

TOTEM Results in 2012

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on behalf of the TOTEM collaboration

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The TOTEM experiment

Programme – forward physics at the LHC

Elastic scattering



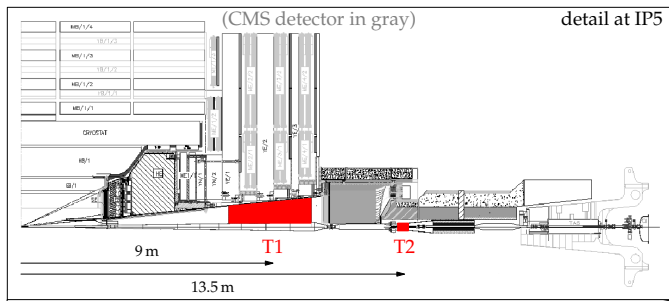
Total cross-section



Soft and hard diffraction

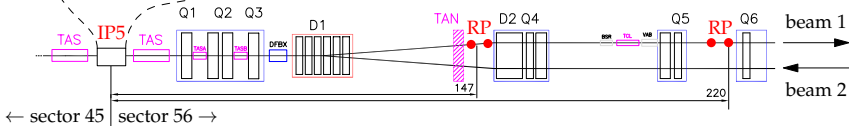


Detector apparatus – symmetric about IP5 (CMS)



← telescopes T1 and T2
charged particles from
inelastic collisions

← Roman Pots at the LHC
elastic and diffractive protons





Measurement of the forward charged particle pseudorapidity density in pp collisions at $\sqrt{s} = 7$ TeV with the TOTEM experiment
[CERN-PH-EP-2012-106, EPL 98 (2012) 31002]



Measurement of proton-proton elastic scattering and total cross-section at $\sqrt{s} = 7$ TeV
[CERN-PH-EP-2012-239, submitted to EPL]



Measurement of proton-proton inelastic scattering cross-section at $\sqrt{s} = 7$ TeV
[CERN-PH-EP-2012-352, submitted to EPL]



Luminosity-independent measurements of total, elastic and inelastic cross-sections at $\sqrt{s} = 7$ TeV
[CERN-PH-EP-2012-353, submitted to EPL]



A luminosity-independent measurement of the proton-proton total cross-section at $\sqrt{s} = 8$ TeV
[CERN-PH-EP-2012-354]

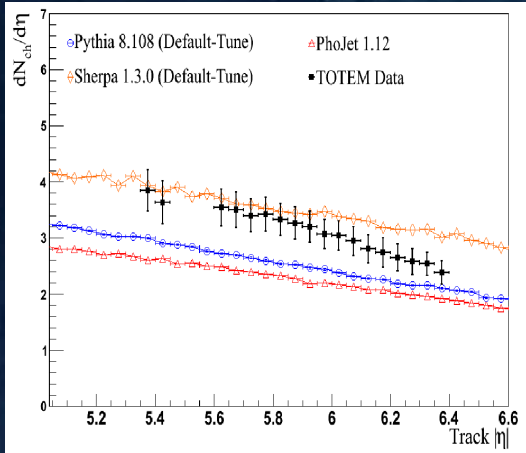


Measurement of the forward charged particle pseudorapidity density in pp collisions at $\sqrt{s} = 7$ TeV with the TOTEM experiment

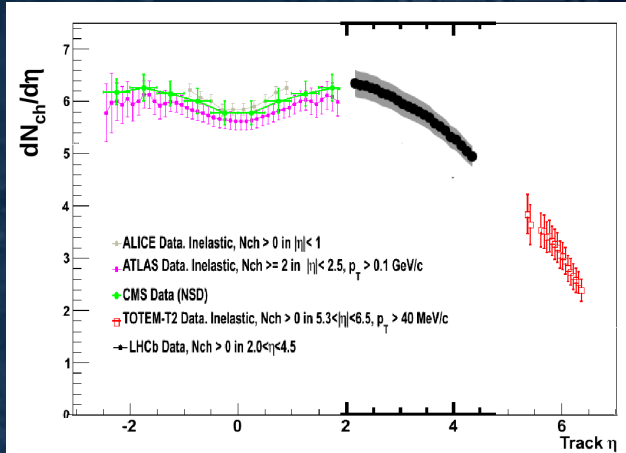
[CERN-PH-EP-2012-106, EPL 98 (2012) 31002]

