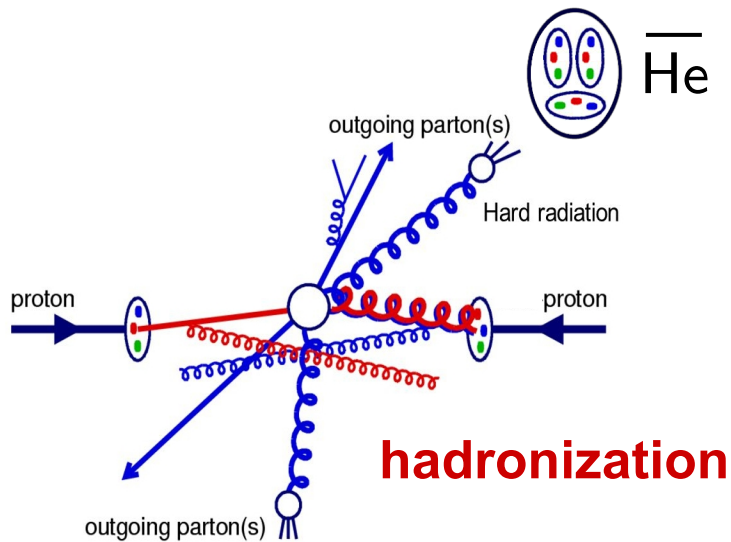
*July 16, 2021*



# Antinuclei in Cosmic Rays

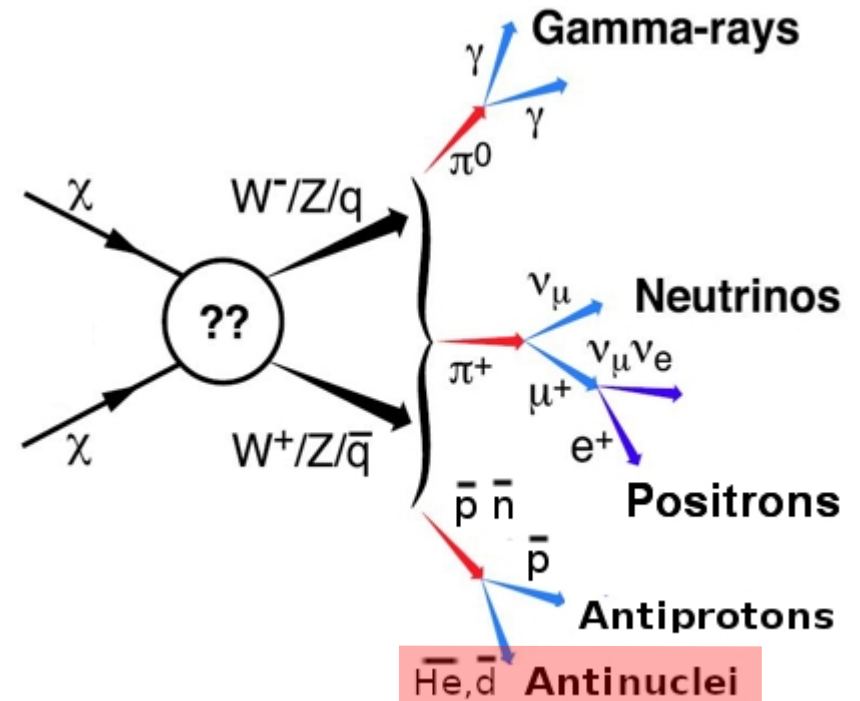
## secondary background

- primary cosmic rays (p,He) scatter on interstellar matter



