Measurement of (anti-) ^{3}He elliptic flow in Pb-Pb collisions and of (anti-) ^{3}He production in p-Pb collisions with ALICE at the LHC

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Physics motivation

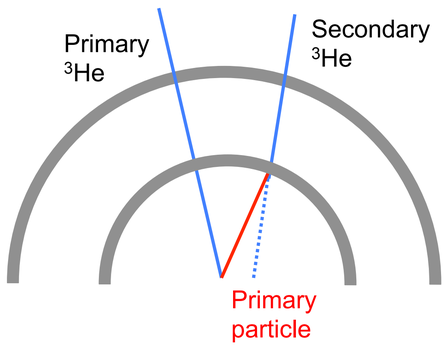
Study production mechanism of ^{3}He in high-energy hadronic collisions by comparing results from different collision systems to existing models

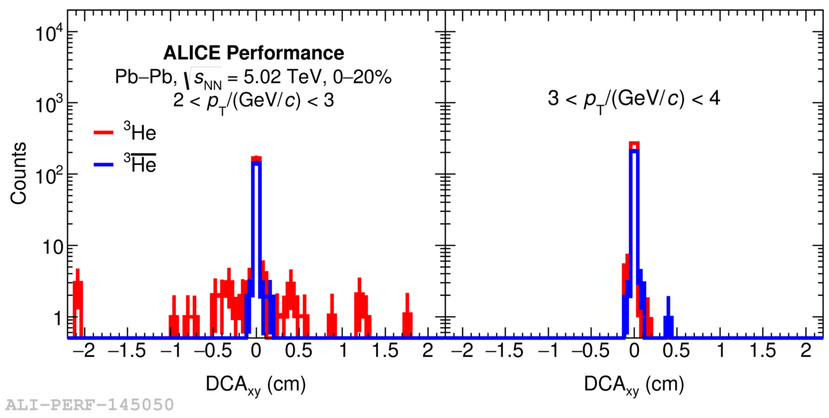
- Test predictions on the elliptic flow of ^{3}He in Pb-Pb collisions from coalescence [1] and Blast-Wave (BW) model [2].
- Add constraints to coalescence approach by measuring ^{3}He production, ^{3}He/p and B_3 vs. multiplicity in p-Pb collisions

Secondary ^{3}He from material

Secondary ^{3}He produced by spallation in interactions between high-energy particles and the detector material

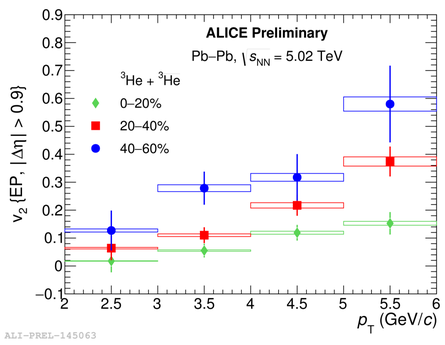
➢ Experimentally separated using the distance to closest approach (DCA) of the ^{3}He track to the primary vertex





Contribution from secondary ^{3}He negligible (<0.3%) for p_T > 2 (3) GeV/c in p-Pb (Pb-Pb) collisions

