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The Reggeizations of the Odderon Spin-3 and Pomeron Spin-2 Exchanges in pp and $p\bar{p}$ Elastic Scattering

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In this study, we investigate the elastic scattering of proton-proton (pp) and proton-antiproton ($p\bar{p}$) systems in the Regge limit ($s \gg |t|$), focusing on the contributions of spin-2 pomeron and spin-3 odderon exchanges to the scattering amplitude. Starting from effective Lagrangians describing these exchanges, we derive the corresponding amplitudes within the standard perturbative method in Quantum Field Theory (QFT). The calculation employs projection operators for higher-spin fields and applies Reggeization techniques to capture the appropriate high-energy behaviors of the odderon and pomeron.

To validate the model, we analyze its implications for the differential cross-section, with particular comparison to data from the TOTEM and DØ collaborations. Furthermore, we examine the effects of six distinct form factors at six center-of-mass energies: 1.80 TeV, 1.96 TeV, 2.76 TeV, 7 TeV, 8 TeV, and 13 TeV, respectively. The results reveal the sensitivity of elastic scattering profiles to both spin structure and energy scale, all relevant parameters are also extracted from the data with a reliable statistical approach, as well as providing deeper insight into the role of charge-conjugation parity in hadronic interactions.

Keywords: Elastic Scattering, Pomeron, Odderon, Regge Limit, Quantum Field Theory (QFT), Differential Cross-Section

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