pseudorapidity density of charged particles

TOTEM measurement compared to Monte-Carlo predictions



TOTEM measurement extends the reach of LHC experiments

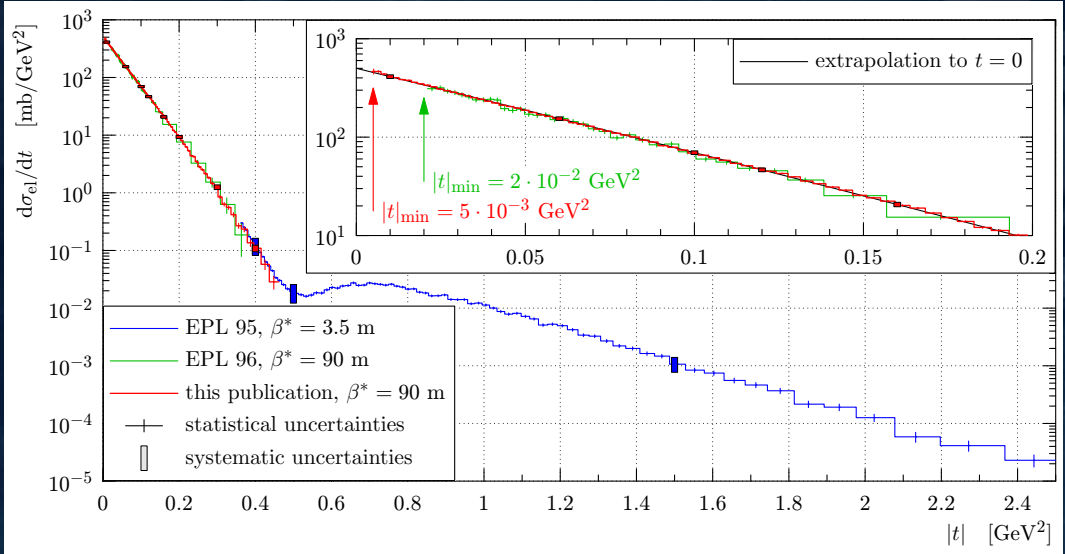




Measurement of proton-proton elastic scattering and total cross-section at $\sqrt{s} = 7$ TeV

[CERN-PH-EP-2012-239]

elastic scattering: differential cross-section



+ optical theorem \Rightarrow total cross-section $\sigma_{tot} = (98.6 \pm 2.3)$ mb



Measurement of proton-proton inelastic scattering cross-section at $\sqrt{s} = 7$ TeV

[CERN-PH-EP-2012-352]

inelastic cross-section

counting inelastic events with T1 and T2

95% of events detected!

low-mass diffraction constrained
by combination of measurements

$$\sigma_{\text{inel}} = (73.7 \pm 3.4) \text{ mb}$$

[CERN-PH-EP-2012-239]

(previous slide):

$$\sigma_{\text{el}} = (25.4 \pm 1.1) \text{ mb}$$

$$\sigma_{\text{tot}} = (98.6 \pm 2.2) \text{ mb}$$

$$\sigma_{\text{inel}} = (73.2 \pm 1.3) \text{ mb}$$

$$\sigma_{\text{inel}}^{\eta > 6.5} = (2.3 \pm 2.2) \text{ mb}$$

$$\sigma_{\text{tot}} = \sigma_{\text{inel}} + \sigma_{\text{el}} = (99.1 \pm 4.3) \text{ mb}$$



three methods to determine total cross-section

elastic observables only:

$$\sigma_{\text{tot}}^2 = \frac{16\pi}{1+q^2} \frac{1}{\mathcal{L}} \left. \frac{dN_{\text{el}}}{dt} \right|_0$$

$$\sigma_{\text{tot}} = (98.3 \pm 2.0) \text{ mb (data: Jun 2011)}$$

$$\sigma_{\text{tot}} = (98.6 \pm 2.3) \text{ mb (data: Oct 2011)}$$

σ_{tot}

q-independent:

$$\sigma_{\text{tot}} = \frac{1}{\mathcal{L}} (N_{\text{el}} + N_{\text{inel}})$$

$$\sigma_{\text{tot}} = (99.1 \pm 4.4) \text{ mb}$$

luminosity-independent:

$$\sigma_{\text{tot}} = \frac{16\pi}{1+q^2} \frac{dN_{\text{el}}/dt|_0}{N_{\text{el}} + N_{\text{inel}}}$$

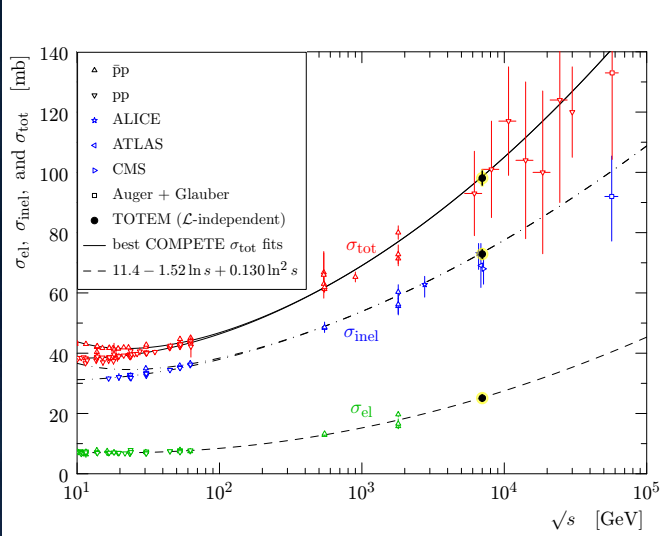
$$\sigma_{\text{tot}} = (98.1 \pm 2.4) \text{ mb}$$



