Elastic and Total Cross-Section Measurements by TOTEM

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The TOTEM experiment at the LHC has measured proton-proton elastic scattering in dedicated runs at $\sqrt{s} = 2.76, 7, 8$ and $13$ TeV centre-of-mass LHC energies. The proton-proton total cross-section has been derived for each energy using a luminosity independent method. TOTEM has excluded a purely exponential differential cross-section for elastic proton-proton scattering with significance greater than $7 \sigma$ in the $|t|$ range from 0.027 to 0.2 GeV$^2$ at $s^{1/2} = 8$ TeV. The $\rho$ parameter has been measured at $s^{1/2} = 8$ TeV via the Coulomb-nuclear interference, and was found to be $\rho = 0.12 \pm 0.03$. The measurement has been repeated at 13 TeV and the result $\rho = 0.09 \pm 0.01$ probes the existence of a colourless three-gluon bound state. The measured 2.76 TeV differential cross-section by TOTEM provides evidence for the colourless 3-gluon bound state, when compared to the D0 experiment $pp\bar{p}$ result at 1.96 TeV (neglecting the small energy difference between TOTEM and D0).

**Primary authors:** TOTEM COLLABORATION; NEMES, Frigyes Janos (CERN (also at Wigner RCP Budapest, Hungary))

**Presenter:** NEMES, Frigyes Janos (CERN (also at Wigner RCP Budapest, Hungary))

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