

# First physics measurements with TOTEM at LHC

K. Österberg, Department of Physics and Helsinki Institute of Physics, Helsinki, Finland

on behalf of the TOTEM collaboration

## Abstract:

The TOTEM experiment at the LHC, placed symmetrically with respect to the CMS Interaction Point IP5, is optimised to measure in dedicated special-optics runs, the total pp cross-section and to study elastic pp scattering over a wide range in momentum transfer from  $|t| \sim 10^{-3}$  to  $10 \text{ GeV}^2$ . Furthermore, diffractive dissociation, including single, double and central diffractive topologies is studied using the forward detectors in combination with Roman pot detectors close to the beams. Very forward event topologies and particle multiplicities are also studied in view of interpretations for Cosmic Rays.

Using data from a short run in 2011 with dedicated large  $\beta^*$  optics, TOTEM measured the differential cross-section for elastic proton-proton (pp) scattering at the LHC energy of  $\sqrt{s} = 7 \text{ TeV}$  in the range  $0.02 < |t| < 0.33 \text{ GeV}^2$  that is described by an exponential with a slope parameter  $B = (20.1 \pm 0.2^{\text{stat}} \pm 0.3^{\text{syst}}) \text{ GeV}^{-2}$ . Based on an extrapolation to  $|t| = 0$ , a total elastic scattering cross-section of  $(24.8 \pm 0.2^{\text{stat}} \pm 1.2^{\text{syst}}) \text{ mb}$  is obtained. Applying the optical theorem and using the luminosity measurement from CMS, a total pp cross-section  $(98.3 \pm 0.2^{\text{stat}} \pm 2.8^{\text{syst}}) \text{ mb}$  is deduced. From the total and elastic pp cross-section measurements, an inelastic pp cross-section of  $(73.5 \pm 0.6^{\text{stat}} + 1.8^{\text{syst}} - 1.3^{\text{syst}}) \text{ mb}$  is inferred.

Using data from a special run in 2010 with standard LHC optics, TOTEM measured the differential cross-section for elastic proton-proton scattering at the LHC energy of  $\sqrt{s} = 7 \text{ TeV}$  in the in the range  $0.36 < |t| < 2.5 \text{ GeV}^2$ . The differential cross-section in the range  $0.36 < |t| < 0.47 \text{ GeV}^2$  is described by an exponential with a slope parameter  $B = (23.6 \pm 0.5^{\text{stat}} \pm 0.4^{\text{syst}}) \text{ GeV}^{-2}$ , followed by a significant diffractive minimum at  $|t| = (0.53 \pm 0.01^{\text{stat}} \pm 0.01^{\text{syst}}) \text{ GeV}^2$ .