

Two-photon contribution to elastic lepton-proton scattering measured by the OLYMPUS experiment

N. Akopov,¹ R. Alarcon,² O. Ates,³ A. Avetisyan,¹ R. Beck,⁴ S. Belostotski,⁵ J.C. Bernauer,⁶ J. Bessuille,⁶ F. Brinker,⁷ J.R. Calarco,⁸ V. Carassiti,⁹ E. Cisbani,¹⁰ G. Ciullo,⁹ M. Contalbrigo,⁹ N. D'Ascenzo,^{7,*} R. De Leo,¹¹ J. Diefenbach,^{3,†} T.W. Donnelly,⁶ K. Dow,⁶ G. Elbakian,¹ P.D. Eversheim,⁴ S. Frullani,¹⁰ Ch. Funke,⁴ G. Gavrilov,⁵ B. Glaeser,¹² N. Goerrissen,⁷ D.K. Hasell,⁶ J. Hauschildt,⁷ B.S. Henderson,⁶ Ph. Hoffmeister,⁴ Y. Holler,⁷ L. Ice,² E. Ihloff,⁶ A. Izotov,⁵ R. Kaiser,¹³ G. Karyan,^{7,‡} J. Kelsey,⁶ D. Khanefit,¹² A. Kiselev,^{5,§} P. Klassen,⁴ M. Kohl,³ A. Krivshich,⁵ I. Lehmann,¹³ P. Lenisa,⁹ D. Lenz,⁷ S. Lumsden,¹³ Y. Ma,^{12,¶} F. Maas,¹² H. Marukyan,¹ O. Miklukho,⁵ R. Milner,⁶ A. Movsisyan,^{1,**} M. Murray,¹³ Y. Naryshkin,⁵ C. O'Connor,⁶ R. Perez Benito,¹² R. Perrino,¹¹ R.P. Redwine,⁶ D. Rodríguez Piñeiro,¹² G. Rosner,¹³ R. Russell,⁶ A. Schmidt,⁶ U. Schneekloth,⁷ B. Seitz,¹³ M. Statera,⁹ A. Thiel,⁴ H. Vardanyan,¹ D. Veretennikov,⁵ C. Vidal,⁶ A. Winnebeck,⁶ and V. Yeganov¹

(OLYMPUS Collaboration)

¹*Alikhanyan National Science Laboratory (Yerevan Physics Institute), Yerevan, Armenia*

²*Arizona State University, Tempe, AZ, USA*

³*Hampton University, Hampton, VA, USA*

⁴*Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany*

⁵*Petersburg Nuclear Physics Institute, Gatchina, Russia*

⁶*Massachusetts Institute of Technology, Cambridge, MA, USA*

⁷*Deutsches Elektronen-Synchrotron, Hamburg, Germany*

⁸*University of New Hampshire, Durham, NH, USA*

⁹*Universita' di Ferrara and Istituto Nazionale di Fisica Nucleare sezione di Ferrara, Ferrara, Italy*

¹⁰*Istituto Nazionale di Fisica Nucleare sezione di Roma and Istituto Superiore di Sanità, Rome, Italy*

¹¹*Istituto Nazionale di Fisica Nucleare sezione di Bari, Bari, Italy*

¹²*Johannes Gutenberg Universität, Mainz, Germany*

¹³*University of Glasgow, Glasgow, United Kingdom*

(Dated: August 2, 2016)

The OLYMPUS experiment was designed to measure the two-photon contribution in elastic lepton-proton scattering thought to explain the discrepancy between the form factor ratio, $\mu_p G_E^p / G_M^p$, measured with polarization techniques and unpolarized experiments. The DORIS storage ring at DESY with electron and positron beams at 2.01 GeV incident on an internal hydrogen gas target was used to measure the ratio in the elastic scattering cross sections for positrons and electrons. A toroidal magnetic spectrometer instrumented with drift chambers and time of flight scintillators detected both the elastically scattered lepton and the recoil proton. Data for four-momentum transfers up to $2.2 (\text{GeV}/c)^2$ ($\epsilon > 0.4$) were collected. To monitor the luminosity a symmetric Møller / Bhabha calorimeter at 1.29° and telescopes of interleaved GEM and MWPC detectors at 12° were used. A total luminosity of $\sim 4.5 \text{ fb}^{-1}$ was collected. This letter gives a brief overview of the experiment, the analysis, and first results.

PACS numbers: 25.30.Bf 25.30.Hm 13.60.Fz 13.40.Gp 29.30.-h

Keywords: elastic electron scattering; elastic positron scattering; two-photon exchange; form-factor ratio

* Currently with Huazhong University of Science and Technology, Wuhan, China and Institute of Applied Mathematics, Russian Academy of Sciences, Russia

† Currently with Johannes Gutenberg Universität, Mainz, Germany

‡ Also with Alikhanyan National Science Laboratory (Yerevan Physics Institute), Yerevan, Armenia

§ Currently with Brookhaven National Laboratory, Brookhaven, NY, USA

¶ Currently with RIKEN, Nishina Center, Advanced Meson Science Laboratory, Japan

** Also with Universita' di Ferrara and Istituto Nazionale di Fisica Nucleare sezione di Ferrara, Ferrara, Italy