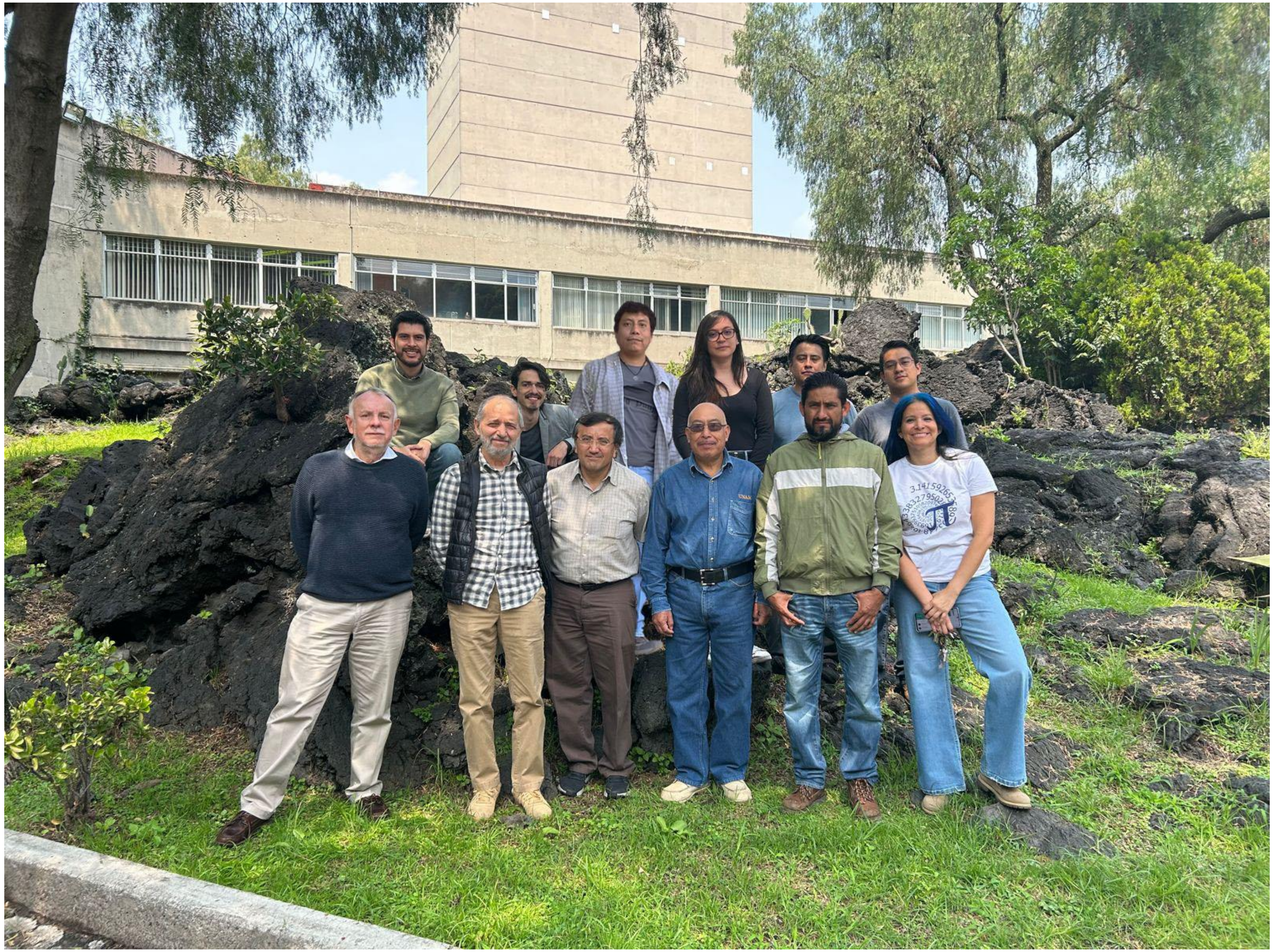
Arturo Menchaca-Rocha

Instituto de Física, UNAM

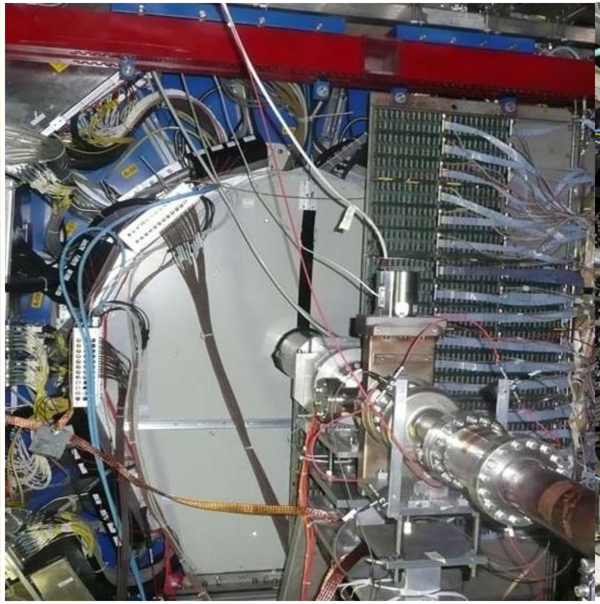
IFUNAM-Group

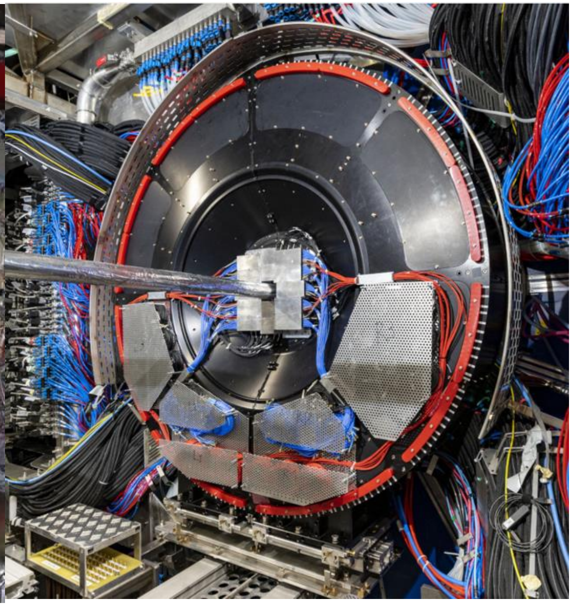


Instrumentation (Laura González @ 11:25 am & Rubén Alfaro @ 3:00 pm)

