INTRODUCTION

TOTEM[1] is an LHC (Large Hadron Collider) experiment devoted to a deeper understanding of the proton structure by precise measurements of the elastic, inelastic and total cross-sections and comprehensive studies of diffraction. The TOTEM apparatus is shown in Fig.1. In TOTEM, charged particles are detected by the T1 (at ±9 m from the interaction point (IP)) and T2 (at ±14 m) telescopes with a pseudorapidity coverage of 3.1 <|η|< 4.7 and 5.3 <|η|< 6.5, respectively, and the leading protons by Roman Pot (RP) silicon detectors (at ±147 m and ±220 m). We use the charged particle telescopes T1 & T2, in combination with very forward proton detectors (RP220), to measure single charged particle telescopes T1 & T2, in combination with silicon detectors (at ±147 m and ±220 m). We use the charged particle telescopes T1 & T2, in combination with very forward proton detectors (RP220), to measure single diffraction (SD) cross sections as a function of the mass of the diffractive system, for special TOTEM runs at β*=90m.

METHODS

The single diffraction topology “p + gap + X” is shown schematically in Fig.2.

Single diffraction
- Outgoing proton with a small fractional momentum loss (ξ)
- Large rapidity gaps in the final-state hadrons of the event
- Gap size and Δφ related : Δφ ≈ ln(gap)
- MSD = v(Δφ’s)

Runs used
- Special TOTEM run from October 2011: 7 TeV, β*=90m.
- SD data normalized with CMS measured luminosity

Preliminary results

![Cross sections for various SD categories](image)

Event selection
- One proton seen in vertical RP’s (essentially no p in horizontal RPs)
- Tracks in T2; rapidity gap requirement ⇒ 3.4 GeV < M SD < 1.1 TeV
- SD signal: 1 proton + gap + T1/T2 tracks
- Classified into 4 mass ranges:
  - T2 only opposite arm, no T1: M SD = 3.4-7 GeV (2.10^-7 < ξ < 10^-6)
  - T2 & T1 opposite arm: M SD = 7-350 GeV (10^-6 < ξ < 0.25 %)
  - T2 opposite arm, T1 same arm: M SD = 0.35-1.1 TeV (0.25 % < ξ < 2.5 %)
  - T2 both arms: M SD > 1.1 TeV (ξ > 2.5 %); background study ongoing ⇒ no results shown here.

Background subtraction
- Background: gap + T1/T2 tracks independent of proton
- Subtract events with “gap + T1/T2 tracks + 1 proton”

Corrections applied
- T2 trigger efficiency
- RP proton φ acceptance (including nominal optics Δφ dependence)
- RP proton reconstruction efficiency
- Effect of beam divergence and Δφ resolution + category migration (still to be applied)

Total cross section per category corrected by extrapolation of exponential fit down to t=0 (5-10 % correction)

Conclusions

We present preliminary t distributions and differential cross sections for the SD diffractive topology “p+gap+ X” in three different mass ranges. Effects of beam divergence and migration between the different classes still have to be taken into account.

References


Fig. 1: Schematic of experimental setup of TOTEM showing the locations of the tracking telescopes and Roman Pots

Fig. 2: SD event, as seen in TOTEMs RP & T2 detectors (not to scale)

Fig. 3: differential cross section as a function of momentum transfer |t| for 3 classes based on T1+T2 topology (gap size) with fitted slope parameter B

Uncertainty estimated on slope parameter B ~ 15 % and on cross sections ~20%

Fig. 4: cross section for 3 SD classes based on T1+T2 topology (gap size)