**Femtoscopic studies on proton-Ξ^- and proton-Ω^- correlations with ALICE**

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### Femtoscopic studies

**Based on the correlation function:**

\[ C(k^*) = \frac{P(p_a, p_b)}{P(p_a)P(p_b)} \]

where \( k^* \) = reduced relative momentum, with \( p_a^2 + p_b^2 = 0 \).

**Experimentally obtained as:**

\[ C(k^*) = \frac{N_{\text{Same}}(k^*)}{N_{\text{Mixed}}(k^*)} \]

- Generally, the experimental correlation function accounts for the genuine correlation and is affected by residual correlations and finite momentum resolution [1].

- Theoretically formulated as:

\[ C(k^*) = \int \Delta r(r, k) |\psi(r, k)|^2 dr \]

### Data analysis

**pp collisions at \( \sqrt{s} = 13 \text{ TeV} \) of ALICE Run 2**

- Analyzed 10^6 events
- High multiplicity (HM) trigger: 0.1% highest multiplicities with respect to Minimum Bias

- 9.3\times10^5 Ξ^-\Xi^- selected candidates
  - Identified by \( \Xi^-\rightarrow\Lambda\pi\rightarrow(p\pi\pi) \) decay. Purity 92%.
  - 3\times10^4 Ω^-p-Ω^- pairs at \( k^*<200 \text{ MeV}/c \)

- 1.2\times10^6 Ω^-\Omega^- selected candidates
  - Identified by \( \Omega^-\rightarrow\Lambda k\rightarrow(p\pi\pi) \) decay. Purity 75%.
  - 6.5\times10^6 Ω^-p-Ω^- pairs (700 at \( k^*<100 \text{ MeV}/c \))

### Determination of the source characteristics from the p-p analysis

- **Ansatz:** in small collision systems the source is similar for all baryon pairs.

- **Size of the source core** is determined from the \( k^* \) correlation function.
  - The p-p interaction is well known → determination of the source size.

- Effect of strong short-lived resonances computed for all baryons (statistical hadronization model).

- Theoretical correlation function computed by CATS [2] from the shape of the local potential.

- The size of the source core is determined by the correlation function:

\[ C(k^*) = \int \Delta r(r, k) |\psi(r, k)|^2 dr \]

### References


### ALICE data compared with:

- **Lattice HAL-QCD calculations** [4]
- **ESC16:** Meson exchange model [5]

### p^-Ξ^-:

- At which densities hyperons appears in the core of neutron stars?
  - Do Ξ take part in the picture?
  - Depends on the Ξ single particle potential in pure neutron matter, predicted to be repulsive by Lattice QCD calculations

- **Direct observation of an attractive p^-Ξ^- interaction,** firstly observed by ALICE in p-Pb collisions [6]
  - Coulomb only hypothesis excluded by > 5σ

- Femtoscopic measurements sensitive to differences in potentials

### p^-Ω^-:

- The p-Ω^- interaction can only be accessed experimentally via femtoscopic

- Lattice QCD and phenomenological models predict a N-Ω^- interaction attractive at all distances (\( S^3 \) channel), leading to the possible existence of a NΩ^- di-baryon, with several different predictions for the binding energy (\( E_b \))

- The \( S^3 \) channel is modeled by complete absorption at short distances \( r < 2 \text{ fm} \)

### ALICE data compared with:

- **Lattice HAL-QCD potential with physical quark masses** [7]
  - \( \Sigma^- \rightarrow p^0 \pi^- \) decay. Purity 75%.
  - Sekihara, meson exchange model [8]

### ALICE preliminary:

- Fits [9] to Lattice calculations (HAL-QCD [10]) with heavy quark masses:
  - \( V_\Sigma^- = 6.3 \text{ MeV}/c^2 \)
  - \( V_\Xi^- = 26.9 \text{ MeV}/c^2 \)

- The small source size of pp collisions and the high purity of the sample enhances the sensitivity of the ALICE data to interaction parameters

- The Coulomb-only hypothesis is excluded (~6σ) showing the strong attractive character of the interaction.

- Models predicting large binding energies for the NΩ^- di-baryon are excluded by ALICE data

### References