ϕ(1020) production in pp collisions with ALICE at the LHC

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1. Physics Motivation

- The study of short-lived hadronic resonances in heavy-ion collisions provides information about the hadronic phase of the system. Resonance measurements in pp collisions set the baseline to which heavy-ion collisions are compared as well as contribute to the understanding of particle production mechanisms through comparison with different model predictions.
- The ϕ(1020) is reconstructed at mid-rapidity via its hadronic decay channel ϕ -> $K^+ + K^-$ both without particle identification and by using the information of the Time Projection Chamber (TPC) and Time of Flight (TOF) detectors to identify the decay products.

Particle	Electric charge	Quark Content	Rest Mass (GeV/c^2)	Resonance width (MeV/c^2)	Mean lifetime (s)	Decay Length (fm)	Decay Channels (B.R.)
Phi Meson ϕ(1020)	0	s-sbar	1.019	4.26	1.55×10^{-22}	46.2	$K^+ + K^-$ (48.9%) $K_s^0 + K_L^0$ (34.2%) $\rho\pi + \pi^+\pi\pi^0$ (15.2%)

2. A Large Ion Collider Experiment (ALICE)

- At the LHC, ALICE has collected data in pp collisions at √s = 0.9, 2.76, 5.02, 7.0, 8.0 and 13.0 TeV.
- Global tracking in ALICE is performed using the ITS and TPC detectors.
- In order to maximize acceptance, tracks were accepted only in the range $|\eta| < 0.8$ and with $p_T > 0.15$ GeV/c.

Detectors used for these analyses

- Inner Tracking system (ITS)
  - Tracking
  - Vertexing
- Time Projection Chamber (TPC)
  - Main tracking device
  - Particle identification (PID)
  - Momentum measurement
- Time of Flight (TOF)
  - PID via time of flight measurement

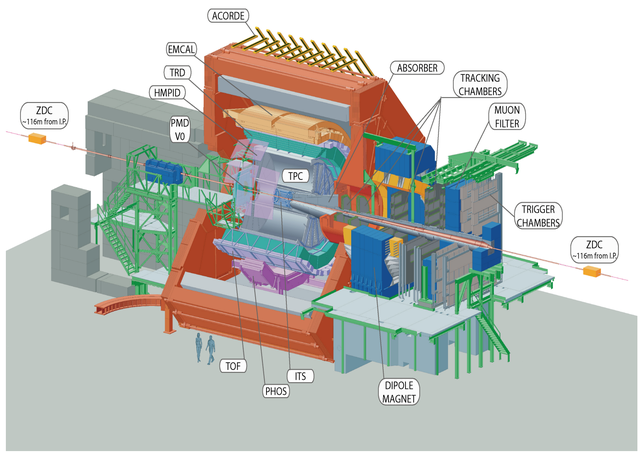

Fig. 1: Schematic drawing of the ALICE detector at the LHC

3. Invariant mass and p_T spectra of ϕ

- The uncorrelated background was estimated using two different techniques: like-sign pairs and event mixing.
- The invariant mass distributions are fitted with a Voigtian function and a polynomial residual background.

