

# STUDIES OF ELASTIC, INELASTIC AND TOTAL PROTON-PROTON CROSS SECTIONS WITH TOTEM AT THE LHC

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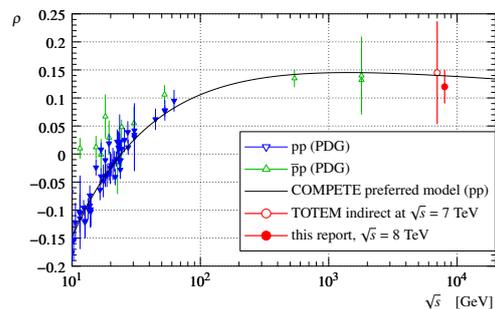
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The TOTEM [1] experiment at the Large Hadron Collider is devoted to a deeper understanding of the proton structure by precise measurement of elastic, inelastic and total cross-sections and comprehensive studies of diffraction. Forward-going charged particles are detected at pseudorapities of  $3.1 \leq |\eta| \leq 4.7$  and  $5.3 \leq |\eta| \leq 6.5$  by the T1 and T2 telescopes, respectively, and the leading protons by silicon detectors in Roman Pots.

TOTEM has studied in detail both elastic and inelastic proton-proton (pp) interactions at 2.76, 7, 8 and 13 TeV. Here we focus on a detailed measurement of elastic scattering down to very low  $|t|$  ( $\sim 6 \cdot 10^{-4}$  GeV) at 8 TeV [2] and first total, inelastic and elastic cross section measurements at 2.76 TeV [3]. The former allows to determine both the electromagnetic and the hadronic contribution to elastic pp scattering as well as extract the  $\rho$ -parameter (the phase at  $t = 0$  for the nuclear pp interaction amplitude) due to the interference of the two. At the same time, a total pp cross-section measurement of  $103.0 \pm 2.3$  mb without any other input is extracted. The simplest approximation of the hadronic amplitude (constant phase, constant exponential in  $|t|$ ) is also excluded by the data.

At 2.76 TeV, we find preliminary values of the total, inelastic and elastic cross-section of 85, 63 and 22 mb, respectively, each having a preliminary uncertainty of 3 mb. Our result is favouring the CDF measurement [4] of the proton-antiproton total cross-section at 1.8 TeV though due to the uncertainties the E811 measurement [5] is not incompatible.

Figure 1: Energy dependence of the  $\rho$ -parameter with the new TOTEM  $\rho$  measurement at 8 TeV of  $0.12 \pm 0.03$  added. The COMPETE fit is an extrapolation from the low-energy data. Most data points are calculated using the simplification of constant phase and constant exponential slope in  $|t|$ .



- [1] G. Anelli et al. (TOTEM Collaboration), JINST, 3 (2008) S08007.
- [2] G. Antchev et al. (TOTEM Collaboration), Eur. Phys. J. C 76 (2016) 661.
- [3] G. Antchev et al. (TOTEM Collaboration), A luminosity independent measurement of the total, elastic and inelastic cross-sections at  $\sqrt{s} = 2.76$  TeV (2017, *in preparation*).
- [4] F. Abe et al. (CDF Collaboration), Phys. Rev. D 50 (1994) 5550.
- [5] C. Avila et al. (E811 Collaboration), Phys. Lett. B 445 (1999) 419.