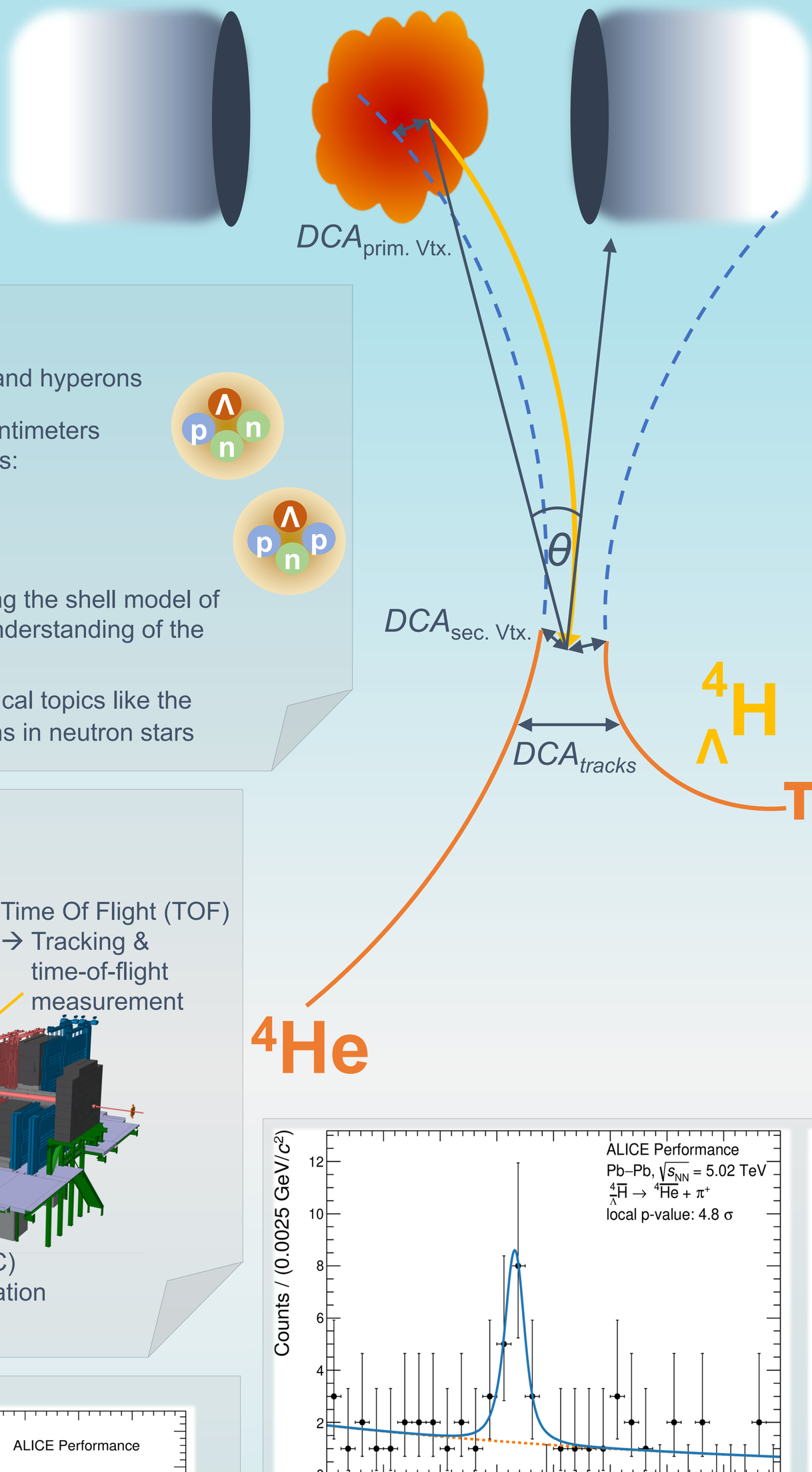
ALICE as an (anti)hypernuclei factory

Janik Ditzel[1] for the ALICE Collaboration

[1]Goethe-University Frankfurt am Main



Hypernuclei…

… are bound states of nuclei and hyperons

… decay weakly after a few centimeters in the following decay modes:

