

Extraction of the $\phi(1020) \rightarrow KK$ signal with early CMS data

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on behalf of the CMS collaboration

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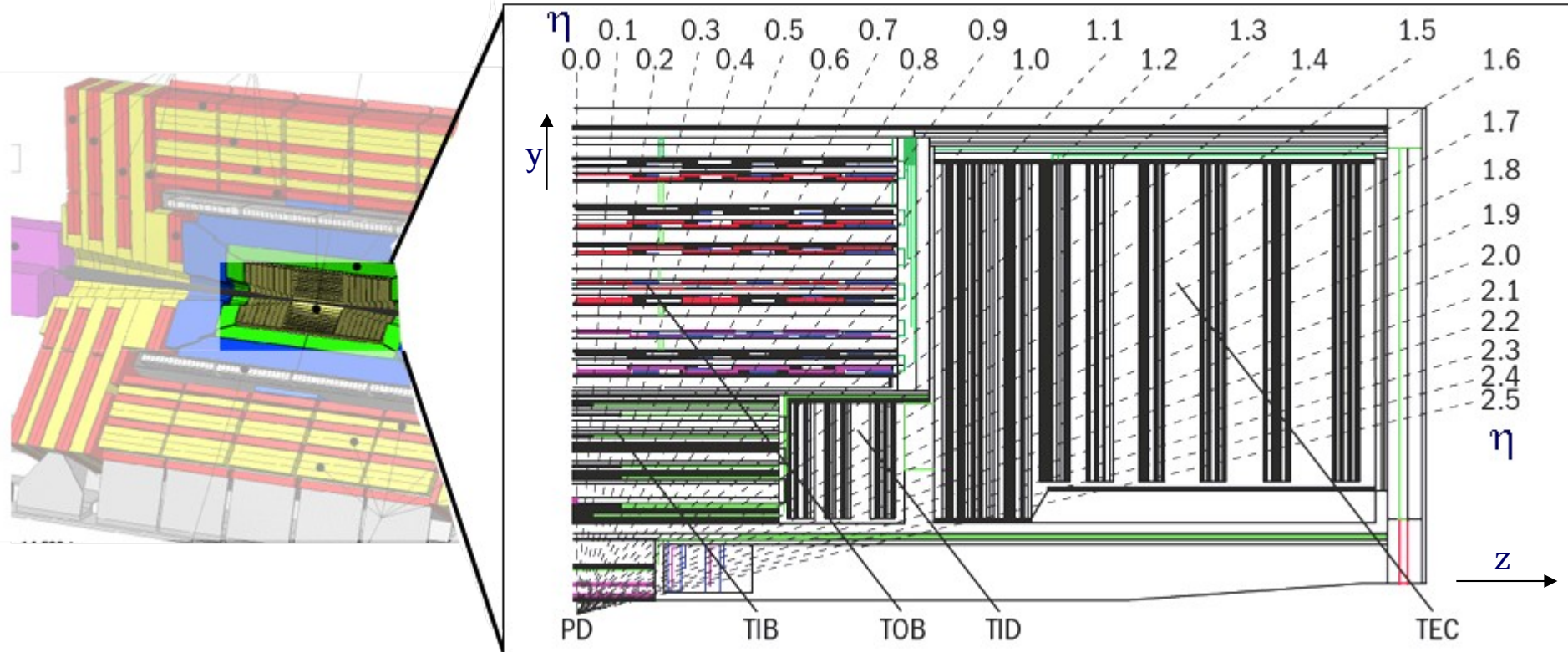


Introduction

- The **first LHC collisions** at center of mass energies of **900 GeV** were recorded by the **CMS detector** in Dec. 2009
- The **trajectories of charged particles** produced in the collisions were reconstructed using the **silicon tracker** and their momenta were measured in the 3.8 T solenoidal magnetic field
- Tracks were used to **reconstruct the decays** of several hadrons, including K_s^0 , Λ , and ϕ
- The **performance of track reconstruction** has been assessed in the data and is **compared** to the expectation from **simulation**

CMS Tracker sketch

- Schematic (y,z) view of the tracker divided into:
 - Pixel Detector (PD)
 - Microstrips System (beyond a radius of about 20 cm) sub-divided into:
 - Tracker Inner Barrel (TIB) and Discs (TID)
 - Tracker Outer Barrel (TOB) and Tracker Endcaps (TEC).