V0A (2017)

FV0 (2022)





Antimatter studies: 16 years ago, @ CERN

Deuteron/anti-deuteron production in ALICE

E. Serradilla, P. González and P. Ladrón de Guevara
CIEMAT, Spain
and
A. Menchaca-Rocha
IFUNAM, Mexico

PWG2 Meeting, 9 December 2008

Outline

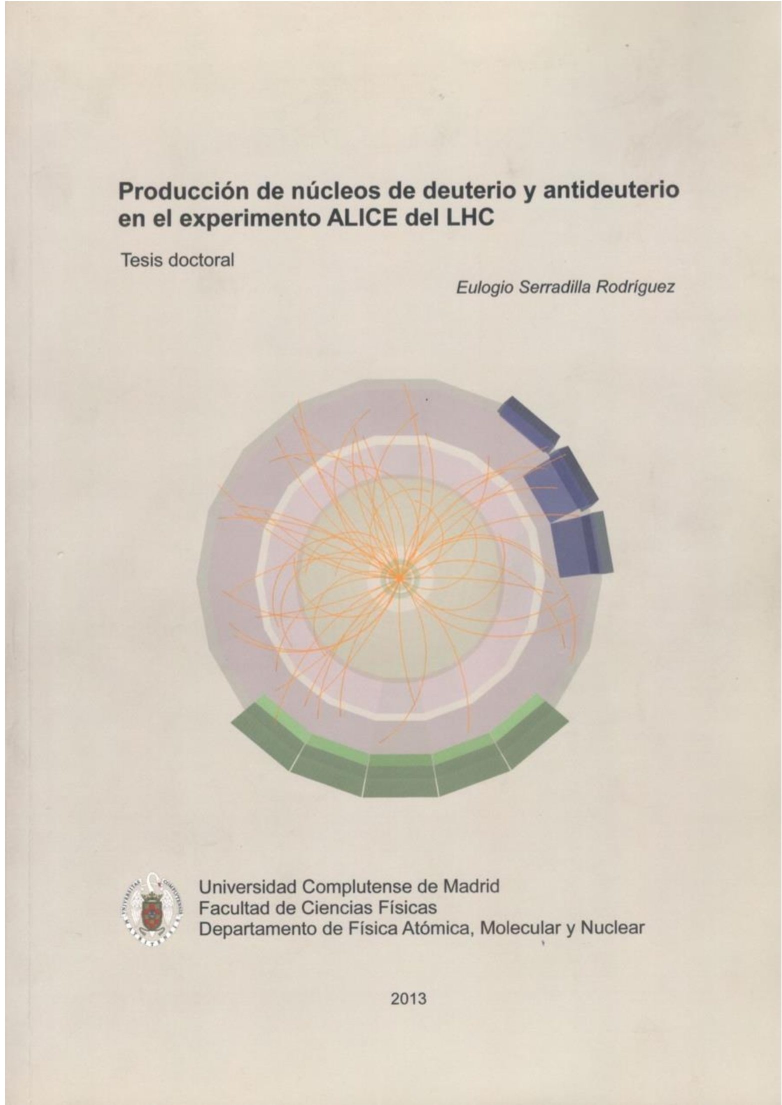
- Motivations (p-p and A-A)
- ALICE adequacy
  - ITS+TPC+TRD+TOF
- Coalescence afterburner
  - Background limitations
  - Deuteron detection efficiency
  - Anti-deuteron estimate

$$E_A \frac{d^3 N_A}{dp_A^3} = B_A \left(E_p \frac{d^3 N_p}{dp_p^3} \right)^Z \left(E_n \frac{d^3 N_n}{dp_n^3} \right)^N := B_A \left(E_N \frac{d^3 N_N}{dp_N^3} \right)^A$$

Conclusions

- d and d-bar measurements at ALICE are interesting:
  - As a natural extension to lower energy data
  - For cosmic nuclear abundance interpretation
- A coalescence abfterburner has been constructed
- Simulations indicate ~ 10^{-4} deuterons/m-bias.
- Anti-deuteron detection is also possible at ~half that rate.

La Suite (2013-2018)



November 2013

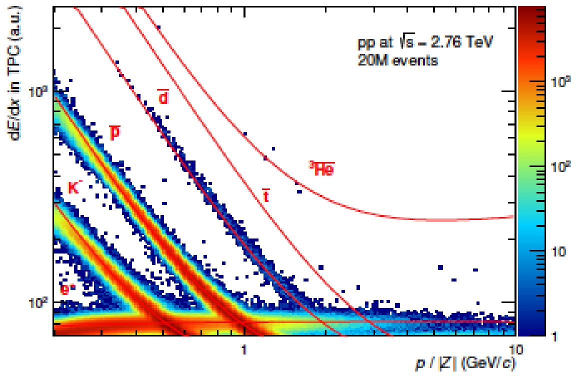


Figura 7.39: Pérdida de energía en la TPC de las partículas con carga negativa en 20 millo
de sucesos pp a $\sqrt{s}$ =2.76 TeV.