## primary antinuclei

- dark matter annihilation

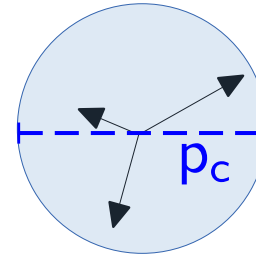


# Coalescence Model

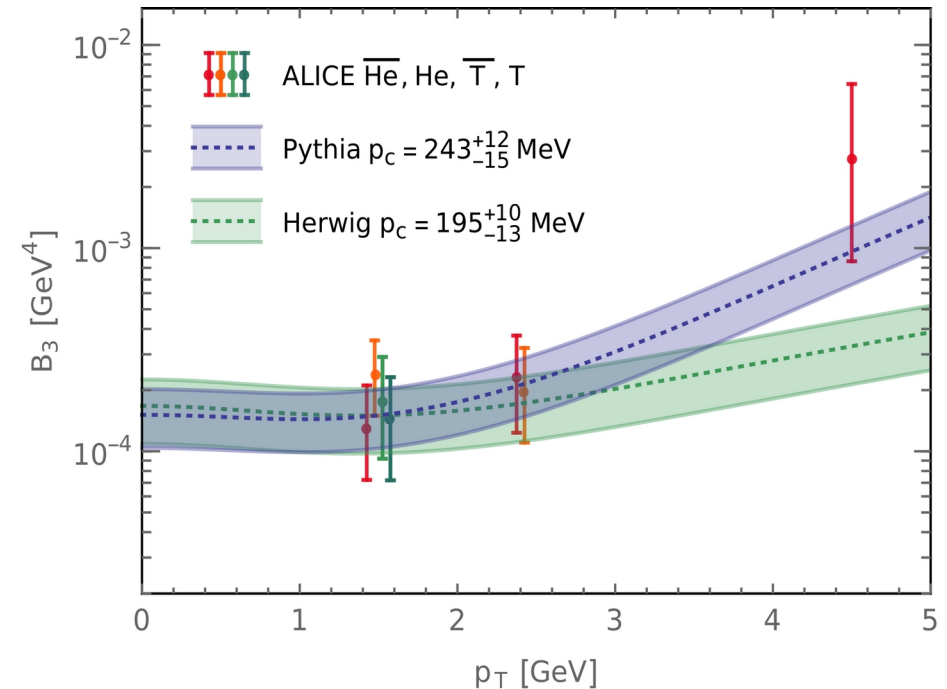
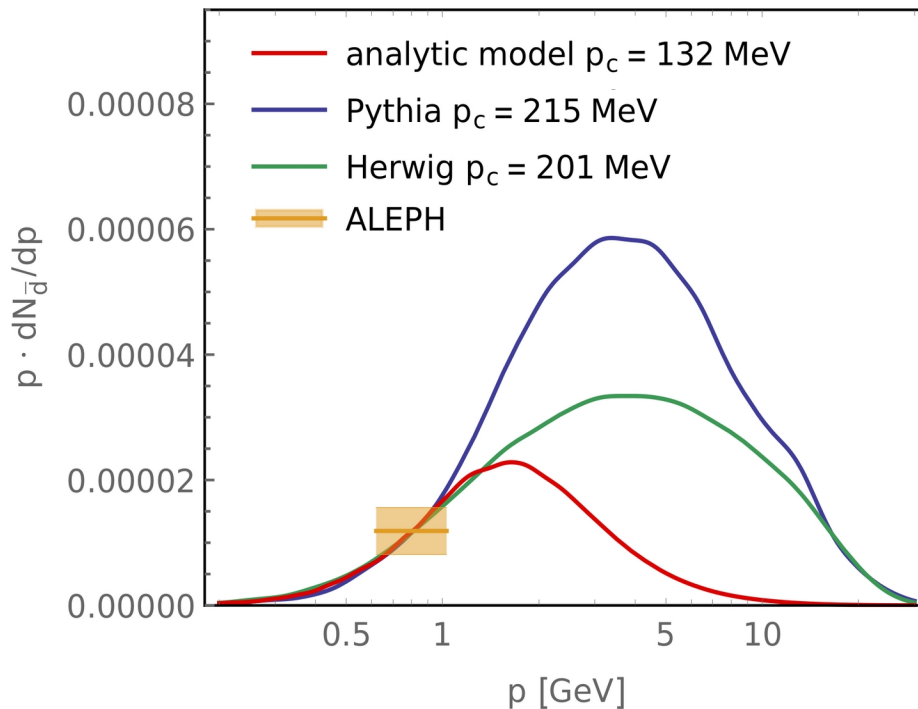
- (anti)nucleons with low relative momentum merge into nucleus