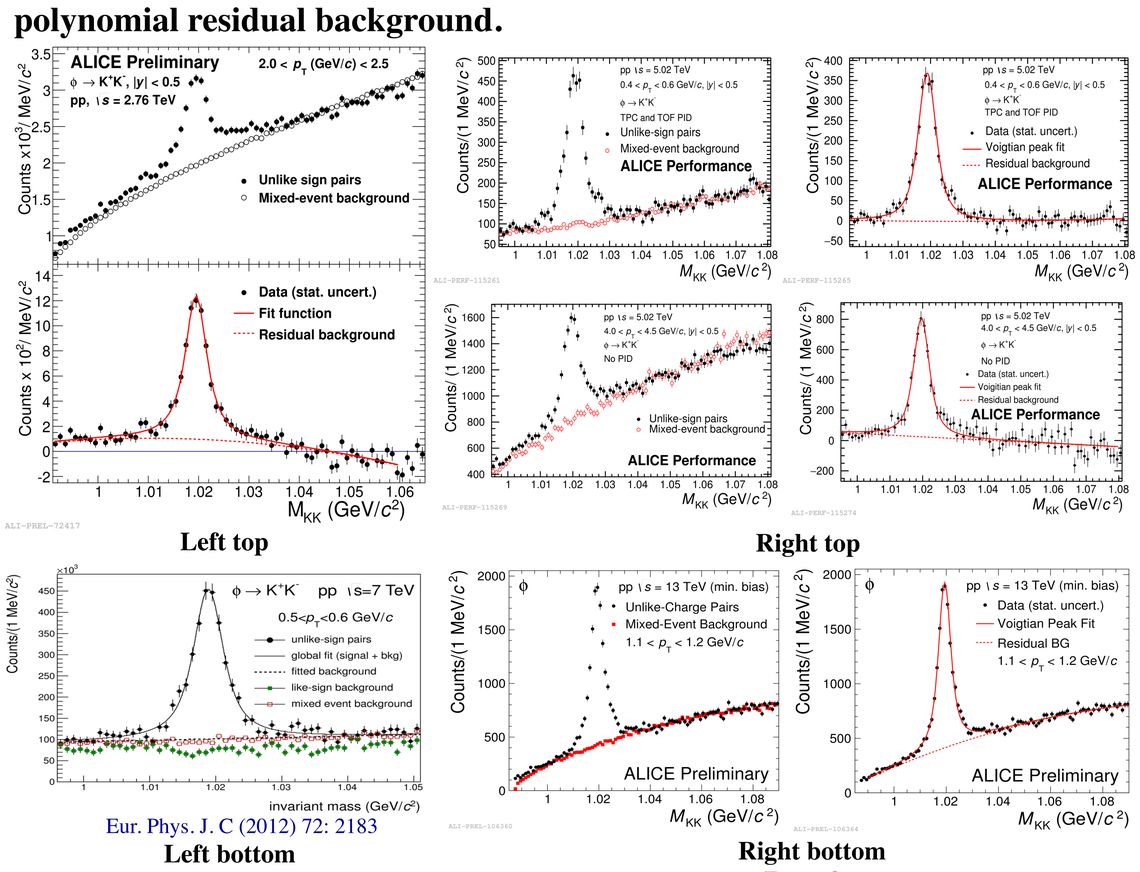

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Fig. 2: Invariant mass distributions of ϕ meson in pp collisions at √s = 2.76 (Left top), 5.02 (Right top), 7.0 (Left bottom) and 13.0 TeV (Right bottom)

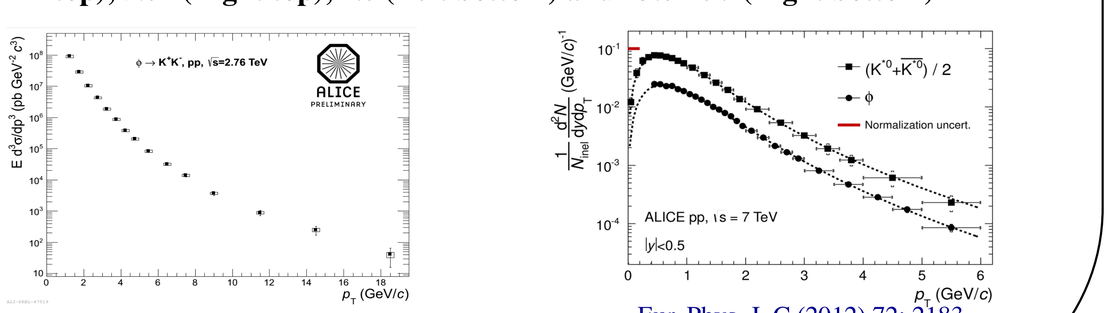

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Fig. 3: p_T spectra of ϕ meson in pp collisions at √s = 2.76 (Left) and 7.0 TeV (Right)

4. Mean transverse momentum (<p_T>)

- <p_T> increases with charged particle multiplicity. The increasing trend with multipicity is similar in pp and p-Pb and steeper than in Pb-Pb. <p_T> also increases with collision energy.