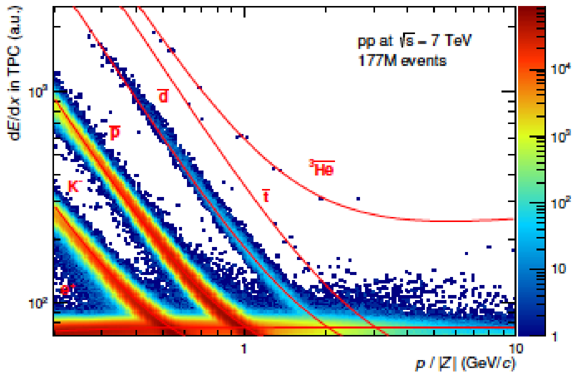
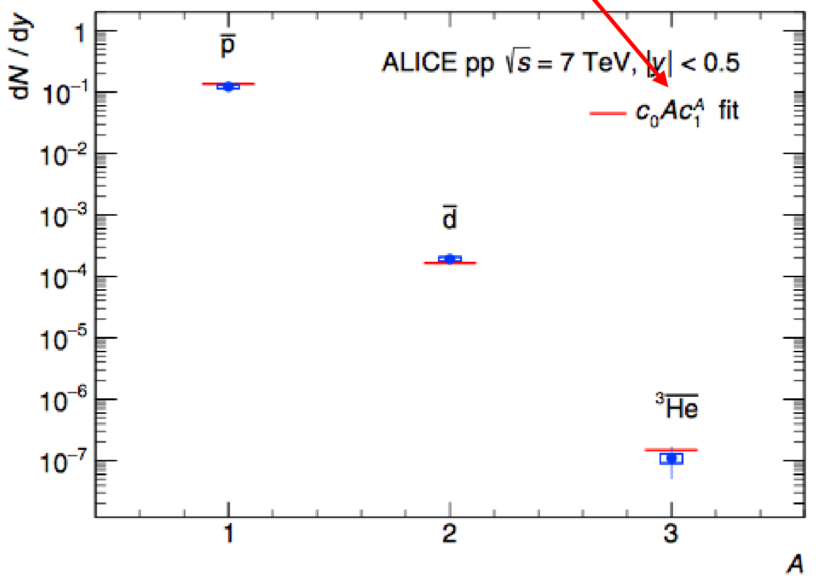


Figura 7.40: Pérdida de energía en la TPC de las partículas con carga negativa en 177 millones de sucesos pp a $\sqrt{s}$ =7 TeV.

The "ALICE Recipe"

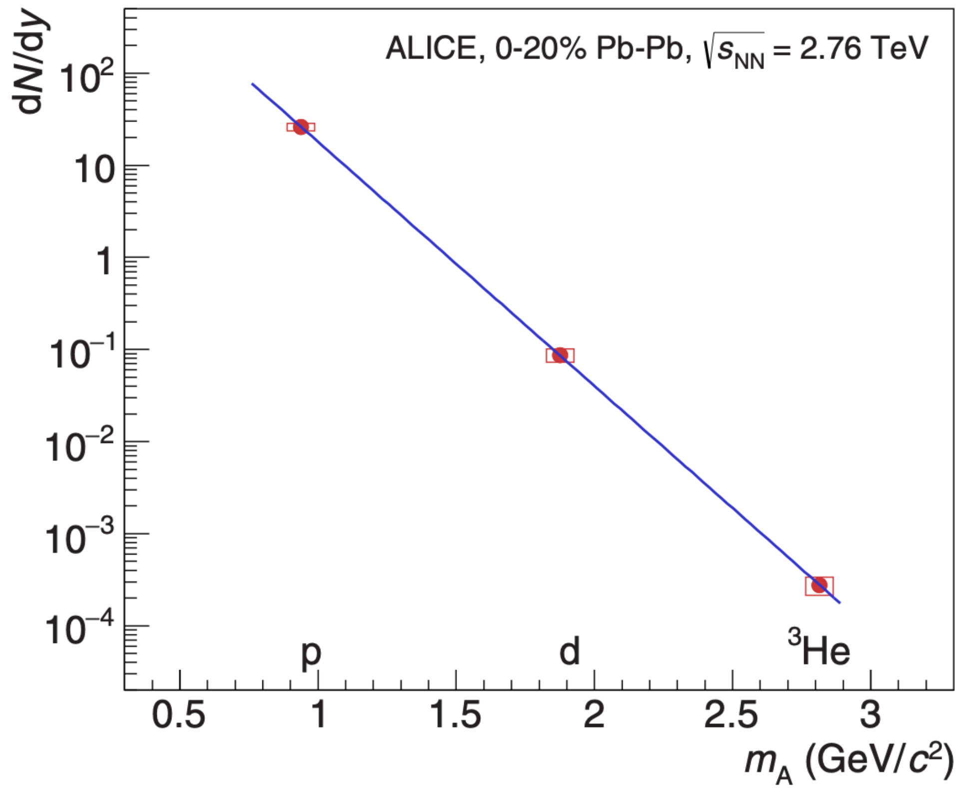


PHYSICAL REVIEW C **97**, 024615 (2018)

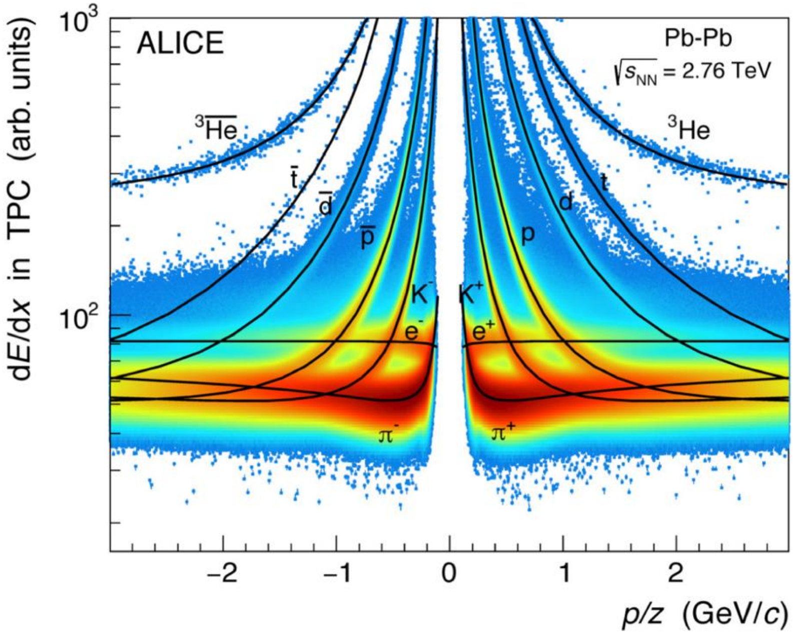
February 2018

p-p vs [p-Pb & Pb-Pb]?