Schwarzschild, Zupancic, Phys. Rev. 129 (1963)

$|\Delta\mathbf{p}| < p_c$  antideuteron

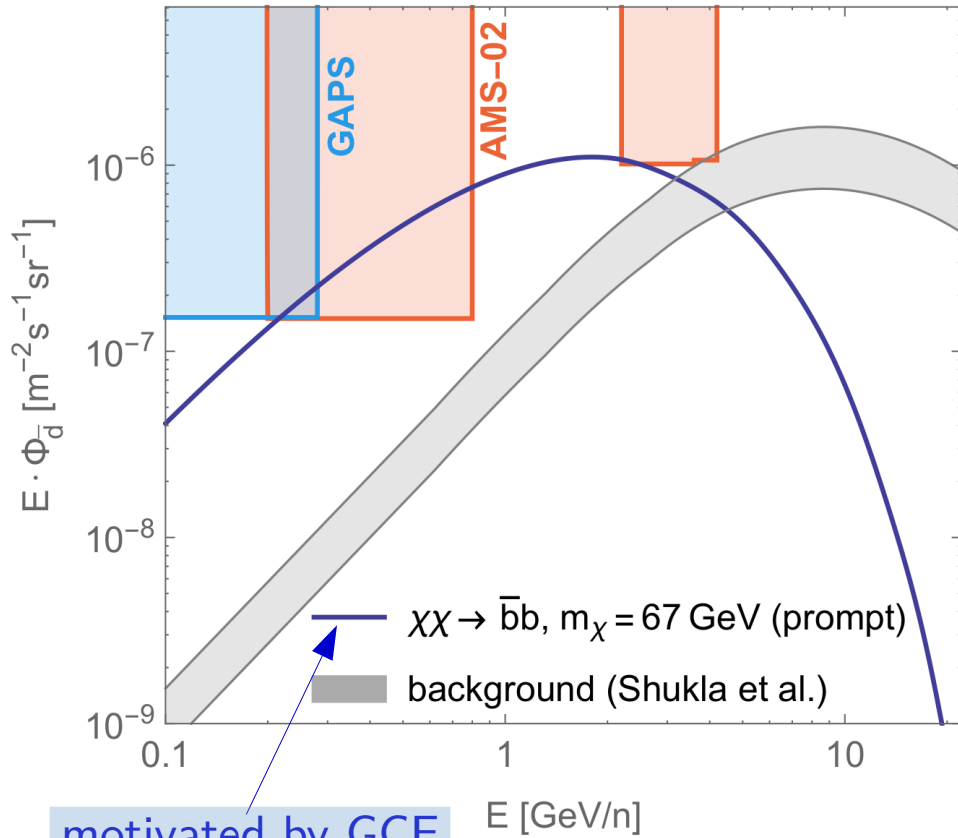


antihelium

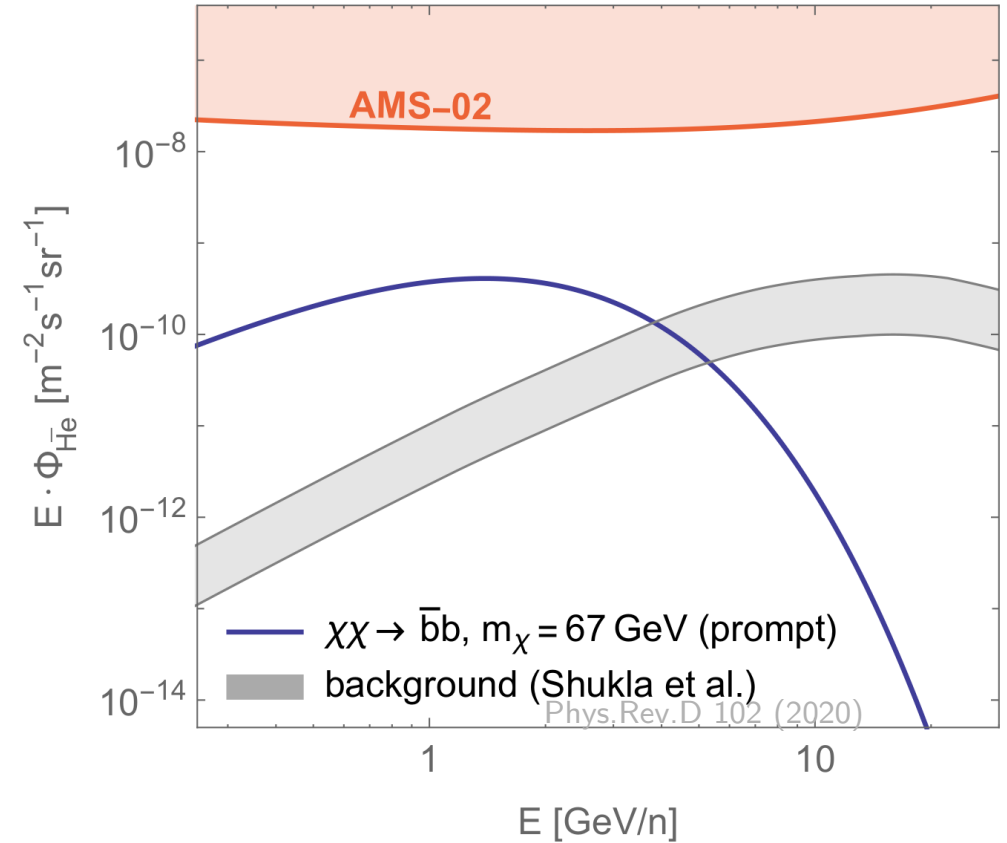


# Antinuclei Fluxes (Status 2020)

## Antideuteron



