Unfolding the effects of FSI and QS in two-particle angular correlations

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The ALICE Collaboration has found that all baryon-baryon pairs show a **depression (anticorrelation)** instead of a typical near-side peak.

- Baryon-antibaryon pairs or meson pairs produce “expected” correlation shape.

\[ \Delta \eta \Delta \phi \] of baryons


\[ \text{pp + } \text{p} \bar{p} \]

\[ \rho \Lambda + \bar{\rho} \bar{\Lambda} \]

\[ \Lambda \Lambda + \bar{\Lambda} \bar{\Lambda} \]

\[ \text{pp @ } \sqrt{s} = 7 \text{ TeV} \]

“strange” small peak at (0,0) strongest for pp pairs.
What is the origin of the "small peak" in pp correlations?

- The peak seems to behave **strangely** → decreases with increasing $p_T$
- Is it an unnoticed and not removed **detector effect** OR is there some **physics behind it**?
  - the **ALICE paper claims** it is a **manifestation of the strong baryon-baryon final-state interaction** (strong FSI) → how to prove it?
Strong interaction studies with femtoscopy

- Femtoscopy has recently become a powerful tool used to study two-particle interactions.

- Can we use femtoscopic measurements to test the “small peak” hypothesis in the angular correlations?

H. Zbroszczyk, Ph.D. thesis

6 April 2022, QM2022
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Unfolding FSI and QS effects

In our new paper we propose a simple algorithm to unfold the angular correlation from measured femtoscopic one

- we test the method with PYTHIA 8 simulations coupled to Lednicky and Lyuboshitz formalizm
- we show how the effects of strong FSI and QS manifest in angular correlations

Ł.G. & M.J., PRC 104, 054909 (2021)
Unfolding procedure

- **Direct transformation** from $C(k^*)$ to $C(\Delta\eta\Delta\phi)$ **not possible**
- **We propose a simple Monte Carlo procedure**
  - we obtain the angular correlation function by **sampling** the measured (or theoretical) femtoscopic correlation
  - femto CF has **increased sensitivity** to **short-range effects** (i.e. strong FSI), and **reduced sensitivity** to **event-wide effects**
    → the global energy-momentum conservation shape is not preserved in unfolded angular CF
    → the strong FSI is well-preserved and clearly seen as a sharp, narrow peak at (0,0), which proves the ALICE hypothesis
    → weaker femto CF for $p\Lambda$ and $\Lambda\Lambda$ pairs (weaker contribution from strong FSI) → less prominent “small peaks” in angular CF

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**RATIO**

**UNFOLDED FROM FEMTO CF**

**PYTHIA WITH LEDNICKY SIMULATED QS+FSI**

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