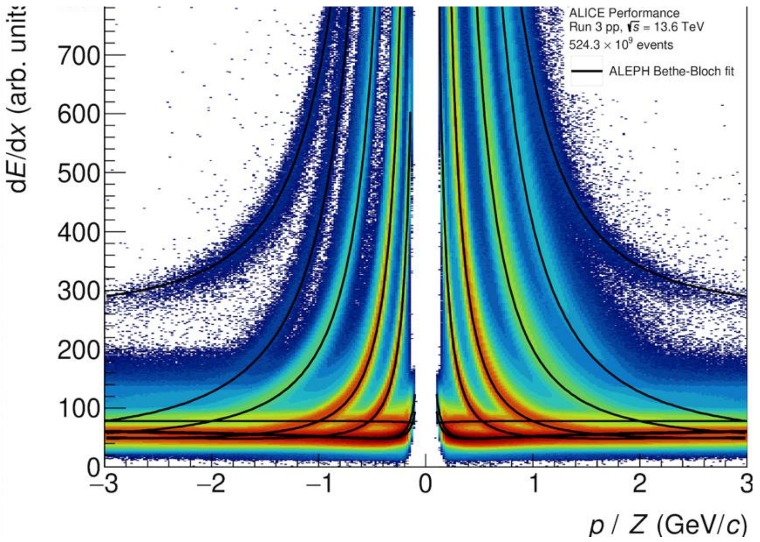
In cosmos Pb-Pb/pp ≈ 10^{-20}



PHYSICAL REVIEW C **93**, 024917 (2016)
Natasha Sharma's PhD Thesis, 2013
Panjab University, India

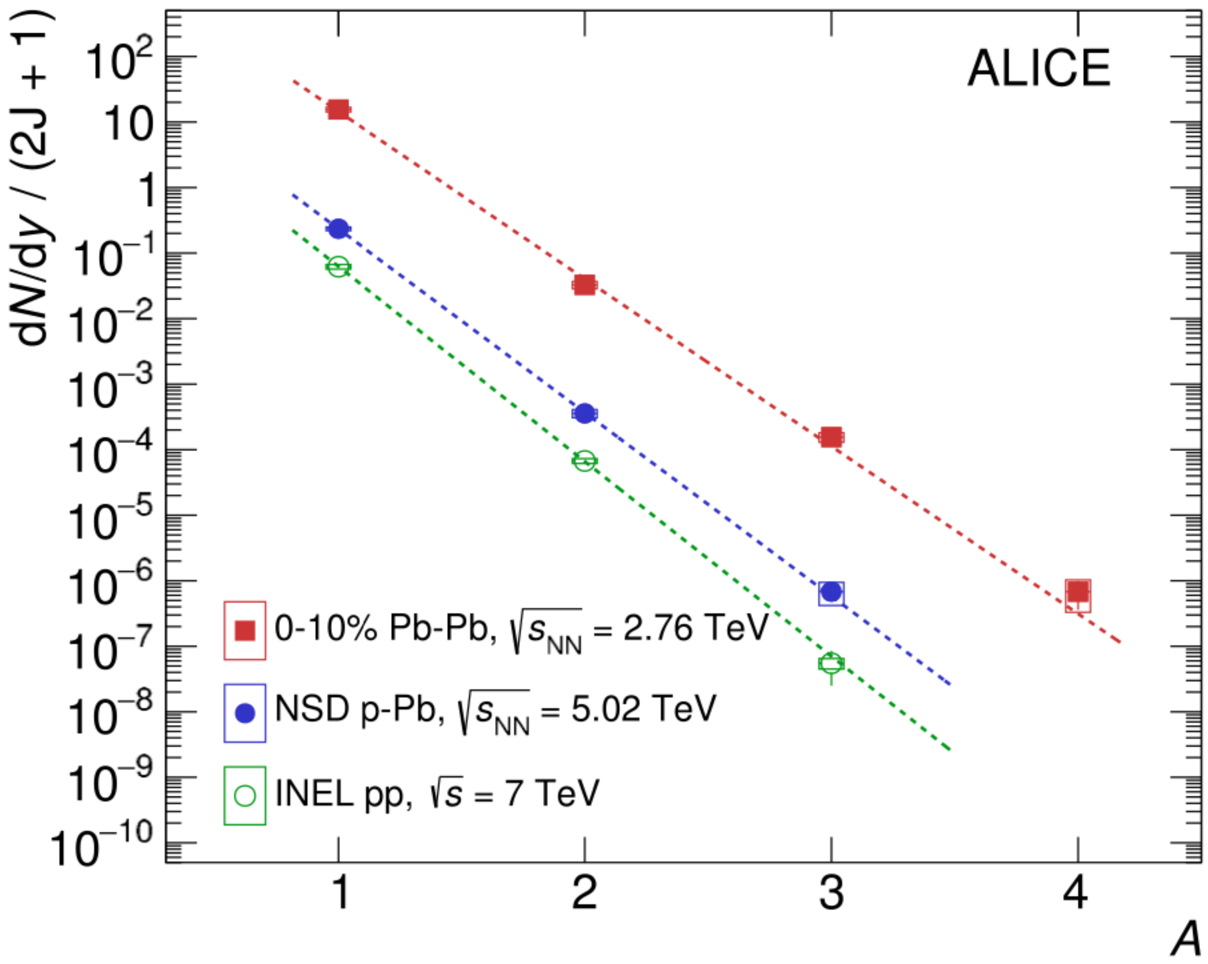


Pb-Pb → d (Run 3)
(2016)



