Search for higher mass resonances via KK decay channel in pp collisions with ALICE at the LHC

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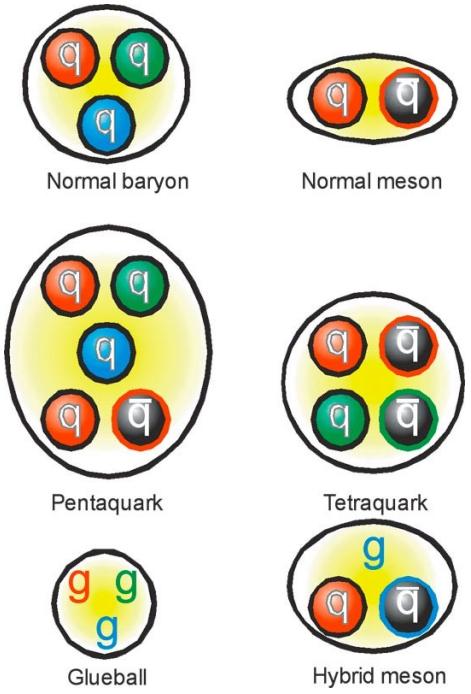
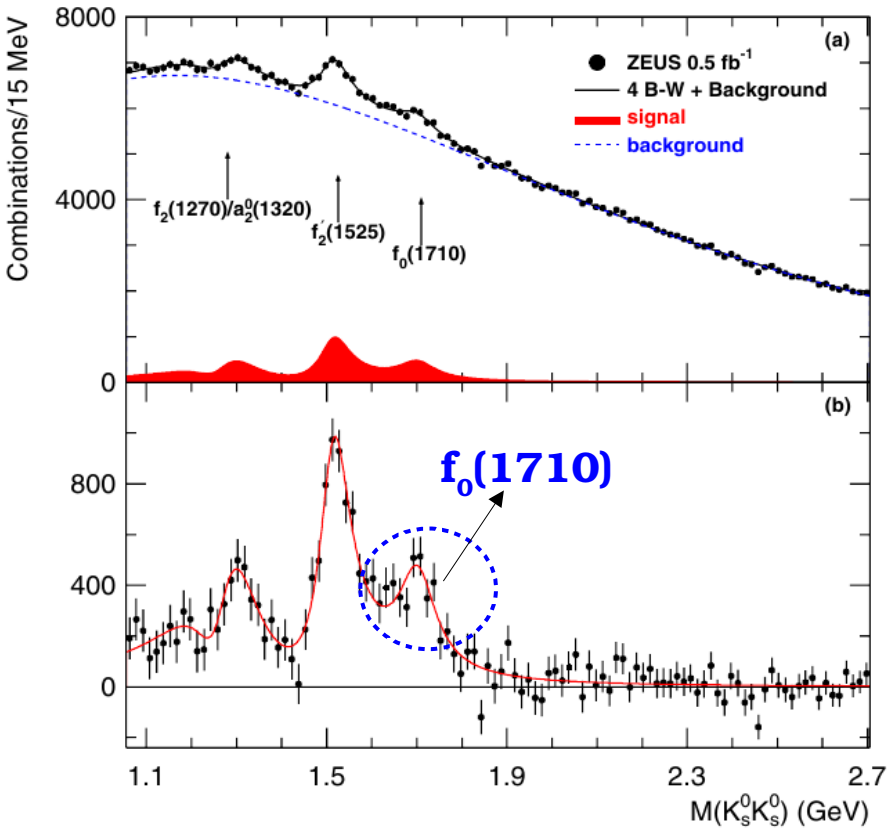


Motivation

Lattice QCD predicts the possible existence of glueballs [1],[2].

[1] S. Chekanov et al. (ZEUS Collaboration),PRL101, 112003 (2008)
[2].P.A. Zyla et al. (Particle Data Group)

K^0_s-K^0_s resonance in ep collisions



Candidates

Mass range : 1550-1750 MeV/c^2

Total angular momentum, charge and parity : J^{PC} (0^{++})

$f_0(1710)$ is the lightest scalar glueball candidate

can we see these states in pp collisions with the ALICE detector ??

