Total, elastic and inelastic cross section measurements in TOTEM

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The TOTEM experiment, located at the interaction point 5 of the LHC, has measured the total, elastic and inelastic proton-proton cross sections in a centre-of-mass energy range from 2.76 to 13 TeV, mostly in dedicated fills with special beam optics. Most recently, TOTEM has performed a series of detailed measurements at $\sqrt{s} = 13$ TeV. The total, elastic and inelastic proton-proton cross-sections were determined using the luminosity-independent method based on the optical theorem. The elastic scattering was investigated in a wide range of the squared four-momentum transfer $|t|$. The study of Coulomb-nuclear interference region down to $|t| \sim 8 \times 10^{-4}$ GeV$^2$ allowed in particular the first measurement of the $\rho$ parameter at $\sqrt{s} = 13$ TeV, $\rho$ being the ratio between the real and the imaginary part of the nuclear elastic scattering amplitude at $t = 0$. This measurement, combined with the TOTEM total cross-section results, led to the exclusion of all the models classified and published by the COMPETE Collaboration. The results obtained by TOTEM are indeed compatible with predictions of a colorless 3-gluon bound state exchange in the t-channel of proton-proton elastic scattering, as postulated by alternative theoretical models both in the Regge-like framework and in the modern QCD framework.

An overview of these measurements will be given.

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