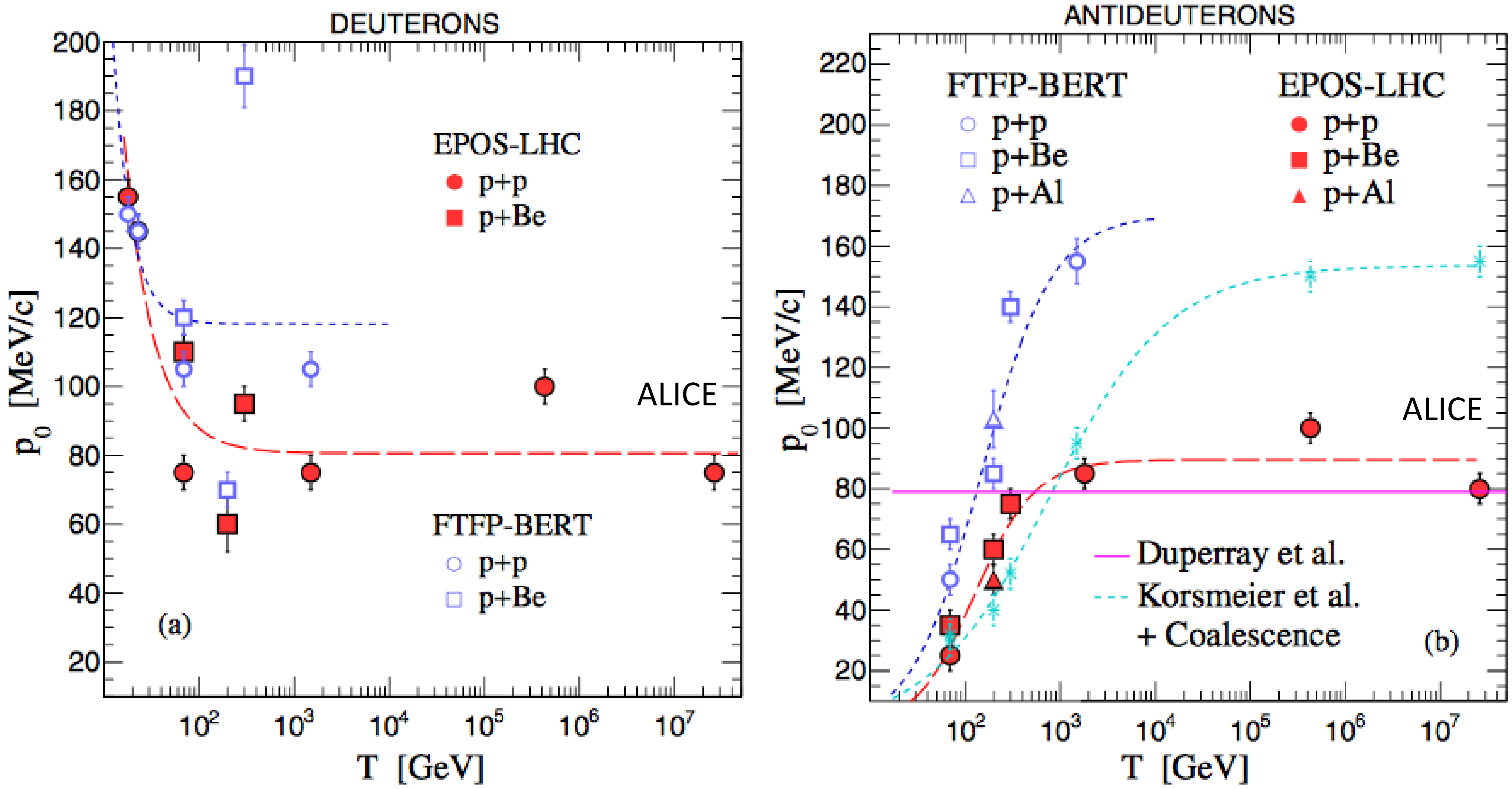
p-p → d (Run 3)
(2024)