Dataset and selection

Analyzed data from 900 GeV pp collisions

- Track quality requirements:

- ✓ $p_t > 0.5 \text{ GeV}/c$

- ✓ $|\eta| < 2.0$

- ✓ $|d_{xy}| < 0.3 \text{ cm wrt beamspot}$

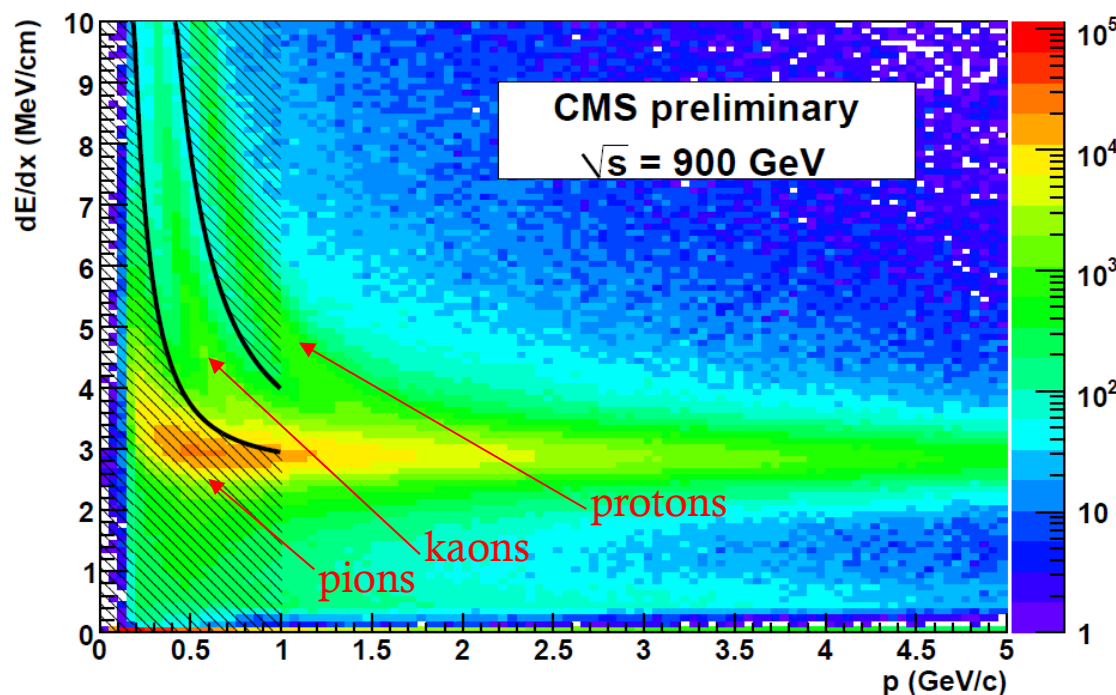
- ✓ Number of hits > 5

- ✓ Reduced chi2 < 2

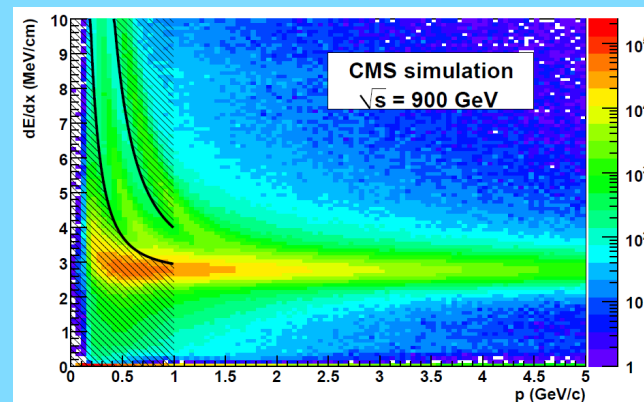
$\phi \rightarrow K^+K^-$ candidates formed by combining all the opposite charge tracks passing above criteria and dE/dx selection (see next slide)

dE/dx selection

- Charged particles **lose energy** in the silicon due to **ionization**
- dE/dx distribution** changes for different particles (e.g. p, π, K)
 - for $p < 1 \text{ GeV}/c$ dE/dx a selection cut can be applied to further improve our analysis

