

CFNS Ad-Hoc Meeting: Radiative Corrections

Report of Contributions

Contribution ID: 1

Type: **not specified**

The current state of affairs

Thursday, 9 July 2020 09:00 (40 minutes)

Presenter: Dr FRIEDRICH, Jan (TUM)

Session Classification: Thursday

Contribution ID: 2

Type: **not specified**

Radiative corrections for precision e-p scattering

Thursday, 9 July 2020 09:40 (40 minutes)

Presenters: AHMED, Jaseer; BLUNDEN, Peter (University of Manitoba)

Session Classification: Thursday

Contribution ID: 3

Type: **not specified**

Radiative corrections and two-photon exchange for MUSE and JLAB

Thursday, 9 July 2020 10:35 (40 minutes)

Presenter: Prof. AFANASEV, Andrei (GWU)

Session Classification: Thursday

Contribution ID: 4

Type: **not specified**

Radiative corrections for the MUSE experiment

Thursday, 9 July 2020 11:15 (40 minutes)

The MUon proton Scattering Experiment (MUSE) at the Paul Scherrer Institute will measure the elastic electron-proton and muon-proton-scattering cross-sections with beam momenta between 115 MeV/c and 210 MeV/c and scattering angles between 20 degrees and 100 degrees. As the momenta of the final-state leptons remain largely unmeasured, the determination of radiative corrections faces experiment-specific challenges. Preliminary estimates of the magnitude of the corrections and instrumental methods to decrease their uncertainties will be discussed.

This work is supported by NSF PHY-1812382.

Presenter: Prof. STRAUCH, Steffen (USC)

Session Classification: Thursday

Contribution ID: 5

Type: **not specified**

Modeling Radiative Processes for the OLYMPUS Experiment

Thursday, 9 July 2020 13:00 (40 minutes)

The OLYMPUS Experiment at DESY measured the elastic positron-proton to electron-proton cross section ratio, to quantify the effects of hard two-photon exchange (TPE). Hard TPE creates an asymmetry between the electron and positron cross sections, but so do several other radiative processes. One of the challenges faced by OLYMPUS was to properly account for these residual effects in order to isolate hard TPE. We developed a Monte Carlo event generator with several different radiative models, which allowed us to convolve the effects of radiation with the effects of detector acceptance and resolution. OLYMPUS published first results in 2017, in which we determined that hard TPE is an approximately 1-2% effect over the kinematics probed, whereas the residual radiative effects grow to approximately 6% at the highest Q^2 . In this talk, I will detail the approach employed by OLYMPUS, discuss our design choices in our event generator, and explore some possible improvements.

Presenter: Prof. SCHMIDT, Axel (GWU)**Session Classification:** Thursday

Contribution ID: 6

Type: **not specified**

Radiative correction studies for the PRad and planned PRad-II, DRad and SoLID experiments at Jefferson Laboratory

Thursday, 9 July 2020 13:40 (40 minutes)

The interpretation of experimental data in charge radius measurements of proton in elastic $e+p$ scattering requires correct calculations or elaborate estimations of radiative corrections. This is also the case for deuteron charge radius measurements in elastic $e+d$ scattering as well as for semi-inclusive DIS scattering measurements of polarized and unpolarized particles. In this talk we will show the results from radiative correction studies for the recent proton radius measurement accomplished by the PRad experiment. We will also discuss the recent studies on radiative corrections for semi-inclusive DIS processes for the planned SoLID experiment. Besides, we will give some details on our plans for similar studies for the planned PRad-II and DRad experiments. The methodology developed for most of these studies is based upon using the covariant approach for calculation of radiative corrections, where the infrared divergence is extracted and cancelled by applying the Bardin-Shumeiko approach.

Presenter: KHACHATRYAN, Vladimir (Duke)

Session Classification: Thursday

Contribution ID: 7

Type: **not specified**

Radiative corrections for MUSE

Thursday, 9 July 2020 14:20 (40 minutes)

The radiative corrections for the low-energy lepton-proton elastic scattering will be presented. Since at low scattering energies utilized in MUSE, the lepton masses are kept in evaluations of the radiative contributions. We use the low-energy heavy baryon chiral perturbation theory and evaluate contributions at leading and next-to-leading order.

Presenter: Prof. MYHRER, Fred (USC)**Session Classification:** Thursday

Contribution ID: 8

Type: **not specified**

Radiative Corrections in SIDIS: Current Status and Perspectives

Thursday, 9 July 2020 15:15 (40 minutes)

I will i) review approaches for RC calculation in deep inelastic scattering (DIS) and semi-inclusive DIS (SIDIS), ii) present the explicit exact analytical expressions for the lowest order radiative corrections to the SIDIS of the polarized particles, iii) briefly discuss the approach for covariant extraction and cancellation of the infrared divergence from the real and virtual photon emission using different approaches, iv) discuss the contribution of the exclusive radiative tail, v) describe possible approximations and discuss their validity, vi) compare approaches based on Monte Carlo and analytic calculation, and vii) discuss the current status of numeric calculations and describe existing uncertainties, and viii) discuss the iteration procedure of RC extraction from experimental data.

