1. Introduction

- LHC energies lead to large production probabilities for (anti-)(hyper-)nuclei and exotic states.
- At these energies large and equal amounts of particles and antiparticles are produced in the mid-rapidity region.

Production mechanism:

THERMAL MODEL

- Hadrons emitted from the interaction region at the chemical freeze-out temperature ($T_{\text{ch}}$).
- Abundance of species $\propto \exp(-m/T_{\text{ch}})$.
- (Hyper-)nuclei large m, strong dependence on $T_{\text{ch}}$.

COALESCENCE MODEL

- (Anti-)nucleons close in the phase space at the kinetic freeze-out can form a (anti-)nucleus.
- Formation probability can be quantified through the coalescence parameter $B_0$.
- A naive approach $B_0$ is expected to be independent of $p_T$ and centrality.

2. ALICE

Excellent particle identification and high performance tracking and vertexing allow one to:

- Measure the production of (anti-)(hyper-)nuclei and exotic states.
- Probe difference in ($\sigma$)

(a) nucleon interaction encoded in (anti-)nuclei masses

(b) Mass-over-charge ratio measured with the TOF

c) The binding energy of nucleus A

- $\Delta E / m_A$ measured with SHARE.

3. Nuclei

$p_T$ spectra:

- $d$- and He-Pb-Pb spectra become harder as the centrality increases.
- Blast-Wave fit to obtain transverse expansion velocity and kinetic freeze-out temperature.
- Coalescence parameter $B_0$ and $B_1$:
  - Decrease with increasing centrality: $B_0 = E_{\text{kin}}$, where $E_{\text{kin}}$ is source volume.
  - $p_T$ dependence for central collisions in contrast with the simple model (ii).

4. Hypertriton

- Light (anti)nuclei mass difference

- Probe difference in (anti)nuclei interaction encoded in (anti)nuclei masses

- Mass-over-charge ratio measured with the TOF.

- $\Delta E / m_A$:

- $\Delta E / m_A$ measured with SHARE.

5. Exotica

- H-dibaryon and $N$ bound state discovery would be important as it would provide crucial information on the $\Lambda$-nucleon and $\Lambda$-nucleation interaction.

- H-dibaryon is a hypothetical bound state of two neutrons ($\Lambda\Lambda$), first predicted by R.L. Jaffe (ii) using a bag model approach.

- Prediction from thermal model ($T_{\text{ch}} = 156$ MeV)

- $dN/dy = 6.03 \times 10^{-4}$ for H-dibaryon

- $dN/dy = 4.06 \times 10^{-3}$ for $\Lambda\Lambda$

- ALICE upper limits are a factor 20 below these model predictions for the A-free lifetime.

6. Conclusion and perspective

- (Hyper-)Nucleon production in heavy-ions collisions described by equilibrium thermal model ($T_{\text{ch}} = 156$ MeV) and coalescence model.

- ALICE tested the CPT symmetry in the nucleon sector with an excellent precision.

- H-dibaryon and $N$ search in Pb-Pb lead to upper limits which are at least one order of magnitude lower than thermal model predictions.

- ALICE measured the $\Lambda\Lambda$ lifetime in the charged mesonic 2-body decay channel and started the analysis in the 3-body decay channel ($\Lambda\Lambda \rightarrow p\pi + \gamma$). Run2 will be crucial to improve the resolution on this measurement.

- LHC Run2 will allow to enhance the measurements in the nucleon sector thus improving the constraints on the theoretical models (e.g., coalescence).

- Very good improvement in (anti-)nuclei/jammer studies thanks to the ALICE Upgrade Program in Lb2S.