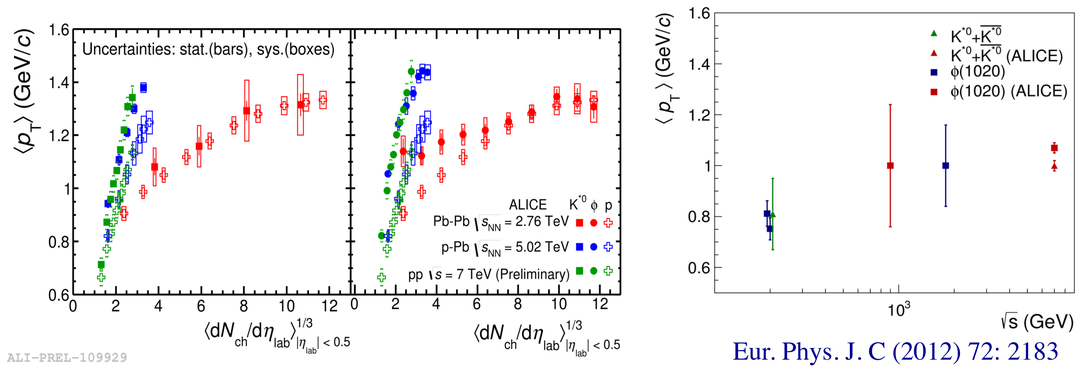

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Fig. 4: (Left) <p_T> in pp at √s = 7.0 TeV (Green) for different V0M multiplicity event classes and (Right) <p_T> as a function of energy in pp collisions

5. Particle Ratios

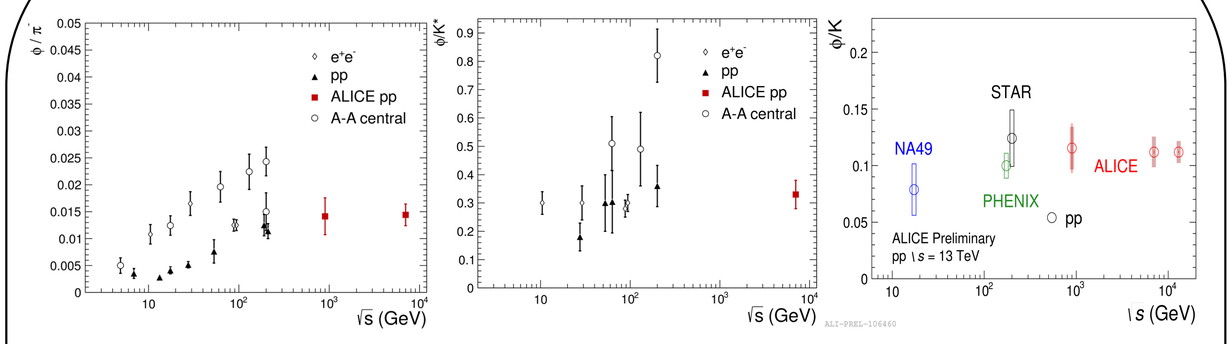

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Fig. 5: Collison energy dependence of ϕ/π (Left), ϕ/K^* (Middle), ϕ/K (Right)

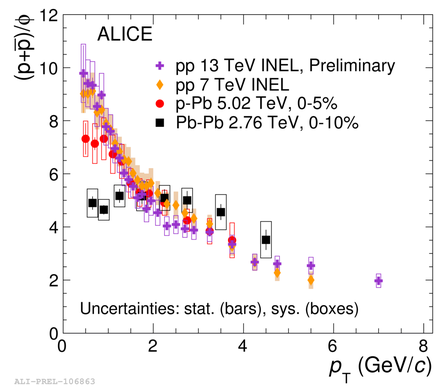

Fig. 6: p/ϕ ratio as a function of transverse momentum in pp collisions

- ϕ/π, ϕ/K^* and ϕ/K ratios do not show collision energy dependence in a range √s = 0.9 - 13.0 TeV.
- p/ϕ ratio decreases as a function of p_T in pp collisions at √s = 7.0 and 13.0 TeV, whereas a flat behavior is observed in Pb-Pb and at low p_T in p-Pb collisions.

6. Summary

- ϕ signals have been extracted in pp collisions at √s = 2.76, 5.02, 7.0 and 13.0 TeV.
- <p_T> increases with charged particle multiplicity as well as collision energy.
- Ratio to π, K and K^* do not depend on collision energy.
- p/ϕ decreases as a function of transverse momentum.

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