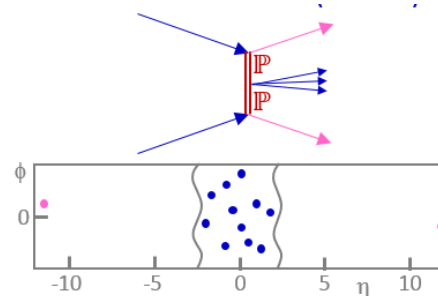


Studies of central diffractive production of open charm with CMS and TOTEM experiments

Eduardo Coelho, Helio Nogima, Wagner Carvalho

Overview

- Search for D mesons produced at proton-proton collisions at 13 TeV in a central diffractive topology;
- D mesons \rightarrow good probe to investigate pomeron properties and QCD aspects in a hard scale;
- Full reconstruction of D^0 , D^* in their dominant decay modes.



Channel	Mass (GeV)	B.R. (%)	τ (s)	F ($c \rightarrow D$)
$D^0 \rightarrow (K^\pm \pi^+)$	1,864	$3,89 \pm 0,5$	$4,10 \times 10^{-13}$	$0,549 \pm 0,026$
$D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^\pm \pi^+) \pi^\pm$	2,010	$(67,7 \pm 0,5) \times \text{B.R.}(D^0)$	$6,9 \times 10^{-21}$	$0,235 \pm 0,010$

- A recent paper about cross sections of diffractive D mesons production at LHC: “Single- and central-diffractive production of open charm and bottom mesons at the LHC: theoretical predictions and experimental capabilities”, **Marta Łuszczak, Rafał Maciuła, Antoni Szczurek, Phys. Rev. D 91, 054024 (2015)**

Overview

- According to PYTHIA8, one should expect the following range of effective cross sections for prompt D^0 and D^* , in **central diffractive** topology @ 13 TeV:

D Meson	Effective cross section (nb)
$D^0 \rightarrow (K^\pm \pi^+)$	4 - 18
$D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^\pm \pi^+) \pi^\pm$	0.030 – 0.30

Ranges based on different pomeron flux models: Schuler and Sjostrand, Berger and Streng and MBR

- Final yields obtained after applying cut on:

pions/kaons $p_t > 0.5$ GeV/c

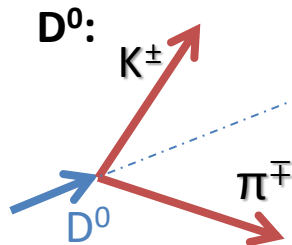
pion slow $p_t > 0.25$ GeV/c

all product's $|\eta| > 2.5$

Protons' $|t| : 0.03 < |t| < 1$ (GeV/c)²

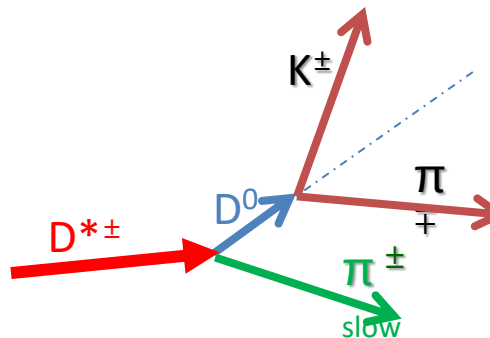
Protons' $|\xi| < 0.1$

Analysis strategy



Two opposite charge tracks combined to form D^0 vertex.

$D^{*\pm}$ and D^0 from $D^{*\pm}$:



Get 2 opposite charge tracks to form a D^0 vertex
Combine it with a 3rd track

Candidates kept if $|M_{D^0} - 1.865| < 0.15 \text{ GeV}/c^2$

Cuts:

- D^0 opening angle ($D^0\text{OpAngle}$) < 0.15 rad;
- D^0 significance w.r.t PV ($D^0\text{Sxy}$) > 2 ;
- Pion/Kaon p_t w.r.t D^0 line of flight ($D^0\text{Kt}$) $> 0.7 \text{ GeV}/c$

Candidates kept if $|M_{D^0} - 1.865| < 0.2 \text{ GeV}/c^2$ and
If $(M_{D^{*\pm}} - M_{D^0}) < 0.16 \text{ GeV}/c^2$

Cuts for $D^{*\pm}$:

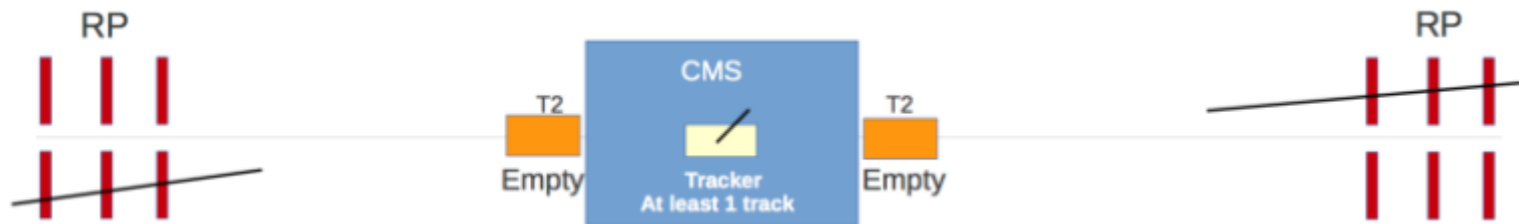
- $|m_{D^0} - 1.865| < 0.024 \text{ GeV}/c^2$;
- $D^{*\pm}_{pt} > 4.2 \text{ GeV}/c$