## Antihelium

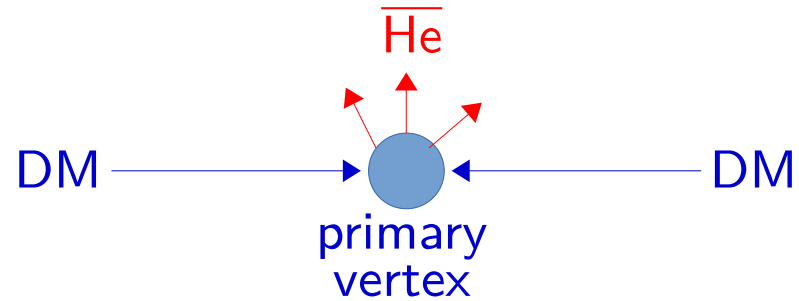


- tentative detection of  $\sim 10 \bar{\text{He}}$  events at AMS-02

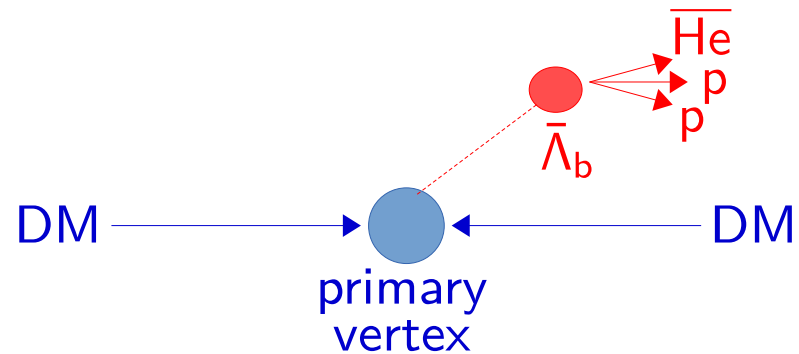
S. Ting, CERN Colloquium 2016, Science Magazine 2017