Presenter: Prof. AKUSHEVICH, Igor (Duke)**Session Classification:** Thursday

Contribution ID: 9

Type: **not specified**

Fifth Force in Atomic Systems: Where to Look

Thursday, 9 July 2020 15:55 (40 minutes)

Recently, the so-called X17 boson may have been seen in nuclear physics experiments at the ATOMKI institute in Debrecen, Hungary. The mass range of the particle, which is about 17 MeV, hence its name, makes the particle hard to detect in low-energy atomic physics experiments, despite the unprecedented accuracy of modern experiments. We find the effective Hamiltonians generated by X17 exchange, for both the pseudoscalar as well as the vector hypothesis. The general conclusion of our investigations is that the X17-mediated effects should be most visible in the shift of hyperfine sublevels, and rather leave the Lamb shift invariant. Our findings, summarized in Physical Review A vol. 101, 062503 (2020), have further implications for the search of new forces in high-precision atomic spectroscopy experiments

Presenter: Prof. JENTSCHURA, Ulrich (Missouri S&T University)

Session Classification: Thursday

Contribution ID: 10

Type: **not specified**

Summary EIC MC activities

Friday, 10 July 2020 09:00 (40 minutes)

The EIUCG Software Working Group (SWG) is working on physics and detector simulations that enable a quantitative assessment of the measurement capabilities of the EIC detector(s) and their physics impact for the Yellow Report Initiative. The common simulation tools and workflow environment being set up by the working group allows the EICUG to pursue the Yellow Report studies in a manner that is accessible, consistent, and reproducible. In my presentation, I will give an overview about the SWG activities with a focus on Monte Carlo event generators. I will emphasize on growing our workflow environment with the community and will invite the experts on merging QED and QCD effects in simulations to contribute to our community effort.

Presenter: DIEFENTHALER, Markus (Jefferson Lab)**Session Classification:** Friday

Contribution ID: 11

Type: **not specified**

Second order Radiative corrections for ep Scattering

Friday, 10 July 2020 09:40 (40 minutes)

High-precision measurements of lepton nucleon scattering will require knowledge of higher-order radiative corrections.

I'll describe a calculation of QED leptonic corrections including contributions from 2-loop virtual corrections, 2-photon emission and 1-loop corrections for 1-photon radiation. A Monte Carlo simulation code was developed for elastic ep scattering.

Presenter: Prof. SPIESBERGER, Hubert (JGU Mainz)

Session Classification: Friday

Contribution ID: 12

Type: **not specified**

Higher-order calculations of RC for ep and Moller scattering

Friday, 10 July 2020 10:35 (40 minutes)

Proton radius puzzle is the discrepancy between inferred proton radius in ep scattering and in muonium spectral measurements. In a remarkable recent experiment, PRad, it was demonstrated that earlier results for r_p in ep scattering must be reconsidered. The systematic error analysis for this experiment has shown that the dominant source of systematic error comes from radiative corrections. Therefore, the task of precision calculation of the radiative corrections becomes very important. I will review the experiment, including its sources of systematic errors. Then I will describe the recent one loop calculation of RC beyond ultra relativistic approximation. I will then move to 2loop and 2photon processes and will review existing approaches to this calculation and go into the details of our own work in this direction.

Presenter: Dr SREDNYAK, Stan (Duke)**Session Classification:** Friday

Contribution ID: **13**

Type: **not specified**

New approach to RC

Friday, 10 July 2020 11:15 (40 minutes)

Presenter: QIU, Jianwei (Jefferson Lab)

Session Classification: Friday

Contribution ID: 14

Type: **not specified**

Radiative corrections in MC event generators in HEP

Friday, 10 July 2020 13:00 (40 minutes)

Presenter: HOECHE, Stefan (Fermilab)

Session Classification: Friday

Contribution ID: 15

Type: **not specified**

Radiative Corrections in MC for EIC

Friday, 10 July 2020 13:40 (40 minutes)

Presenter: BRESSAN, Andrea

Session Classification: Friday

Contribution ID: 16

Type: **not specified**

Opportunities at EIC with Both Lepton Signs

Friday, 10 July 2020 14:35 (40 minutes)

EIC is motivated by the possibility to scatter electrons from hadrons. i.e. to utilize the well-determined QED interaction to understand how the quarks and gluons of QCD form the bound systems which account for the visible mass in the universe. The perturbative QED expansion is significantly affected both by radiative processes as well as higher-order terms which are believed to be significant in elastic electron-proton scattering at moderate Q^2 . The ability to change the lepton sign allows direct access to the higher order multi-photon exchange contributions. Further, beam charge asymmetries provide access to new information in a number of important reactions. These issues will be presented and discussed.

Presenter: MILNER, Richard (MIT)**Session Classification:** Friday