Cuts for D^0 from $D^{*\pm}$:

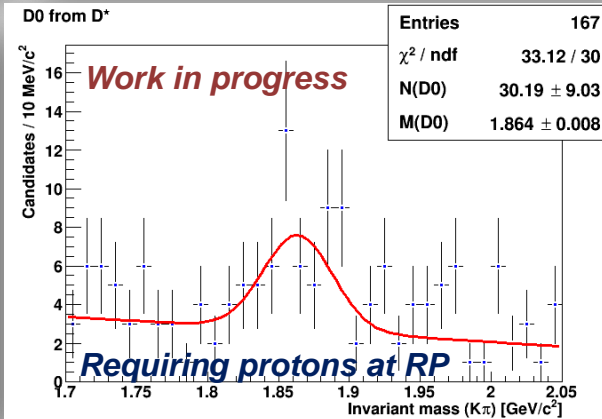
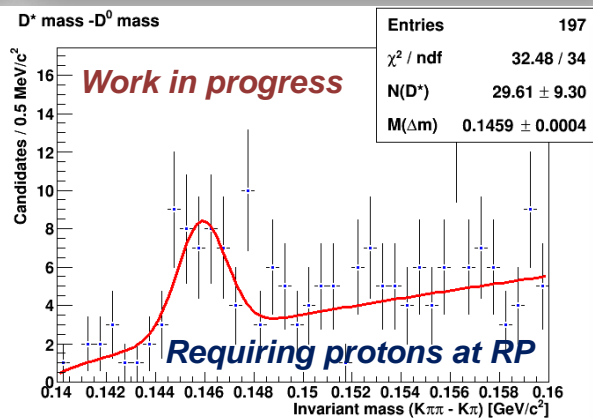
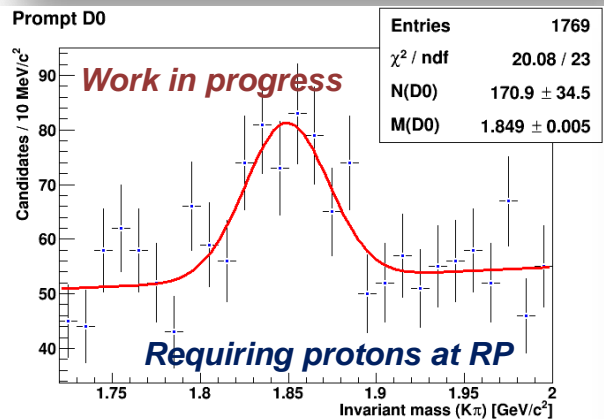
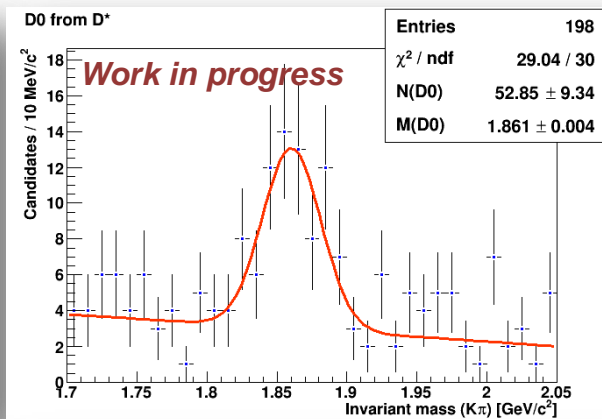
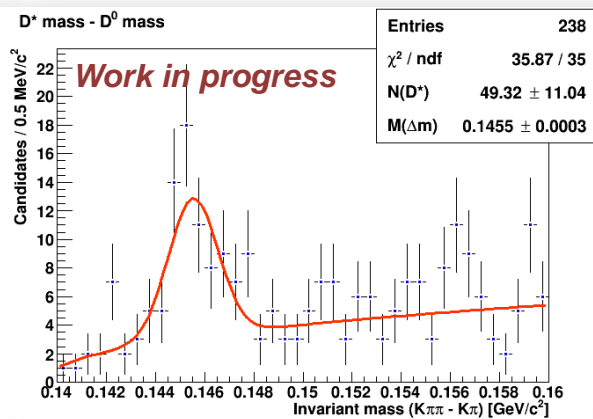
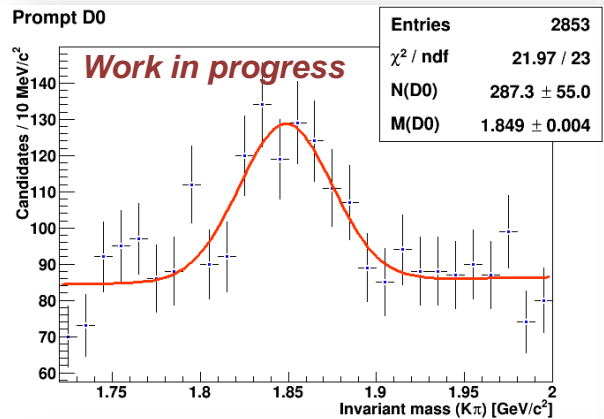
- $|(m_{D^{*\pm}} - m_{D^0}) - 1.865| < 0.0013 \text{ GeV}/c^2$;
- $D^{*\pm}_{pt} > 4.2 \text{ GeV}/c$