# Antihelium from $\bar{\Lambda}_b$

- previous analyses focused entirely on prompt  $\bar{\text{He}}$  emission



- potentially **dominant**  $\bar{\text{He}}$  production mode has been missed



- $\bar{\Lambda}_b$  are perfect “catalysts” for  $\bar{\text{He}}$  production

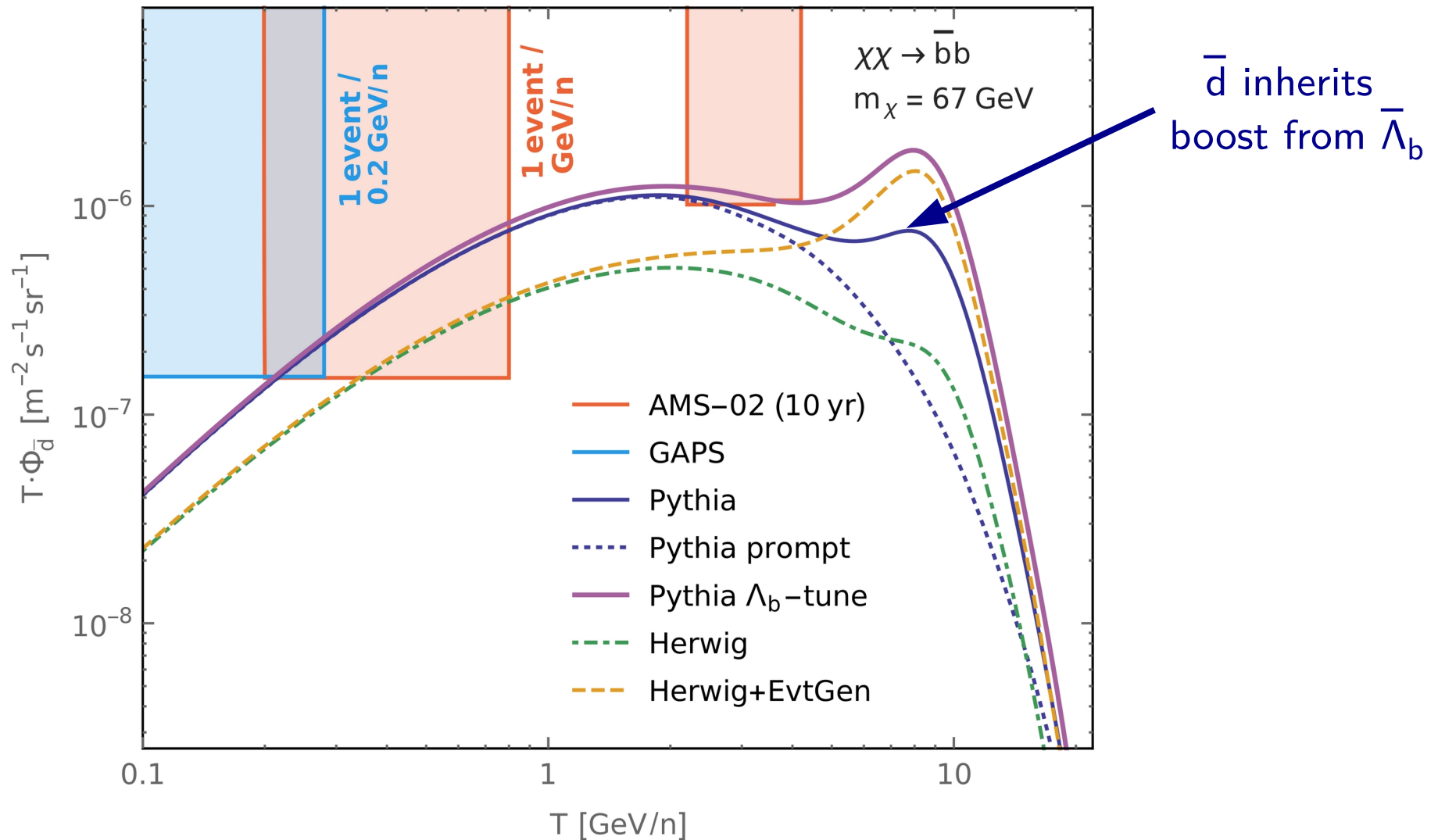
▶ frequent in DM annihilation:  $f(b \rightarrow \Lambda_b) \sim 0.1$