$^4_\Lambda\text{H} \rightarrow {}^4\text{He} + \pi^-$

$^4_\Lambda\text{He} \rightarrow {}^3\text{He} + p + \pi^-$

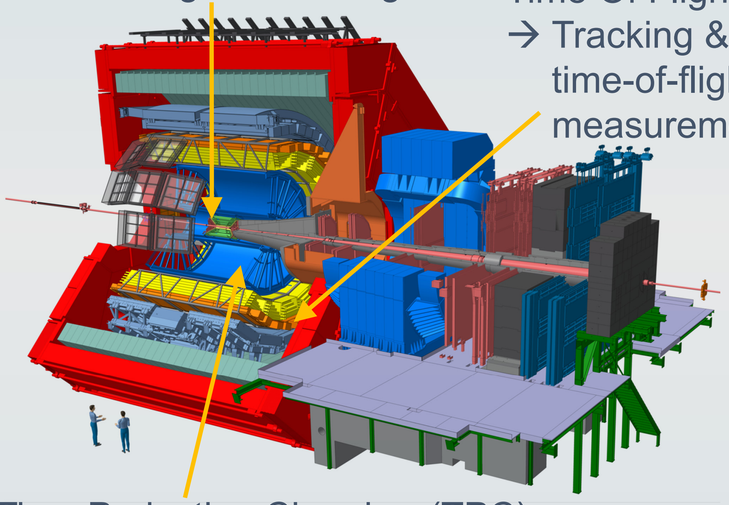
… are a unique probe for testing the shell model of nuclei and to improve the understanding of the Y-N interaction

→ impact on astrophysical topics like the existance of hyperons in neutron stars

ALICE Setup

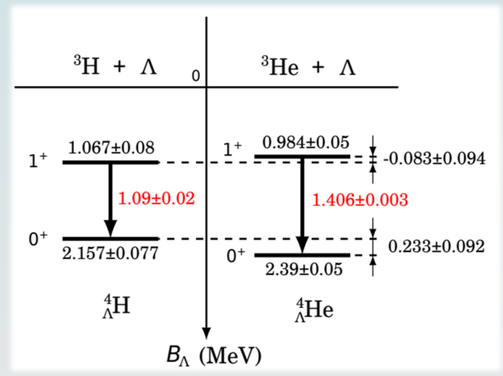
Inner Tracking System (ITS)
→ Tracking & Vertexing

Time Of Flight (TOF)
→ Tracking & time-of-flight measurement



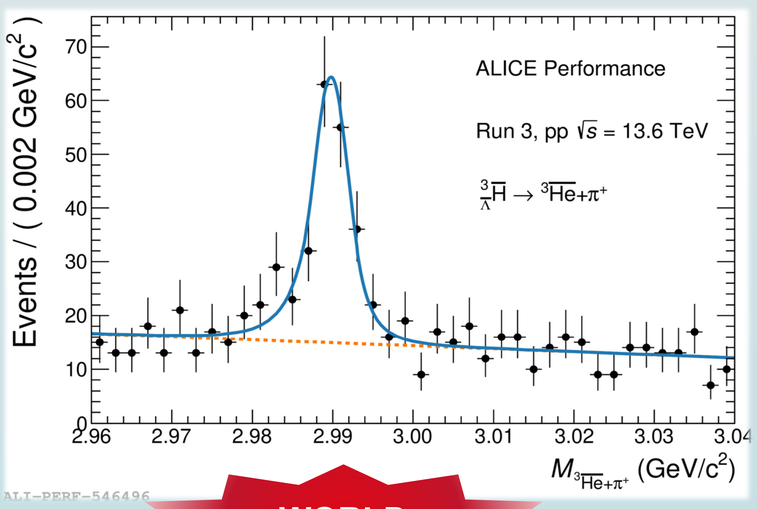
Time Projection Chamber (TPC)
→ Tracking & Particle Identification via specific energy-loss