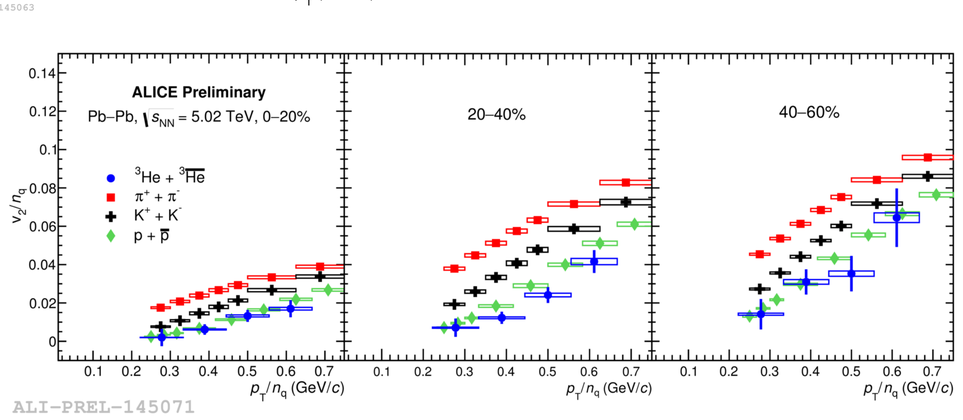
Results: v_2 in Pb-Pb collisions



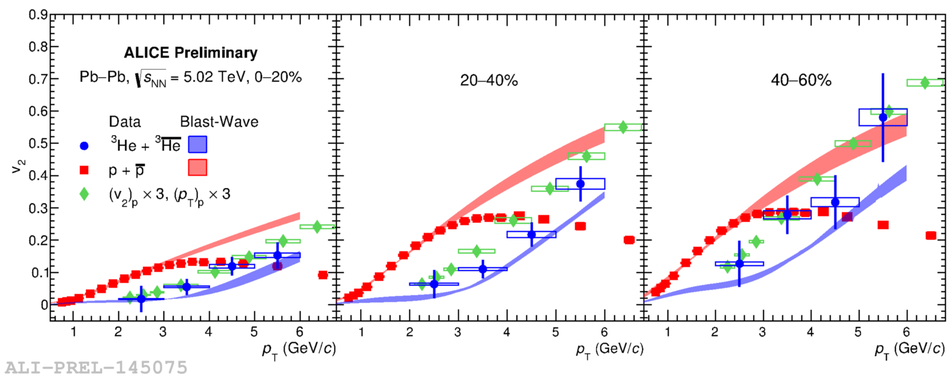
Elliptic flow of ^{3}He measured in Pb-Pb collisions for the first time

➢ Heaviest baryon whose flow is measured

n_q-scaling is violated for all charged particles (observed also for deuterons in Pb-Pb collisions at 2.76 TeV [3]).



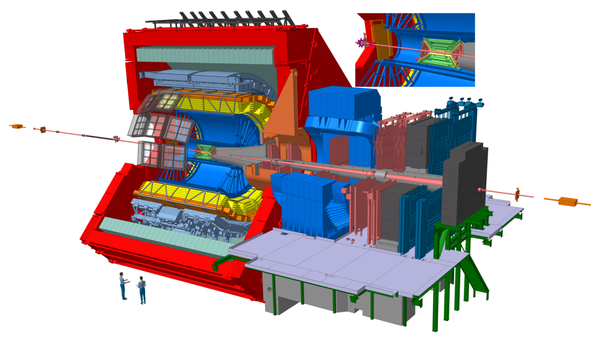
Coalescence predictions and BW based on π, K, p fail to describe the measured v_2 of ^{3}He

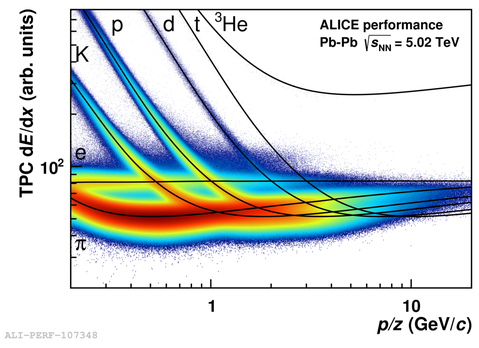


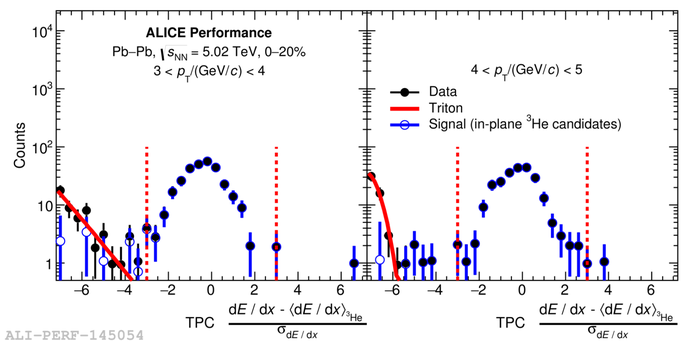
^{3}He identification

^{3}He identification using the dE/dx measured by the Time Projection Chamber (TPC)