▶ carry antibaryon number

▶ decay to low momentum antinucleons

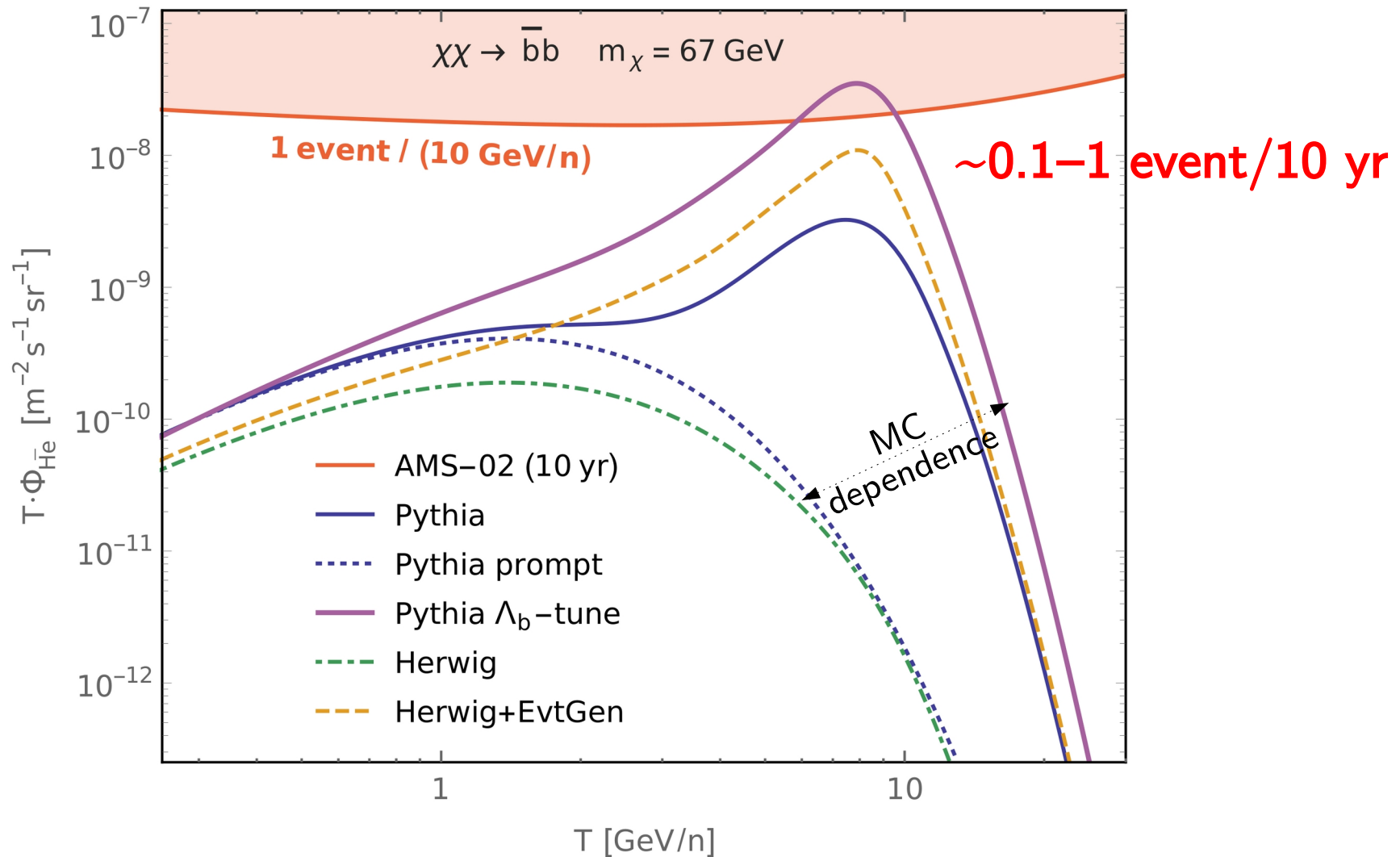
}  $\text{Br}(\bar{\Lambda}_b \rightarrow \bar{\text{He}}) \sim 10^{-6}$

