

A new era of experimental studies on the $\bar{K}N$ interaction

Otón Vázquez Doce (INFN-LNF, otón.vd@cern.ch)

$\bar{K}N$ interaction: building block of non-perturbative regime of QCD

$\bar{K}N$ and $\bar{K}N$ strong interactions are very different:

The presence of the strange quark has dramatic consequences

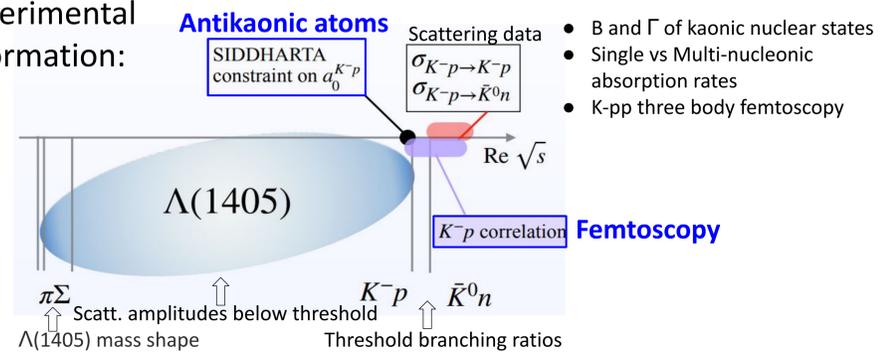
Strong attractiveness in $\bar{K}N$ gives rise to bound states:

$\Lambda(1405)$ is an "old object" not fitting in the standard 3-quark picture

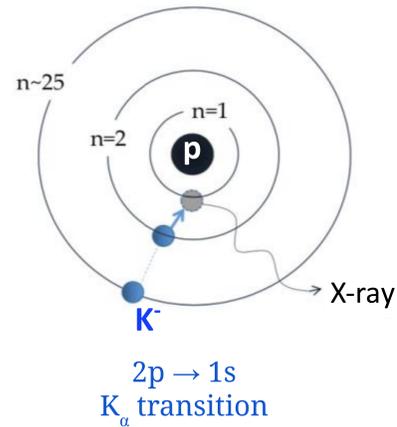
- Molecular state with two poles $\bar{K}N$ - $\Sigma\pi$
- Strong coupled channel dynamics

Theory: modern SU(3) chiral models heavily rely on data

Experimental information:

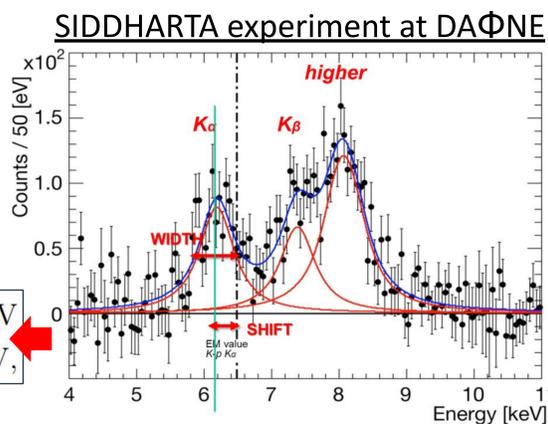


Traditional approach: Antikaonic atoms



Antikaonic hydrogen:

Measurement of the shift(ϵ) and width(Γ) with respect to e.m. value caused by the strong interaction and the presence of inelastic channels



SIDDHARTA Coll. Phys.Lett. B704 (2011)

$$\epsilon_{1s} = -283 \pm 36(\text{stat}) \pm 6(\text{syst}) \text{ eV}$$

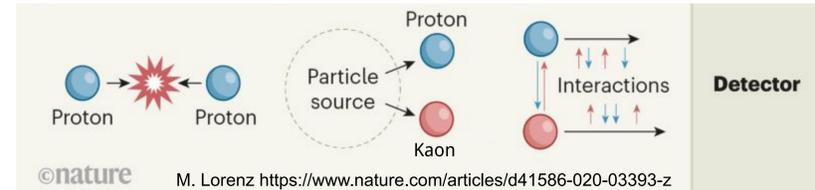
$$\Gamma_{1s} = 541 \pm 89(\text{stat}) \pm 22(\text{syst}) \text{ eV}$$

Translated via Deser-type Formula into a K^+p scattering length that is an average of the $\bar{K}N$ scattering lengths for $l=0$ and $l=1$

$$\epsilon_{1s} - \frac{i}{2}\Gamma_{1s} = -2\alpha^3 \mu_c^2 a_p (1 - 2\alpha \mu_c (\ln \alpha - 1) a_p)$$

New approach: Two-body femtoscopy

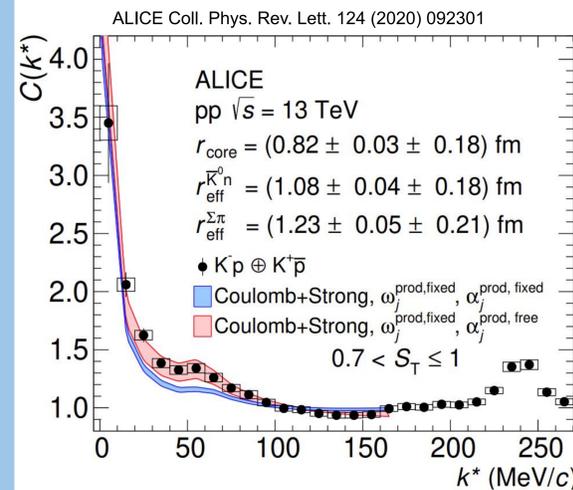
Nucleus-Nucleus (pp, Pb-Pb) collisions at the LHC recorded by ALICE



