**Nuclei Measurements in Run 3 with ALICE**

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**The Production Mechanism of Light (Anti)nuclei in High-Energy Collisions**

The production mechanism of light (anti)nuclei in high-energy collisions is not fully understood. Their low binding energy ($B_N \sim 2$ MeV) and large mass implies that their formation is extremely sensitive to the chemical freeze-out temperature ($T_{\text{chem}} \sim 100$ MeV).

Measuring light (anti)nuclei production in controlled conditions can be used to constrain the dominant background for dark matter searches in space. Antimatter produced in cosmic ray interactions with interstellar medium.

**The Statistical Hadronization Model**

The hadrons are emitted from the interaction region in thermal equilibrium when the fireball reaches the chemical freeze-out. The abundance of produced hadrons is strongly dependent on their mass $m$ and the freeze-out temperature $T_{\text{chem}}$ as

$$dn/dy \propto \exp(-m/T_{\text{chem}}).$$

Light (anti)nuclei abundance is not strongly affected by resonance decays (feed-down). The SHM can be extended from high- to low-multiplicity systems via canonical formulation.

In this model, nuclei are produced at the same time with other light hadrons. Model parameters are extrapolated from fitting the experimental data.

**The Coalescence Model**

The nucleons produced close to each other in the phase space can be bound and form an (anti)nucleus by means of final state interactions.

The formation probability is related to the coalescence parameter $B_N$, experimentally estimated as

$$B_N \propto d^3N/dy^3 dE/dy.$$

The state-of-the-art coalescence model is based on the Wigner-function approach: the nucleons' relative momentum and position and the nucleon wavefunction are considered.

The dependence of coalescence probability on the final-state charged-particle multiplicity is related to the nucleons' source size ($pp$ vs $Pb-Pb$). High multiplicity ($Pb-Pb$) implies a significant drop observed, effect of space separation in a large source ($\sim$2.5 fm radius).

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References