# Impact on Antideuteron Flux



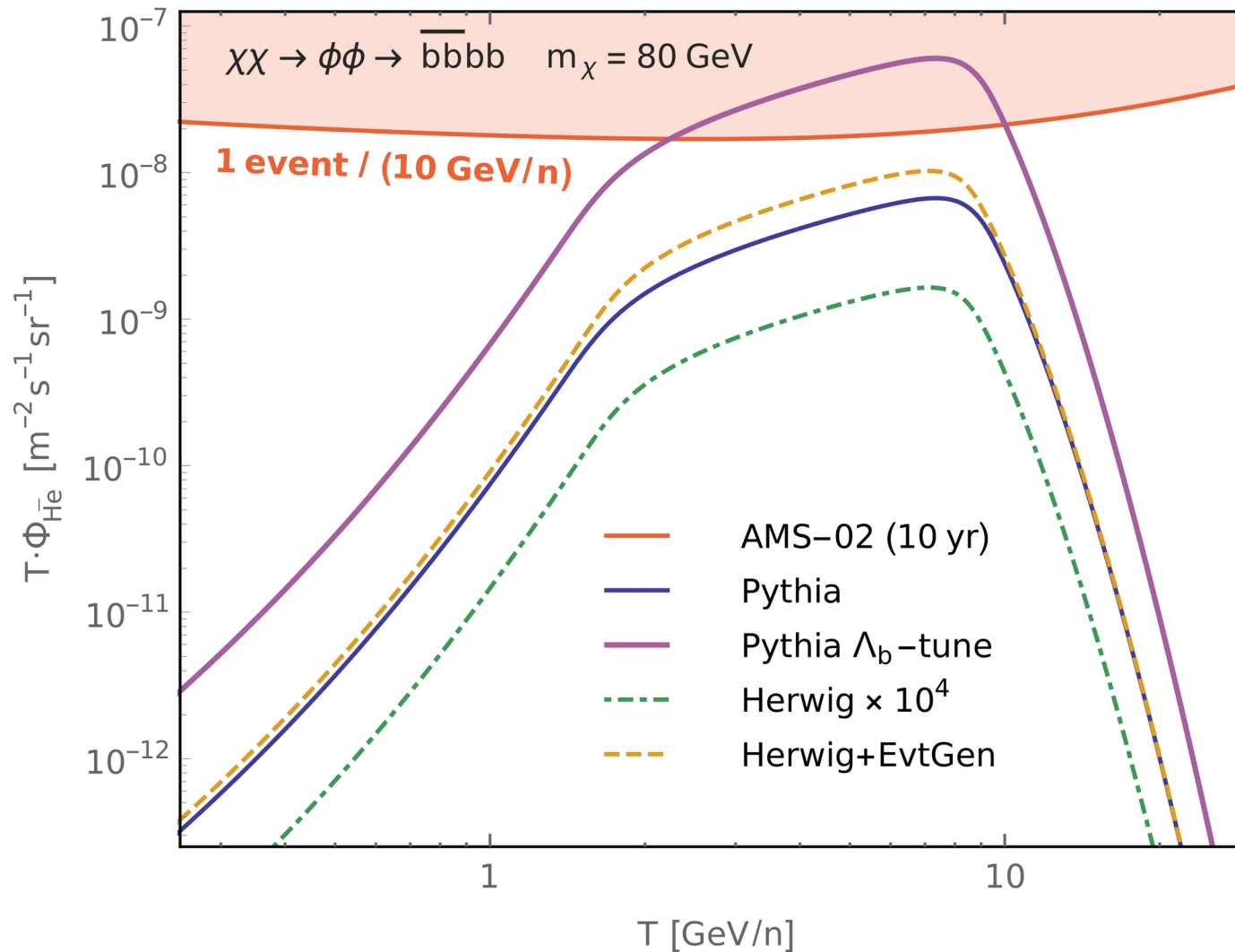
- promising new high-energy signature in antideuteron flux

# Impact on Antihelium Flux



- antihelium events enhanced by up to  $O(100)$  due to  $\bar{\Lambda}_b$

# Light Mediator Model



- further increase of antihelium flux e.g. in mediator-models



# Conclusion and Outlook

- $\bar{\Lambda}_b$  decays can dramatically enhance the cosmic ray  $\bar{\text{He}}$ -flux
- $\bar{\text{He}}$  signal at AMS-02 possible for well-motivated DM candidates
- precise predictions will require an accelerator measurement of  $\text{Br}(\bar{\Lambda}_b \rightarrow \bar{\text{He}})$  which is within LHC reach