Also works for ^{4}He



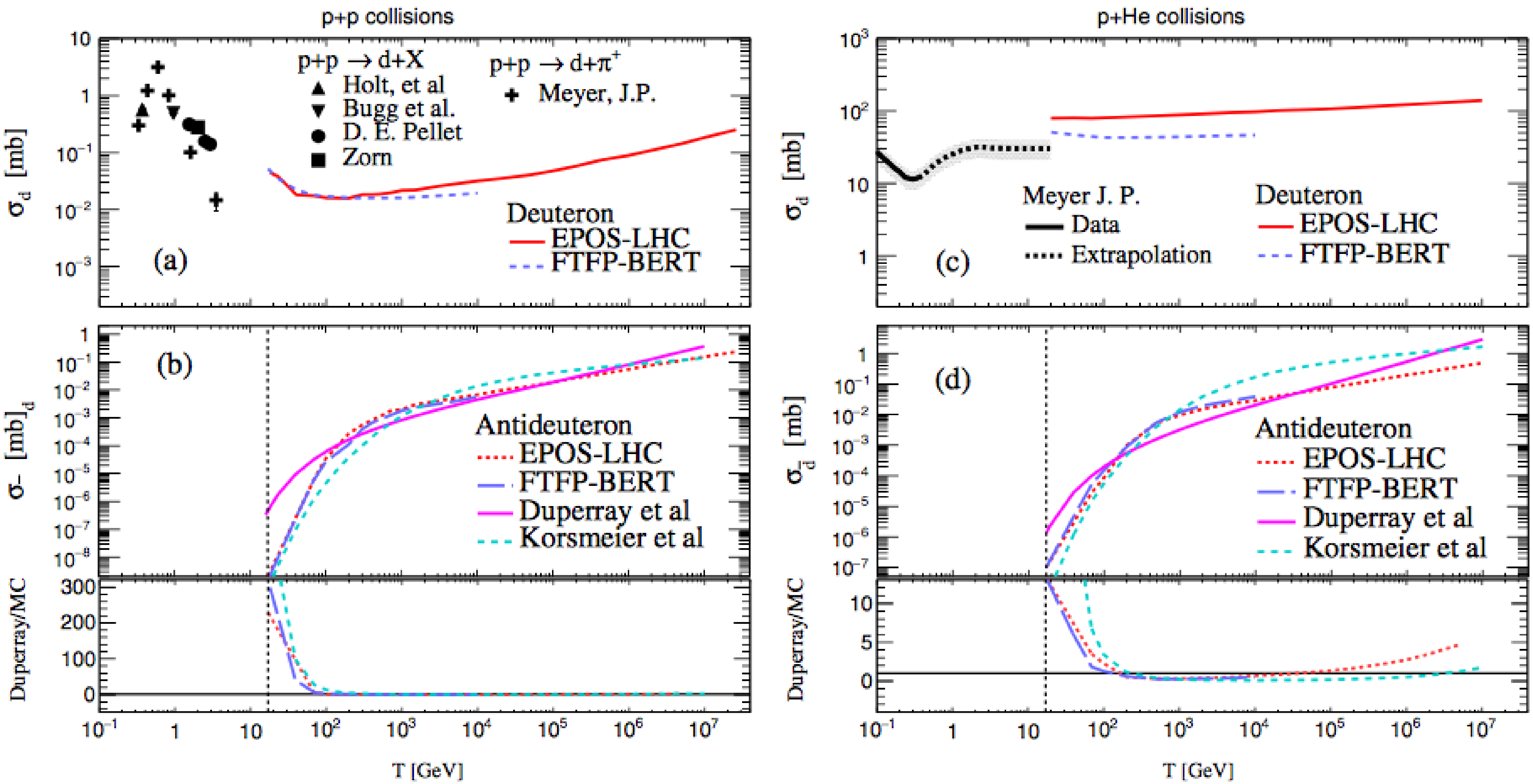
IL NUOVO CIMENTO 47 C (2024) 82

(Anti-)Deuteron production energy dependence



Diego Mauricio Gómez Coral, PhD Thesis (2014-2019)

From P_0 to x-sections for collisions of interest to CR's

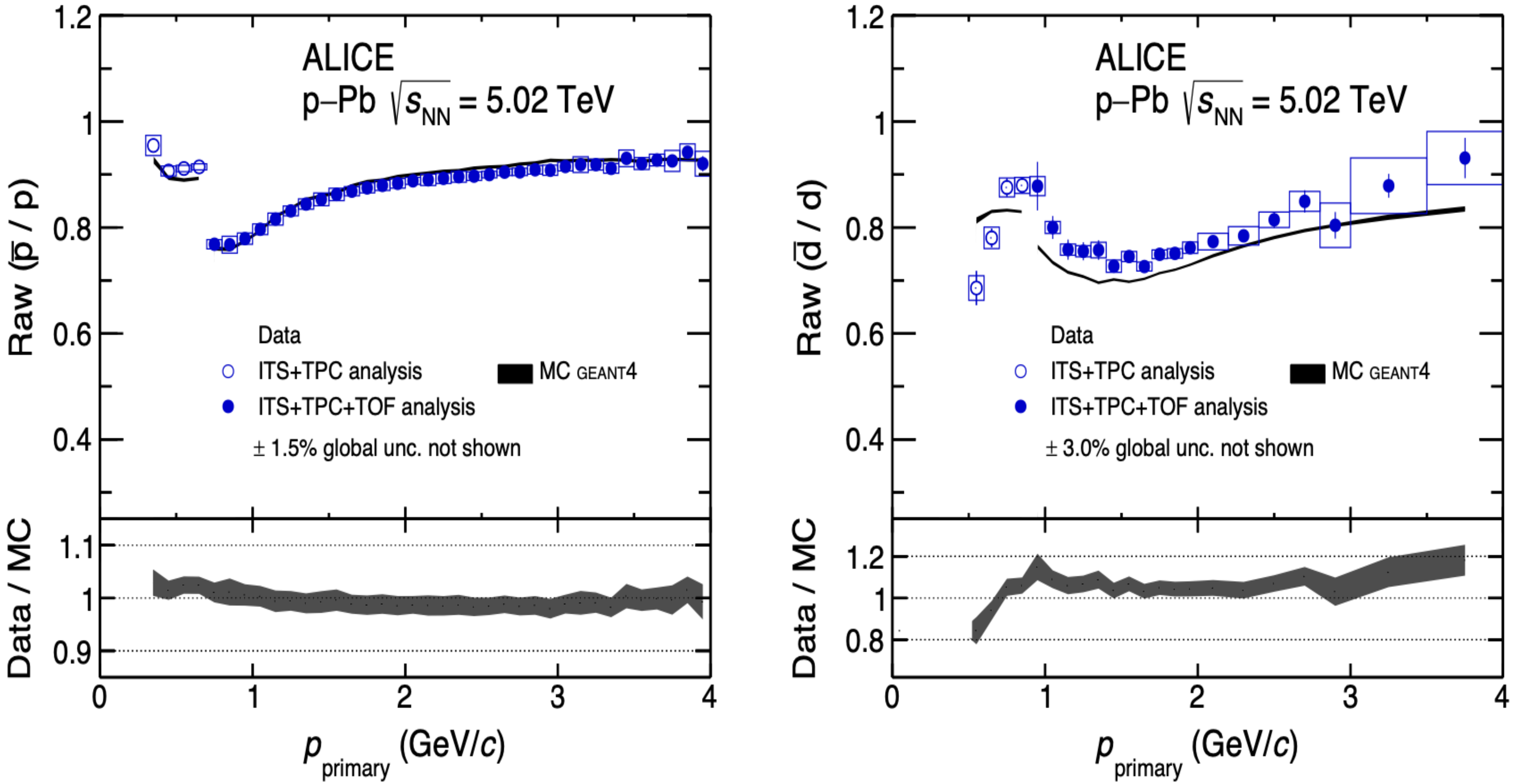


PHYSICAL REVIEW D **98,** 023012 (2018)