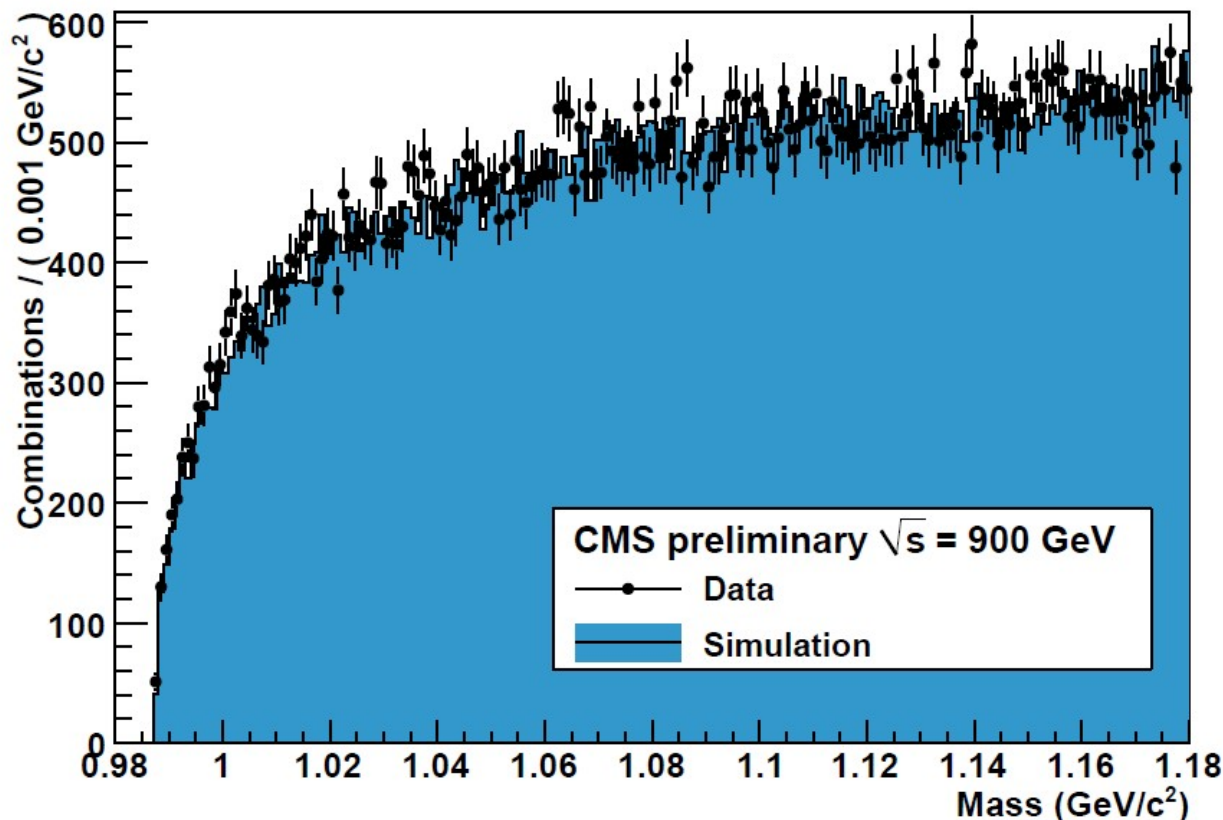


MC comparison



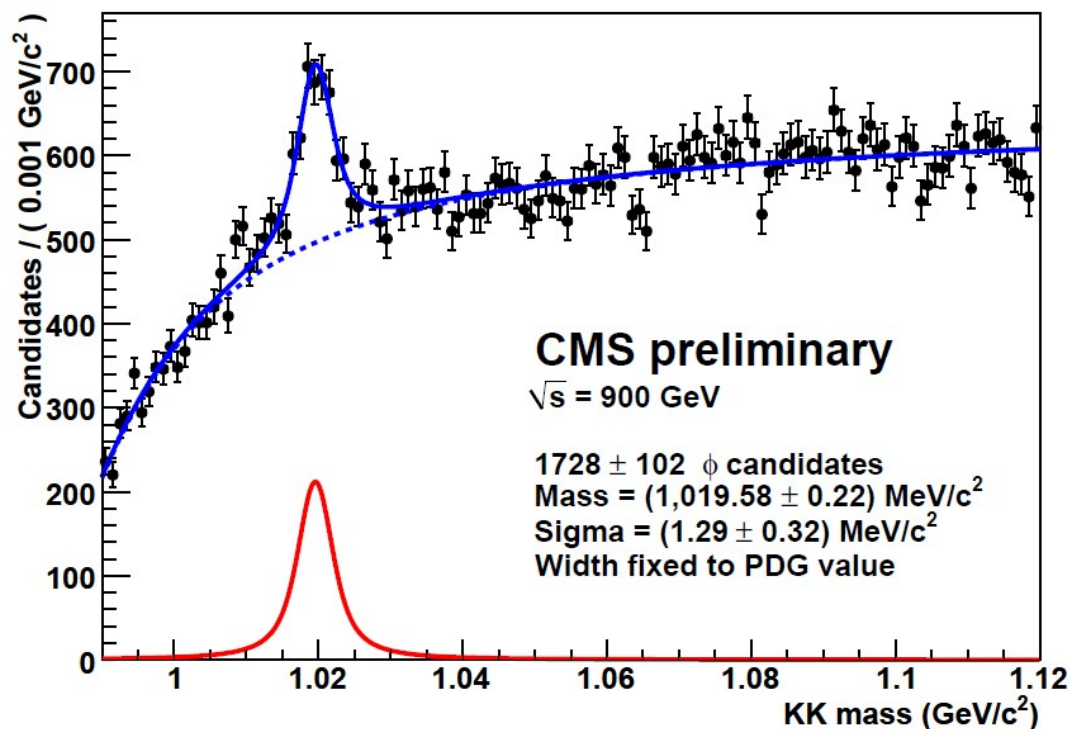
dE/dx rejected combinations

- Combinations in which at least one of the tracks fails the dE/dx cut: no ϕ mass peak is visible