- Production of several particle species in heavy-ion collisions is well described by the Statistical Hadronization Model (SHM)
- Suppression of the production yield by adding one nucleon to a nucleus is about 300 in Pb-Pb collisions
- The yields of $^4_\Lambda$H and $^4_\Lambda$He are enhanced by a factor 4 with respect to the ground state due to the feed-down from excited states
- Yields of the SHM also scale with the spin degeneracy (2J+1)
- The large difference of the mass of $^4_\Lambda$H and $^4_\Lambda$He can be used to address the charge-symmetry breaking (CSB) of hypernuclei, which is not understood by the theory

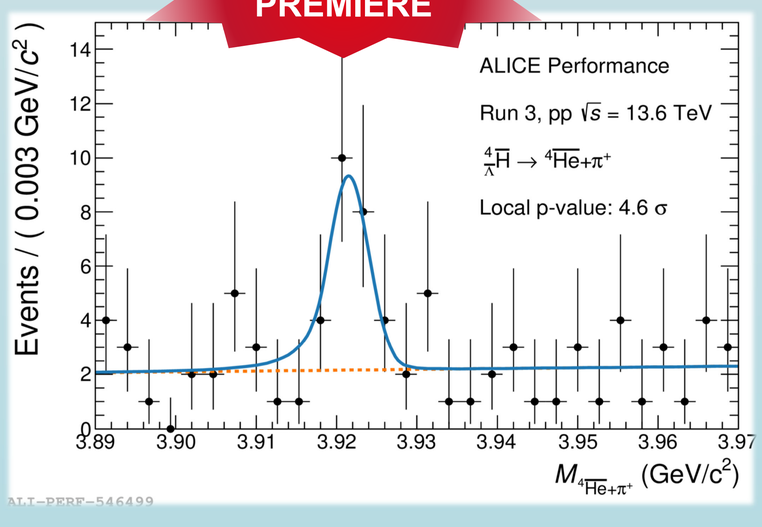


M. Schäfer, N. Barnea, A. Gal, Phys.Rev.C 106, L031001 (2022)

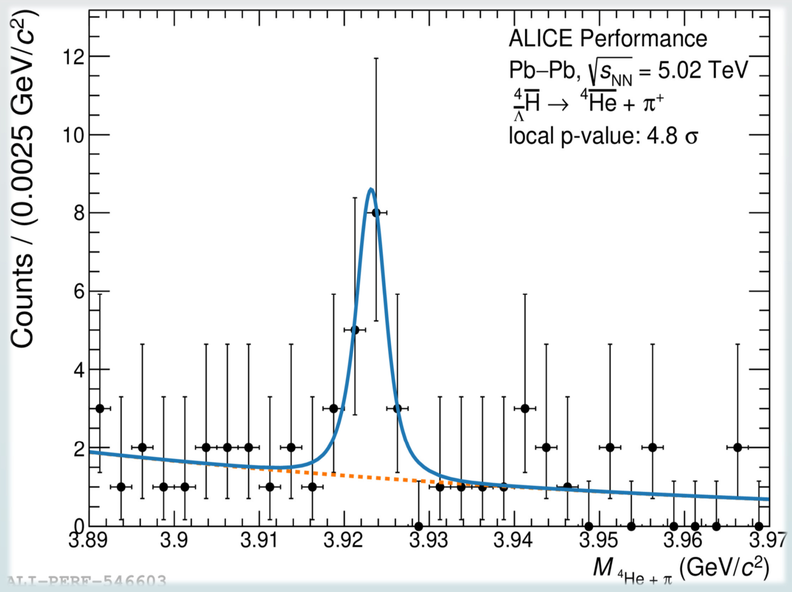
