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# Limits on the effective quark radius from inclusive *ep* scattering at HERA

ZEUS Collaboration

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ABSTRACT

The high-precision HERA data allows searches up to TeV scales for beyond the Standard Model contributions to electron–quark scattering. Combined measurements of the inclusive deep inelastic cross sections in neutral and charged current $ep$ scattering corresponding to a luminosity of around 1 fb$^{-1}$ have been used in this analysis. A new approach to the beyond the Standard Model analysis of the inclusive $ep$ data is presented; simultaneous fits of parton distribution functions together with contributions of "new physics" processes were performed. Results are presented considering a finite radius of quarks within the quark form-factor model. The resulting 95% C.L. upper limit on the effective quark radius is $0.43 \cdot 10^{-16}$ cm.



## 1. Introduction

Precision measurements of deep inelastic $e^{\pm}p$ scattering (DIS) cross sections at high values of negative four-momentum-transfer squared, $Q^2$, allow searches for contributions beyond the Standard Model (BSM), even far beyond the centre-of-mass energy of the $e^{\pm}p$ interactions. For many "new physics" scenarios, cross sections can be affected by new kinds of interactions in which virtual BSM particles are exchanged. The cross sections would also be influenced were quarks to have a finite radius. As the HERA kinematic range is assumed to be far below the scale of the new physics, all such BSM interactions can be approximated as contact interactions (CI). In all cases, deviations of the observed cross section from the Standard Model (SM) prediction are searched for in $ep$ scattering at the highest available $Q^2$. The predictions are calculated using parton distribution function (PDF) parameterisations of the proton.

The H1 and ZEUS collaborations measured inclusive $e^{\pm}p$ scattering cross sections at HERA from 1994 to 2000 (HERA I) and from 2002 to 2007 (HERA II), collecting together a total integrated luminosity of about 1 fb$^{-1}$. All inclusive data were recently combined [1] to create one consistent set of neutral current (NC) and charged current (CC) cross-section measurements for $e^{\pm}p$ scattering with unpolarised beams. The inclusive cross sections were used as input to a QCD analysis within the DGLAP formalism, resulting in a PDF set denoted as HERAPDF2.0. Due to the high precision and consistency of the input data, HERAPDF2.0 can be used to calculate SM predictions with small uncertainties. A search for BSM contributions in the data should take into account the possibility that the PDF set may already have been biased by partially or totally absorbing previously unrecognised BSM contributions.

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