Diego Mauricio Gómez Coral, PhD Thesis

Equivalent for d-Pb

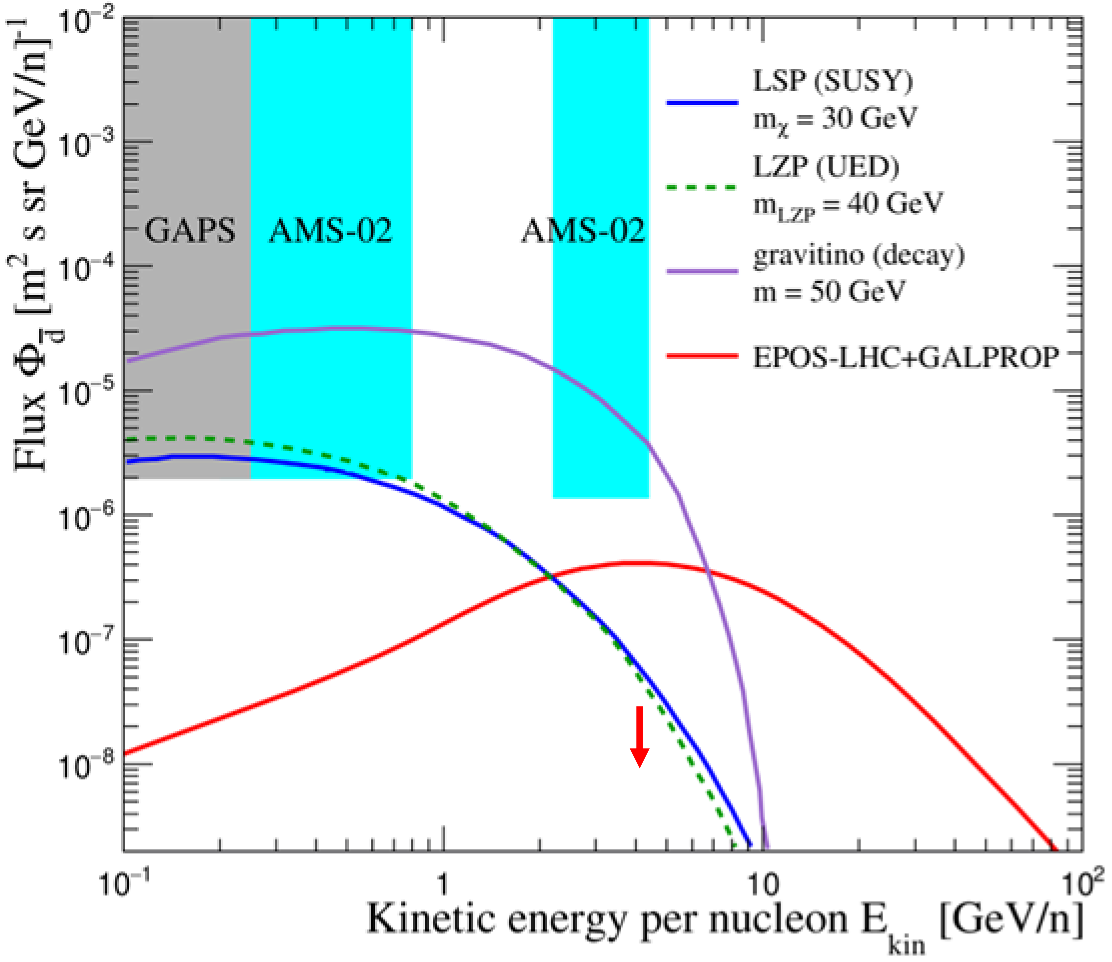
cosmos p-Pb/pp $\approx 10^{-10}$



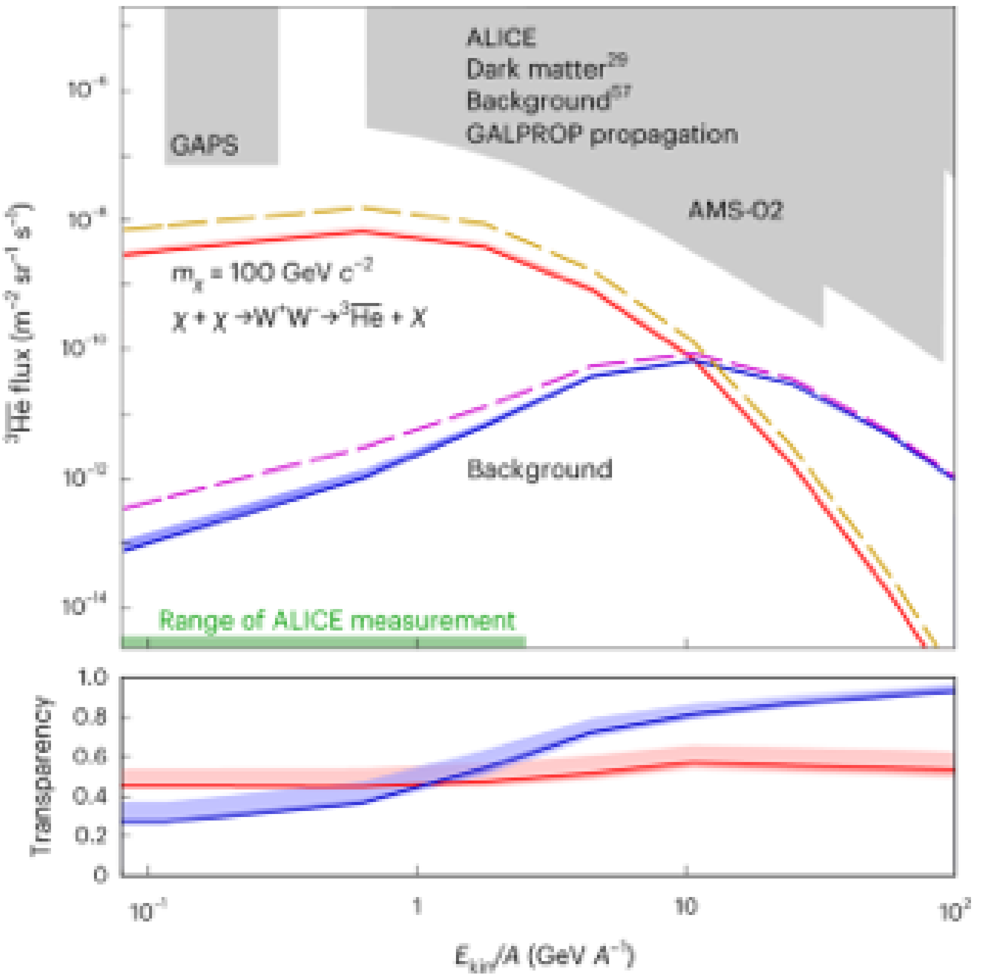
PHYSICAL REVIEW LETTERS 125, 162001 (2020)
ALICE

X-sections to predict SM Cosmic Background

Antideuteron background



Anti- ^{3}He background



Journal of Physics: Conference Series 1602 (2020) 012005
Diego Mauricio Gómez-Coral et al.

