Three-Body Interactions

- Crucial to solve the hyperon puzzle
- Study of exotic bound states such as kaonic nuclei
- Extraction of the three-body interactions from (hyper-)nuclei data requires:
  - a good understanding of their shell-structure
  - spin-dependent two-body interactions
- New experimental approaches essential to pin down the three-body interactions with less model dependency!

Femtoscopy Technique

$$C(k^*) = \xi(k^*) N^{\text{same}}_k \frac{N^{\text{mixed}}_k}{N^{\text{mixed}}_{k'}} = \int S(r^*) |\psi_k(r^*)|^2 d^3r^*$$

- Final-state interactions

Three-Hadron Correlations

- Three-particle correlation function:
  $$C(Q) = \xi(Q) \frac{N^{\text{same}}_k}{N^{\text{mixed}}_k}$$

- Projector method: independent two-body interactions in three-body system [5]
- Good agreement with observed p-p-K$^-$ (1.5 $\sigma$) and p-p-Λ (0.8 $\sigma$) correlation functions
- 6.7 $\sigma$ deviation in the p-p system
- Three-body calculations need to include:
  - genuine three-body strong interaction
  - long-range Coulomb interaction
  - Pauli blocking

Proton-Deuteron Interactions

- Overall repulsive interaction observed for p-d system
- Lednický: point-like particles, deuteron structure not taken into account
- Using expected radius and available scattering parameters → huge discrepancy with data
- More sophisticated model needed!

PISA calculation: full wave function including three-body interactions
- Best description of data using expected radius and including both s- and p-waves

- Predicted few percent sensitivity to the genuine three-body interactions!

Outlook: Run 3 data and theory

- Preliminary PISA results qualitatively predict the observed correlation function!
- Developed offline two- and three-body triggers ready to record all events of interest!
- Up to x60 more triplets at $Q_3<0.6$ GeV/c!

Genuine three-body interactions will be accessible in Run 3!