Some preliminary results

- **Data collected with double-proton tag + minimum activity at central pixel detector + Veto at TOTEM T2**
- Analysis of the data from the joint CMS and TOTEM ($\mathcal{L}_{eff} \sim 0.4/\text{pb}$) low pile-up ($\mu \sim 0.1$) runs from the end 2015.
- D^* (and D^0) and prompt D^0 signals have been obtained.



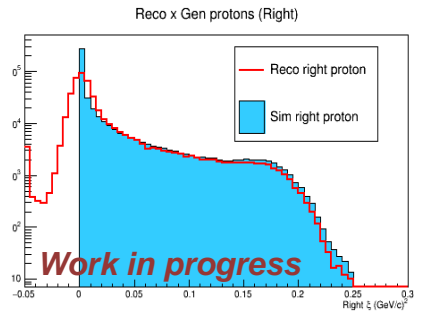
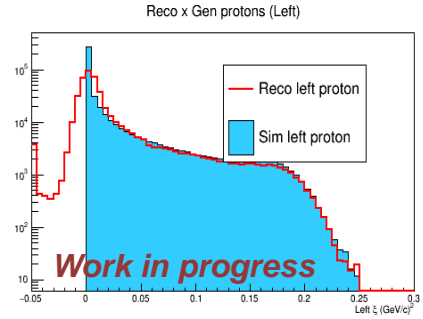
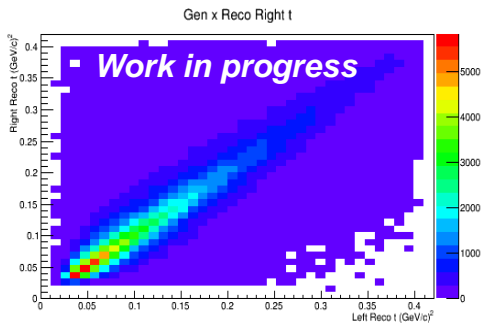
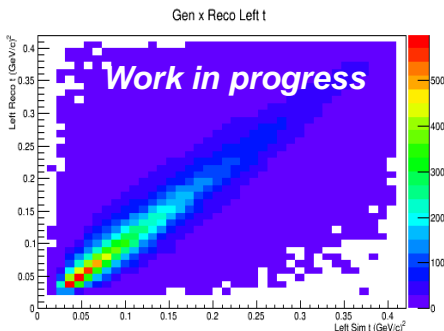
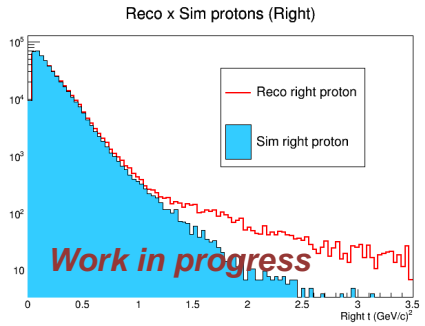
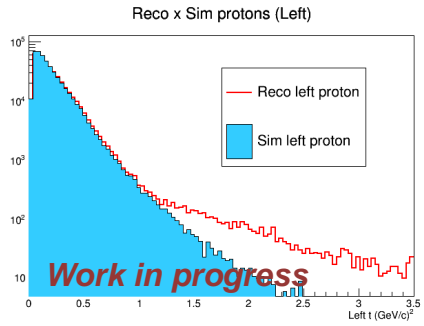
Mass distributions



Monte Carlo Simulation

- CMS+TOTEM full-simulation for runs @ $\beta^* = 90\text{m}$. Same conditions as the data from the end of 2015.
- Working with a sample containing **Inclusive central diffraction @ 13 TeV ~ 2M Events, $\beta^* = 90\text{m}$, PYTHIA 8.**
- Estimate the reconstruction efficiency.

Monte Carlo Simulation



Work in progress and Next steps

- The correlation between ξ and M_x reconstructed by CMS and TOTEM is being studied using the simulation.
- An study about the background is being carried on, in order to separate signals from Pile-Up and signals of interest.
- **Estimates of D^* and D^0 central diffractive production cross section.**

Backup

Vertexing strategy