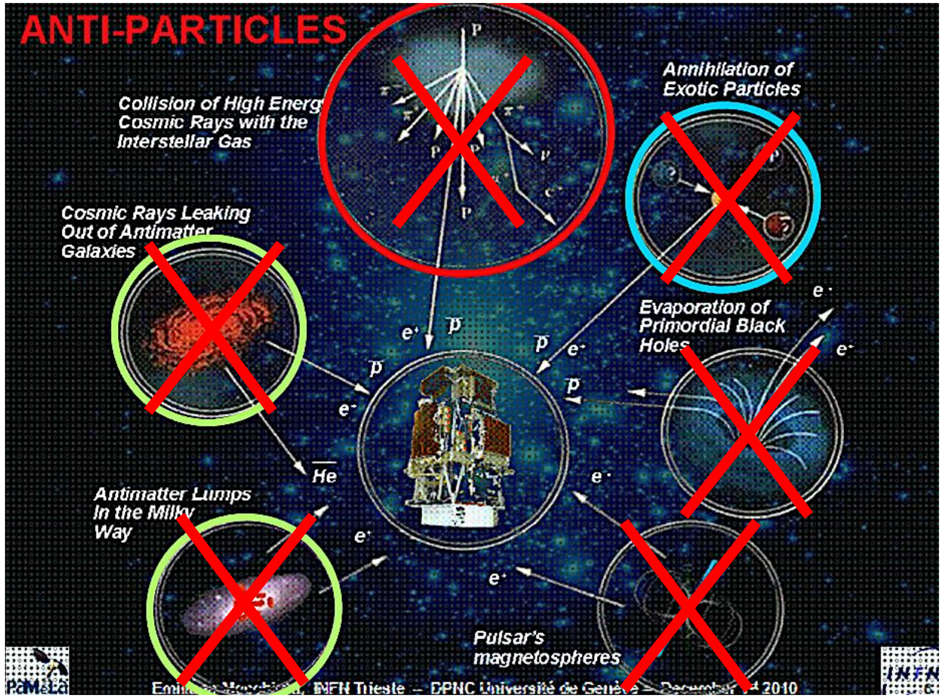
Nature Physics **volume 19**, pages 61–71 (2023)
ALICE

Conclusion: AMS 02 is insensitive to such backgounds

Eppur si muove……

- Near-Earth light anti nuclei flux?

- AMS: preliminary*
  - 7 $\bar{D}$?
  - 10 $\overline{He}$?

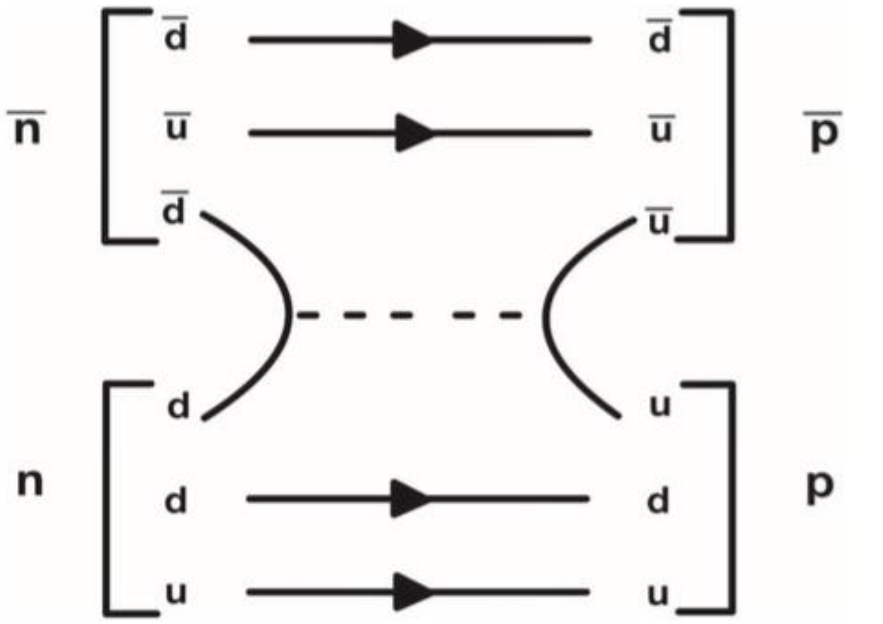


* e.g. V.A. Choutko, AMS days at la Palma (2018)

Is the coalescence assumption, correct?

(Fabiola Lugo @ 10:25 am)

$$E_A \frac{d^3N_A}{dp_A^3} = B_A \left(E_p \frac{d^3N_p}{dp_p^3}\right)^Z \left(E_n \frac{d^3N_n}{dp_n^3}\right)^N := B_A \left(E_N \frac{d^3N_N}{dp_N^3}\right)^A$$



J. Phys. G: Nucl. Part. Phys. 51 (2024) 035005

ALICE anti-matter @ Nature? 40%

- Precision measurement of the mass difference between light nuclei and anti-nuclei
  Nature Phys. 11 (2015) 811–814 ✓
- Enhanced production of multi-strange hadrons in high-multiplicity proton–proton collisions
  Nature Phys. 13 (2017) 535-539
- Unveiling the strong interaction among hadrons at the LHC
  Nature volume 588, pages 232–238 (2020)
- Direct observation of the dead-cone effect in quantum chromodynamics /
  Nature volume 605, pages 440–446 (2022)
- Measurement of anti-3He nuclei absorption in matter and impact on their propagation in the Galaxy ✓
  Nature Phys. 19 (2023) 61-71

Thanks!

menchaca@física.unam.mx