HK 2: Hadronenstruktur und -spektroskopie

Zeit: Montag 14:00–16:00 Raum: HZ 3

Gruppenbericht HK 2.1 Mo 14:00 HZ 3

Determining the Two-Photon Contribution to Elastic ep Scattering — •Jürgen Diefenbach for the OLYMPUS-Collaboration — Institut für Kernphysik, Universität Mainz

To determine the two-photon exchange contribution to the elastic electron-proton scattering cross section, the OLYMPUS experiment was carried out at the DORIS storage ring at DESY in Hamburg in 2012. Measuring the elastic scattering cross sections from hydrogen, alternating daily between electron and positron beams, along with a redundant determination of the luminosity, will yield a ratio between the positron and electron cross sections at the one percent level. This will help resolve the puzzle in the proton form factor ratio between Rosenbluth and polarization transfer measurements. The talk will give a review of the experiment as well as report on the current status of the data analysis.

Gruppenbericht HK 2.2 Mo 14:30 HZ 3

MUSE: Measuring the proton radius with muon-proton scattering — •Jan Christopher Bernauer — Massachusetts Institute of Technology, Cambridge, USA

The proton radius has been measured so far using electron-proton scattering, electronic Hydrogen spectroscopy and muonic Hydrogen spectroscopy, the latter producing a much more accurate, but seven sigma different, result, leading to the now famous proton radius puzzle. The MUSE collaboration aims to complete the set of measurements by using muon scattering to determine the proton radius and to shed light on possible explanations of the discrepancy. The talk will give an overview of the experiment motivation and design and a status report on the progress.

HK 2.3 Mo 15:00 HZ 3

Symmetric Møller/Bhabha luminosity monitor for the OLYMPUS experiment — •Perez Benito Roberto for the OLYMPUS-Collaboration — Helmholtz-Institut Mainz, Germany

The OLYMPUS experiment ran on the DORIS storage ring at DESY, Hamburg to measure the elastic cross sections for both positron and electron scattering from hydrogen to quantify the two-photon contribution to elastic ep scattering. Two-photon exchange is widely considered to be responsible for the the discrepancy in the proton form factor ratio determined using the Rosenbluth technique and polarization transfer. The experiment alternated daily between positron and electron beams at 2.01 GeV incident on an unpolarized, internal, hydrogen gas target. The luminosity delivered to the experiment was monitored by a redundant set of detectors: a high precision, symmetric Møller / Bhabha calorimeter and a tracking telescope at 12 degrees. The symmetric Møller/Bhabha calorimeter was built at Mainz and consisted of two symmetric arrays of lead fluoride crystals. Results on the performance of the SYMB luminosity monitor will be presented together with an overview of the OLYMPUS experiment.

HK 2.4 Mo 15:15 HZ 3

The OLYMPUS radiative *ep* generator — •Rebecca Russell for the OLYMPUS-Collaboration — MIT, Cambridge, USA

The OLYMPUS experiment at DESY has collected datasets with positrons and electrons incident on hydrogen which, in combination, allow a precise determination of the contribution of hard two-photon exchange to elastic *ep* scattering. This radiative correction could explain the discrepancy between measurements using Rosenbluth separation and those using polarization techniques of the proton form factor ratio G_E/G_M. Additional radiative corrections to the final result need to be carefully taken into account as they may be larger than hard two-photon exchange itself. As some radiative corrections are sensitive to detector acceptances, resolutions, and analysis cuts, a radiative generator for use with the OLYMPUS Geant4 Monte Carlo has been developed. This generator includes full elastic corrections and an exact calculation of first order bremsstrahlung. A general description of the generator, its special features, and its usage in the OLYMPUS analysis will be presented.

HK 2.5 Mo 15:30 HZ 3

Two-photon exchange corrections in elastic electron-proton scattering. Dispersion theory — •Oleksandr Tomalak and Marc Vanderhaeghen — Johannes Gutenberg- Universität Mainz, Germany

The recent measurements of the proton charge radius from the Lamb shift of energy levels in muonic hydrogen are in strong contradiction, by 5-7 standard deviations, with the value obtained with electronic hydrogen and the value extracted from the unpolarized electron-proton scattering data. The precise determination of the proton radius from scattering experiments can be taken only with account of the higher order corrections, like two photon exchange diagram and 2-loops QED corrections. Two photon exchange correction was studied with the fixed momentum transfer dispersion relations. It was shown that the dispersion relations calculation of the two- photon exchange processes in elastic electron-proton scattering requires one subtraction. Theoretical predictions of elastic contribution of TPE corrections to the unpolarized elastic electron-proton scattering and polarization transfer were made.

HK 2.6 Mo 15:45 HZ 3

Untersuchungen zur Messung des axialen und magnetischen Strangeness-Formfaktors mit einem P2-Rückwärtswinkel-Setup — •Sebastian Baunack — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Am geplanten supraleitenden Elektronenbeschleuniger MESA in Mainz wird das Experiment P2 eine hochpräzise Messung der schwachen Ladung des Protons durchführen. Den Zugang hierzu liefert eine Messung der paritätsverletzenden Asymmetrie im Wirkungsquerschnitt der elastischen Elektron-Proton-Streuung.

Die hadronische Struktur des Protons geht bei der Interpretation der gemessenen Asymmetrie in Form von Formfaktoren ein. Die größten Beiträge zur hieraus resultierenden Unsicherheit liefern die Unsicherheiten im axialen Formfaktor und im magnetischen Strangeness-Formfaktor. Eine Messung unter Rückwärtswinkeln an MESA könnte dazu beitragen, diese Unsicherheiten deutlich zu reduzieren. Überlegungen hierzu werden vorgestellt.