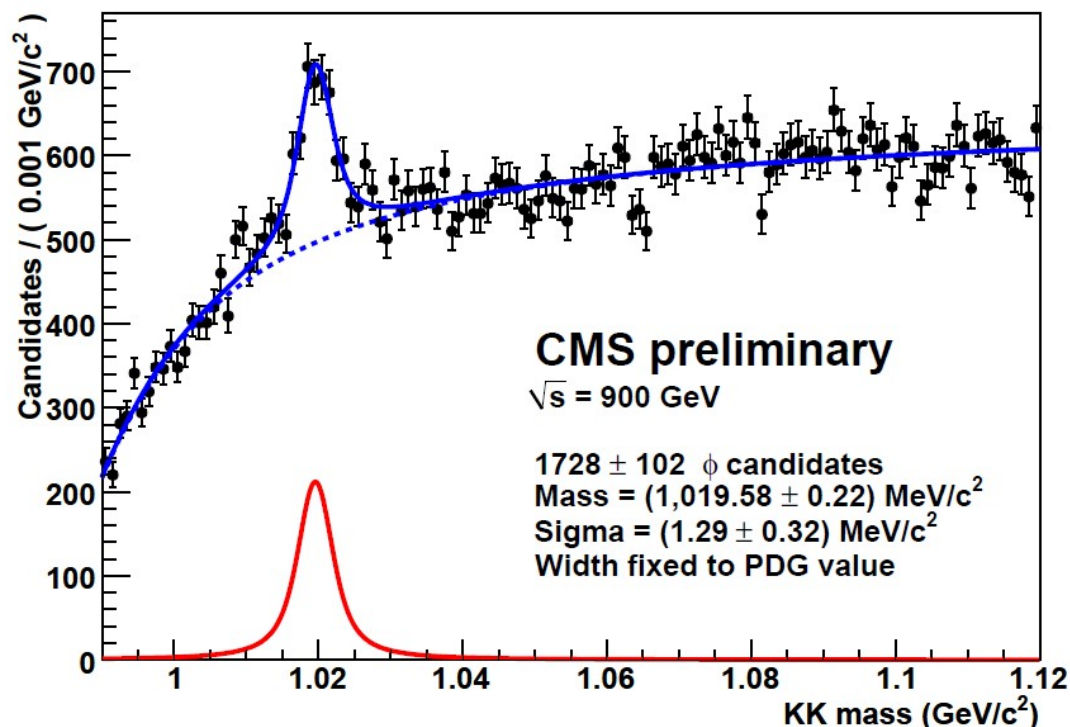
Signal extraction

- We fit the mass spectrum using the sum of two functions:
 - a **Voigtian** (convolution of a relativistic Breit-Wigner shape and a Gaussian smearing) for the ϕ signal
 - a simple **arctangent** form for the background

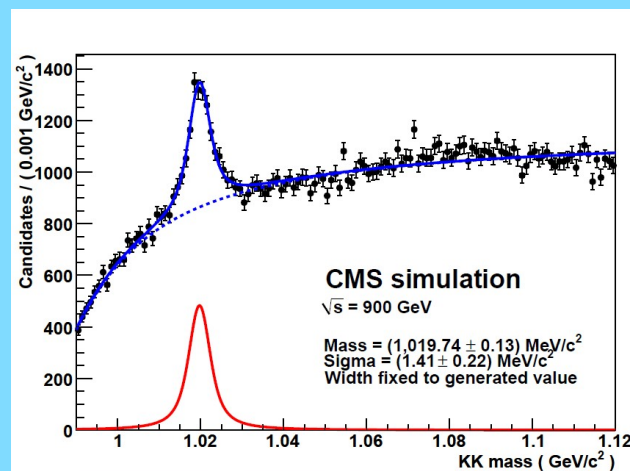


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MC comparison
Mass = $(1,019.74 \pm 0.13) \text{ MeV}/c^2$
Sigma = $(1.41 \pm 0.22) \text{ MeV}/c^2$



Conclusions

- The **CMS detector** recorded the first LHC collisions during last December
 - Several **hadron resonances** have been reconstructed using the **inner tracker** to assess its **physics performance**
- We reconstructed a sample of is **1728 ± 102** $\phi \rightarrow KK$ candidates
- The reconstructed mass is **$1019.58 \pm 0.22 \text{ MeV}/c^2$**
 - This value sits just 0.59σ above the world average value ($1019.45 \text{ MeV}/c^2$)
- The mass resolution is **$1.29 \pm 0.32 \text{ MeV}/c^2$**
 - In very good agreement with Monte Carlo simulation (1.41 ± 0.22) MeV/c^2