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Two-photon exchange and elastic scattering of positrons/electrons on the proton

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We report the experiment on a precise comparison of $(e^+ p)$ and $(e^- p)$ scattering cross sections, which gives a direct experimental evidence for the two-photon exchange (TPE) contribution in this reaction. Such data are in demand now, because they, most likely, may explain the dramatic disagreement of proton electromagnetic form factors measurements in the polarization transfer (PT) experiments at Jefferson Lab with previous unpolarized measurements using a Rosenbluth separation (RS) technique.

Common practice of the analysis of RS experiments was in approximate taking into account of TPE contribution, believing this contribution to be small. Currently there are no accurate calculations of the TPE contribution, what is related to difficulties in accounting of the intermediate states of proton. But recent calculations, which takes particular account of proton structure, shows importance of TPE contribution for RS analysis. As far as the experimental situation, only old (in 1960th) measurements exist, where the TPE contribution were found with low precision and limited kinematics coverage.

Reported experiment was performed recently at VEPP-3 storage ring at the energy of positron/electron beams 1.6 GeV and three regions of electron/positron scattering angle - around 10, 18 and 64 degrees. The smallest angle region was used for luminosity monitoring. Electron and positron beams were replaced each other regularly, one cycle with two beams required 1.5 hours. Internal hydrogen gas target had a thickness $5 \cdot 10^{14}$ at/cm². *Experiment duration was 1500 hours with a mean luminosity of $5 \cdot 10^{31}$ 1/(s cm²).* The preliminary results on $(e^+ p)/(e^- p)$ cross sections ratio will be presented.

Primary author: NIKOLENKO, Dmitri (Budker Institute for Nuclear Physics)

Presenter: NIKOLENKO, Dmitri (Budker Institute for Nuclear Physics)

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