^{4}He

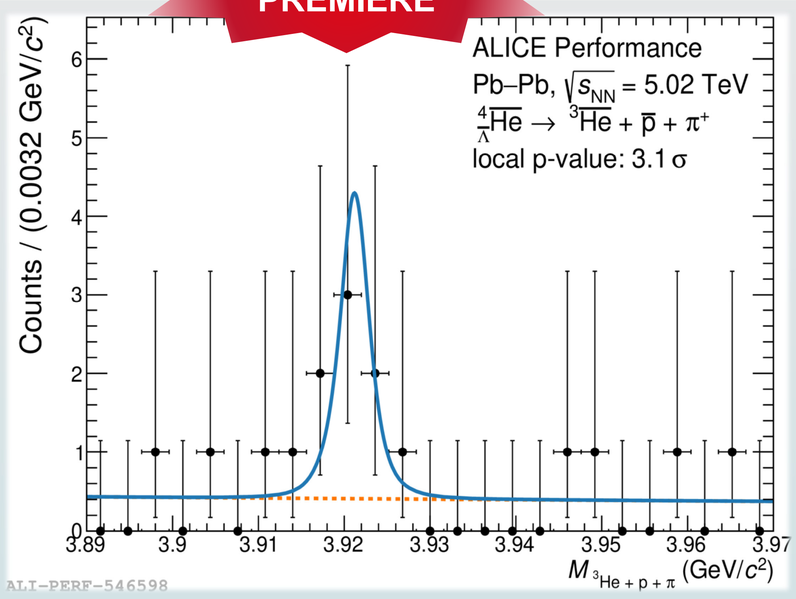


WORLD PREMIERE



First results from the ongoing Run 3





WORLD PREMIERE

First measurement of (anti)$^4_\Lambda$H and (anti)$^4_\Lambda$He at the LHC

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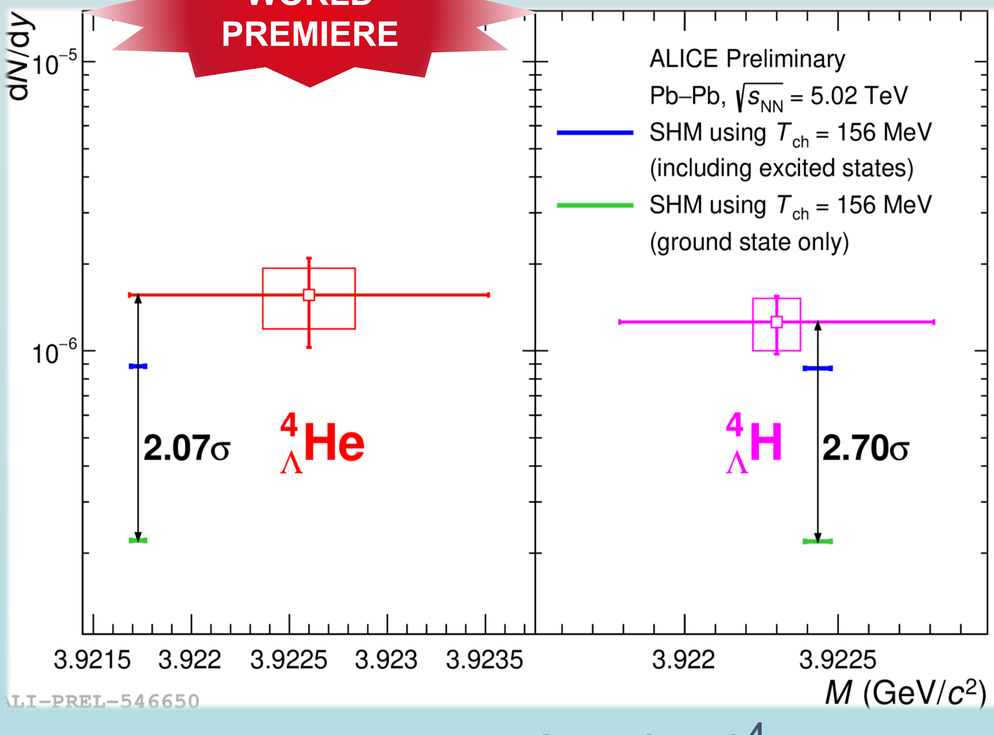

- → Testing the dependence of the yields of the SHM with the spin degeneracy
- → Our yields confirm the existence of excited states for both (anti)hypernuclei: discrepancy with respect to the ground state only > 2σ
- → Mass measurement dominated by statistical uncertainties
  - will be measured with unprecedented precision with Run 3
  - this will allow for the study of the CSB

First ever measurement of the (anti)$^4_\Lambda$He production yield