In the present study we look for resonances decaying in K^0_s-K^0_s and K^+K^- pairs via invariant mass reconstruction in pp collisions at LHC energies

K^0_s selection and reconstruction of resonances

Data set

Collision system : pp

Center-of-mass energy :13 TeV

Events analyzed : 1.52 x 10^9

Invariant mass method

$$M_R = \sqrt{(E_1 + E_2)^2 - (\vec{p_1} + \vec{p_2})^2}$$

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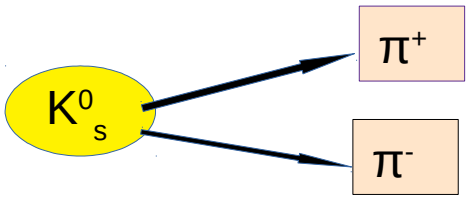


Relativistic Breit-Wigner function (rBW) (for signal): $\frac{M_R \Gamma_0 M_0}{(M_R^2 - M_0^2)^2 + M_0^2 \Gamma_0^2}$

For residual background function (Res.Bkg) : $A(M_R - 2m_0)^B \exp(-C(M_R - 2m_0))$

Fit funtion used for this study [1]

For K^0_s-K^0_s pair : Coherent Breit-Wigner function + Res.Bkg :

c1*|5*rBW{$f_2(1270)$ – 3*rBW{$a_2(1320)$}+2*rBW{$f_2(1525)$}|^2

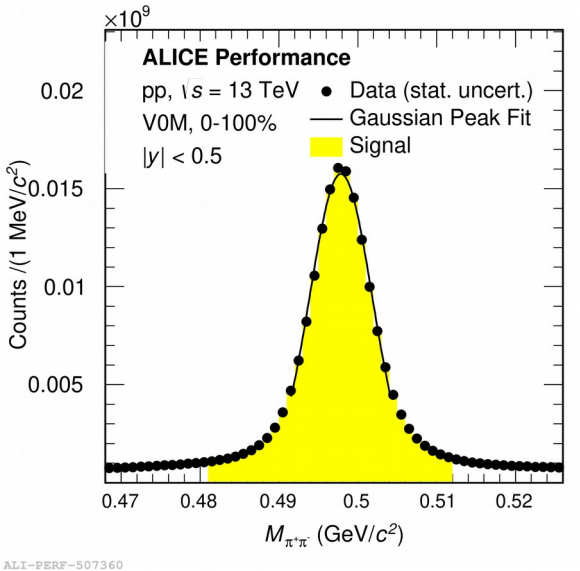
+ c3*|rBW{$f_0(1710)$}|^2,

M_R = mass of reconstructed pair, M_0 = PDG mass of resonance [2],

m_0 = PDG mass of decay daughter of resonance,

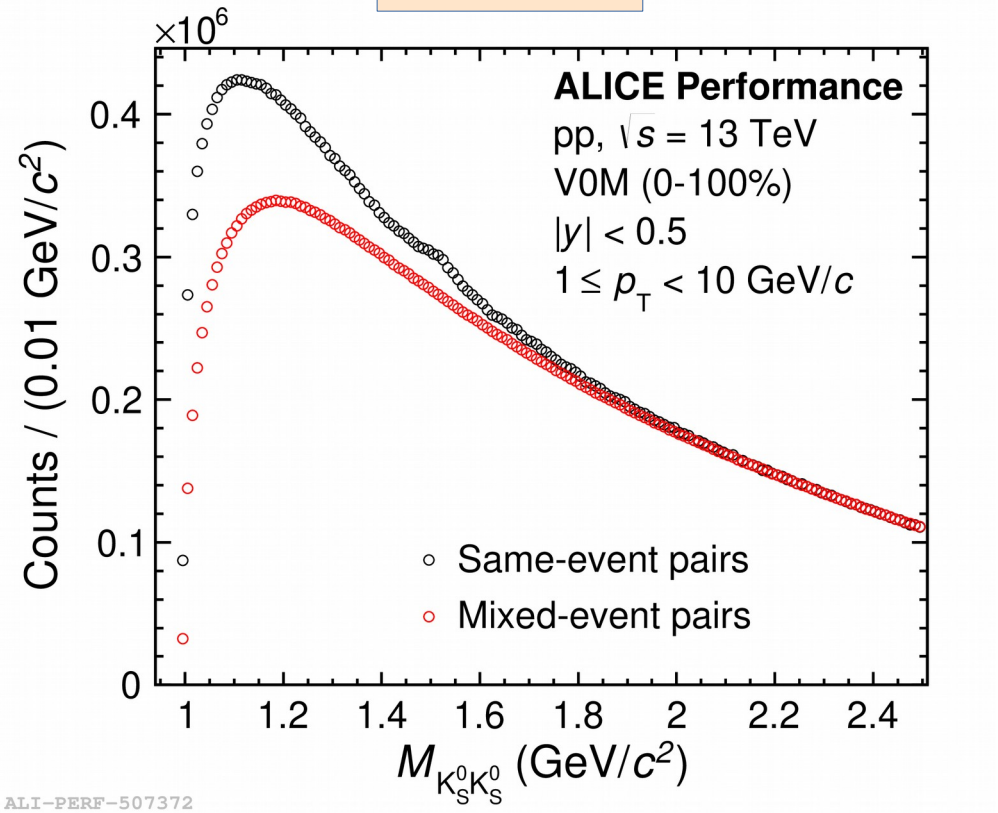
Γ_0 = PDG width of resonance [2] , c1, c3 , A, B, C are free fit Parameters

For K^+K^- pair : Non-coherent Breit-Wigner function + Res.Bkg



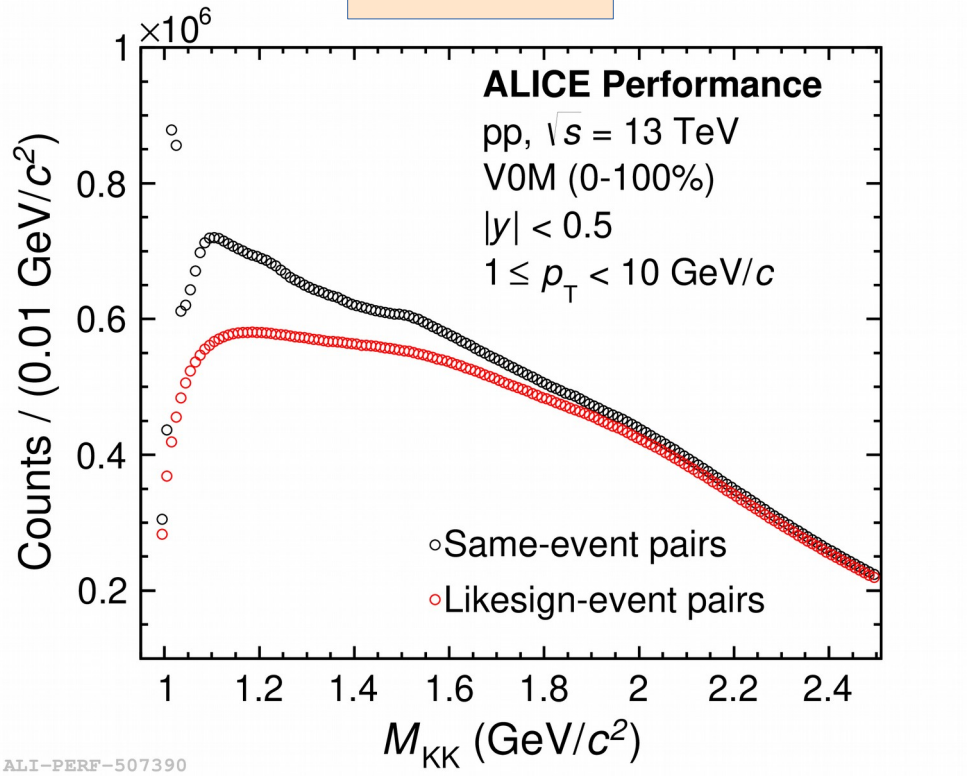
K^0_s-K^0_s and K^+K^- invariant mass distributions