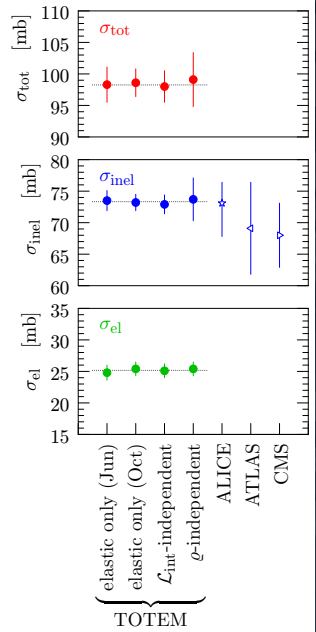
Luminosity-independent measurements of total, elastic and inelastic cross-sections at $\sqrt{s} = 7$ TeV

[CERN-PH-EP-2012-353]

TOTEM cross-section measurements in context



Measurements at $\sqrt{s} = 7$ TeV



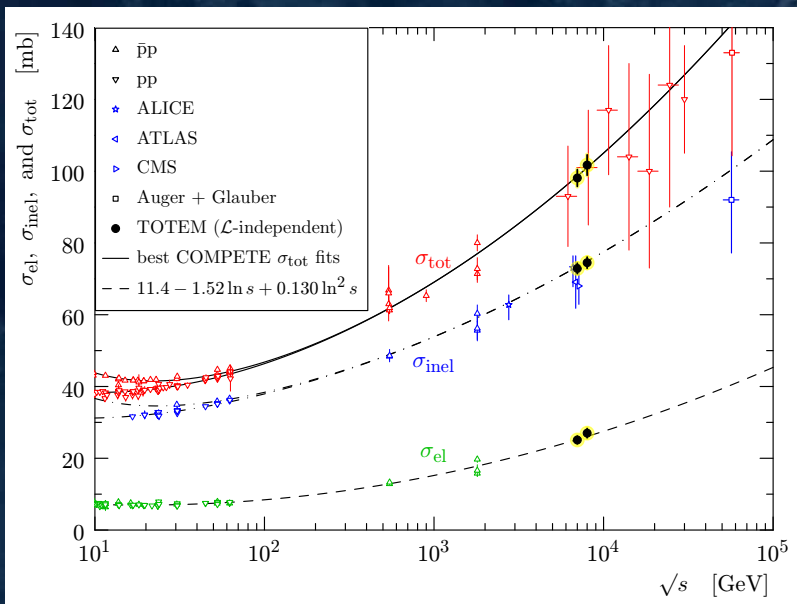


A luminosity-independent measurement of the proton-proton total cross-section at $\sqrt{s} = 8$ TeV

[CERN-PH-EP-2012-354]

luminosity-independent cross-sections at 8 TeV

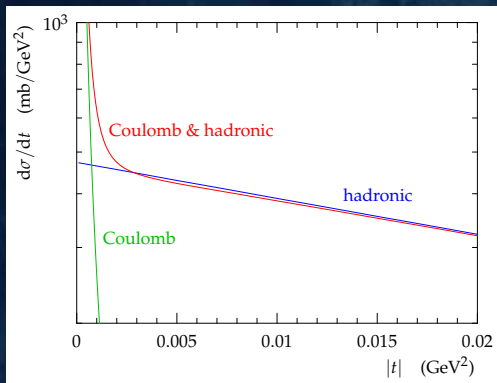
$$\sigma_{\text{tot}} = (101.7 \pm 2.9) \text{ mb}, \quad \sigma_{\text{inel}} = (74.7 \pm 1.7) \text{ mb}, \quad \sigma_{\text{el}} = (27.1 \pm 1.4) \text{ mb}$$



More 8 TeV data available – More analyses ongoing

- common TOTEM+CMS data \Rightarrow variety of diffractive studies
- elastic differential cross-section up to $|t| \approx 1.4 \text{ GeV}^2$
- successful data-taking at $\beta^* = 1 \text{ km}$ optics \Rightarrow exploration of Coulomb-hadronic interference

Theory



TOTEM preliminary measurement