Correlation function:

$$C(k^*) = \xi(k^*) \frac{N_{\text{same}}(k^*)}{N_{\text{mixed}}(k^*)} = \int d^3r^* S(r^*) |\psi(k^*, r^*)|^2$$

source wave function



⇒ pp collisions

Quantitative test of the interaction and the effect of coupled channels

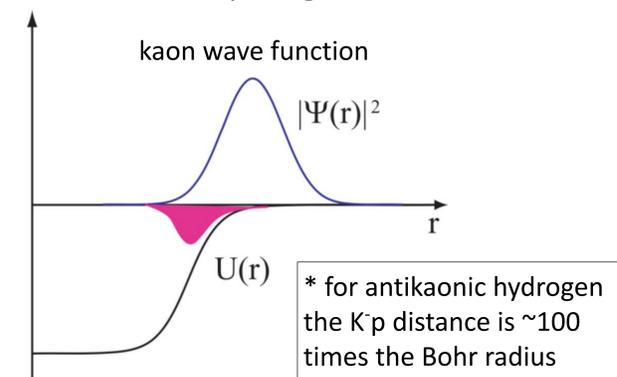
Pb-Pb collisions

Effect of coupled channels negligible: extract scattering parameters

Complementary approaches: $\bar{K}N$ interaction at- and above- threshold

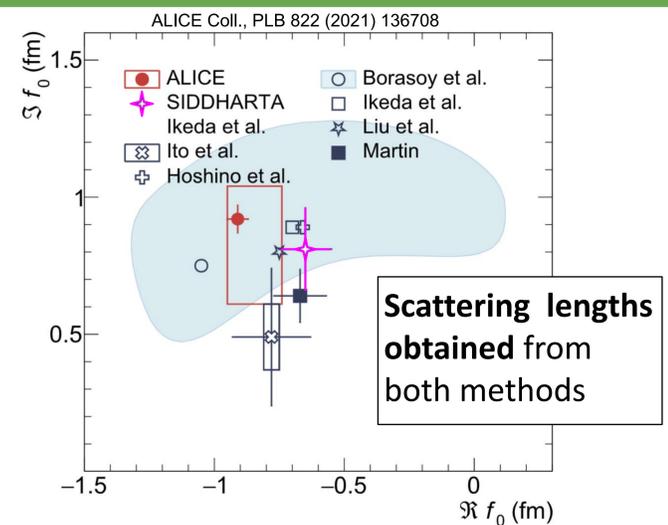
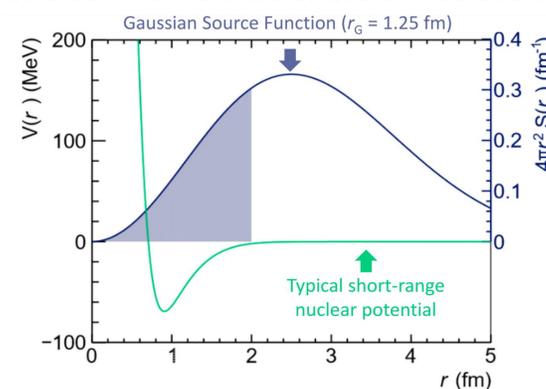
Antikaonic atoms: Kaon wave function

overlaps with nucleon insight into the strong interaction competing with Coulomb

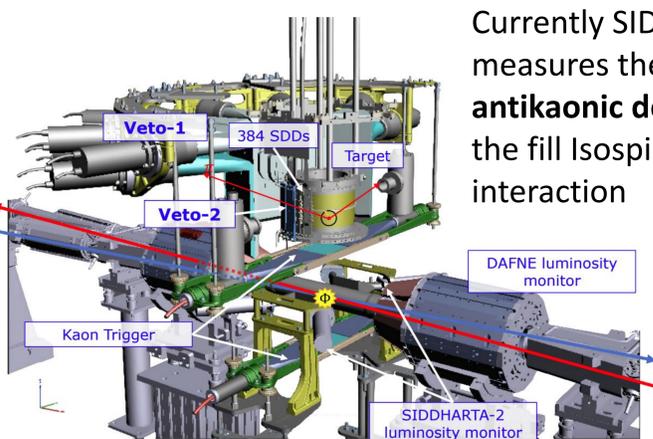


Femtoscopy in small collision systems

Nuclear potential overlaps with particle source ⇒ enhanced effect of interaction



Next steps: K^+n interaction and three-body forces



Currently SIDDHARTA-2 experiment measures the X-ray lines from antikaonic deuterium accessing the full isospin dependence of the interaction

ALICE: Three-body K^+pp femtoscopy enable access to the genuine three-body forces