K^0_s-K^0_s pair



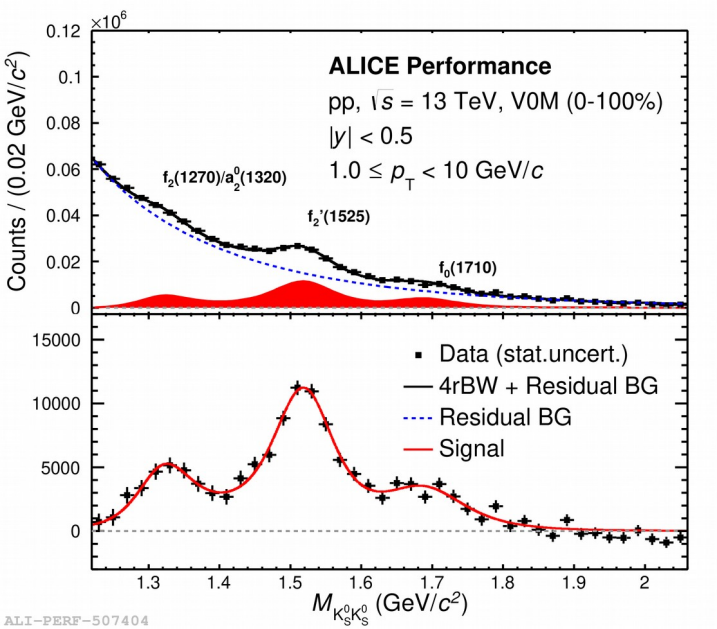
Combinatorial background: Mixed-event pairs

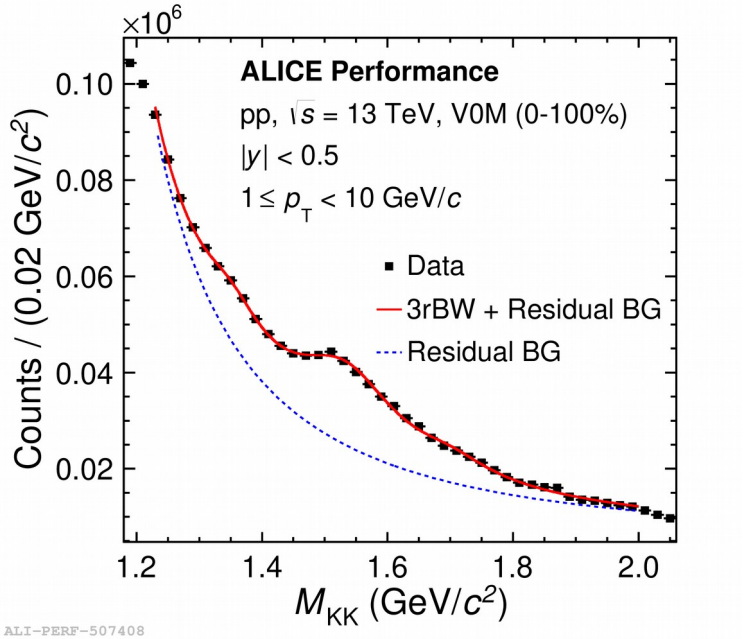
K^+K^- pair



Combinatorial background:
Unlike-sign pairs, Like-sign pairs

Signal after combinatorial background subtraction





- K^0_S-K^0_S channel: 3 invariant mass peaks are seen -> consistent with the observation in ep collisions at HERA[1].
- K^+-K^- channel: 2 invariant mass peaks are visible.
- A prominent $f_2(1525)$ signal is observed in both decay channels.

Summary and outlook

Summary:

- First look to the invariant mass distributions of K^0_S-K^0_S and K^+K^- pairs in pp collisions at 13 TeV.
- Higher mass resonance states are observed and a prominent signal peak is seen for $f_2(1525)$ in both of decay channels.

Outlook:

- Extract mass, width and p_T distributions of the observed high mass resonances.
- High statistics collected in Run 3 and Run 4 is mandatory for precise measurements (examples : multiplicity dependence p_T spectra, nuclear modification factor and anisotropic flow).