➢ Excellent separation from other particle species







Contribution of tritons relevant only at low rigidity

➢ Described using (skewed) gaussian fit

Elliptic flow measurement

^{3}He elliptic flow in Pb-Pb collisions measured using the Event Plane (EP) method

$$v_2(p_T) = \frac{\pi}{4R_2} \frac{N_{in-plane}(p_T) - N_{out-plane}(p_T)}{N_{in-plane}(p_T) + N_{out-plane}(p_T)}$$

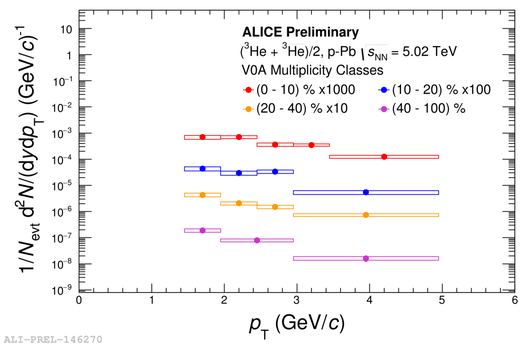
Event plane angle measured by two forward scintillators:

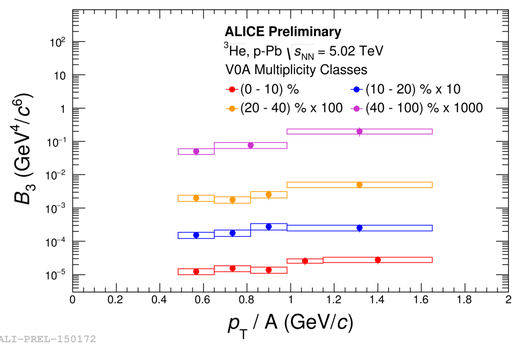
- V0-A: 2.8 < η < 5.1
- V0-C: -3.7 < η < -1.7

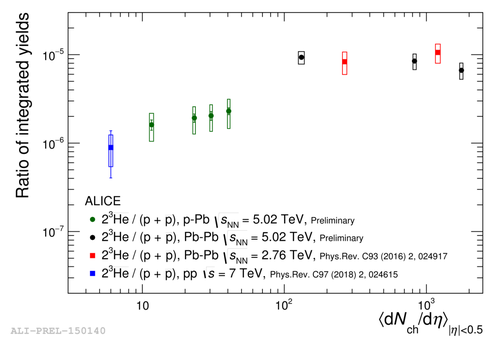
R_2 = resolution of the event plane angle measurement

➢ using the three sub-events method ($\eta_{TPC} > 0$, $\eta_{TPC} < 0$, V0)

Results: ^{3}He vs. multiplicity in p-Pb collisions







^{3}He measured in 4 multiplicity classes

➢ $^3\overline{\text{He}}$/^{3}He consistent with 1 within uncertainties

Coalescence parameter B_3:

➢ Increases vs. p_T/A

➢ Decreases with increasing multiplicity

^{3}He/p increases with multiplicity

➢ Qualitatively explained by coalescence

References

[1] J. I. Kapusta, Phys. Rev. **C21**, 1301 **(**1980**).**
[2] E. Schnedermann *et al.*, Phys. Rev. **C48**, 2462 (1993).
[3] S. Acharya (The ALICE Collaboration), Eur. Phys. J. **C77**, 658 (2017).