Q 69: Post-Deadline Session

Time: Friday 10:30–11:30 Location: K 1.020

Q 69.1 Fri 10:30 K 1.020

Experimental Evidence of Quantum Radiation Reaction in Aligned Crystals — •Tobias Wistisen and Antonino Di Piazza — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Radiation reaction is the influence of the electromagnetic field emitted by a charged particle on the dynamics of the particle itself. Classical theoretical approaches to radiation reaction lead to physically inconsistent equations of motion. In addition, radiation-reaction effects have never been measured, which has prevented a complete understanding of this problem [1]. Here I will talk about experimental results obtained to address this issue [2]. We measured radiation emission spectra from ultrarelativistic positrons in silicon in a regime where both quantum and radiation-reaction effects dominate the dynamics of the positrons. We found that each positron emits multiple photons with energy comparable to its own energy, revealing the importance of quantum photon recoil. Moreover, the shape of the emission spectra indicates that photon emissions occur in a nonlinear regime where positrons absorb several quanta from the crystal field. This experiment is the first fundamental test of quantum electrodynamics in a new regime where the dynamics of charged particles is strongly influenced not only by the external electromagnetic fields but also by the radiation-field generated by the charges themselves and where each photon emission potentially reduces the energy of the charge by a significant amount.

[1] A. Di Piazza et al., Rev. Mod. Phys. 84, 1177 (2012)

[2] T. N. Wistisen, A. Di Piazza, H. V. Knudsen, and U. I. Uggerhøj, arXiv:1704.01080, 2017.

Q 69.2 Fri 10:45 K 1.020

Towards spin-photon entanglement in single ions trapped in UV fiber cavities — Pascal Kobel, Kilian Kluge, •Jonas Schmitz, Maximilian Zawierucha, Hendrik M. Meyer, and Michael Köhl — Physikalisches Institut, Universität Bonn, Wegelerstraße 8, D-53115 Bonn, Germany

Trapped ions coupled to optical cavities are among the most promising candidates for entanglement generation and distribution in quantum networks. We demonstrate single photon generation of a trapped ytterbium ion coupled to an optical fiber cavity as well as coherent qubit control. This paves the way for spin-photon entanglement generation at scalable rates.

Additionally, the setup of a novel dual-species ion trap will be presented. It incorporates macroscopic cavity mirrors designed for transitions at 370 nm (Yb^{+}) and 493 nm (Ba^{+}). Avoiding macroscopic amounts of hydrocarbons inside the vacuum chamber, the cavity finesse shows no degradation on a timescale of months, contrary to earlier experiments employing UV cavities.

Q 69.3 Fri 11:00 K 1.020

Correlated photon-pair emission from a cw-pumped Fabry-Perot microcavity — •Thorsten F. Langerfeld, Hendrik M. Meyer, and Michael Köhl — Physikalisches Institut, Universität Bonn, Wegelerstraße 8, D-53115 Bonn, Germany

The generation of correlated photons is an important milestone in fundamental test of quantum mechanics and in the quest to interconnect remote quantum systems with the goal of creating quantum networks. For the latter, a tunable photon pair source, which can be tailored to the physical properties of the network nodes is desirable. For that purpose, we study a dispersion-compensated high-finesse optical Fabry-Perot microcavity under high-intensity cw pumping. The Kerr non-linearity in the optical coatings causes a spontaneous four-wave mixing process, triggered by vacuum fluctuations of the unoccupied cavity modes, which leads to the emission of time-correlated photon pairs, which are shifted in frequency by ± 1 free spectral range relative to the pump frequency. The ease of the experimental setup, e.g. avoiding a phase matching condition by employing a sub-wavelength thick nonlinear medium, and the principal tunability of the wavelengths and bandwidths of the created photon pair make the scheme an attractive candidate for a photon-pair source with application in hybrid quantum systems in which wavelength has to be bridged between dissimilar systems.

Q 69.4 Fri 11:15 K 1.020

Trident pair-production in strong-field QED: pulse shape dependence — •Uwe Hernandez Acosta and Burkhard Kämpfer — Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf

We present calculations of trident pair (e+,e-) production in laser-electron collisions within the framework of strong-field QED. The Furry picture is suitable to study the impact of the beam shape. Analog to Compton and Breit-Wheeler processes, rich structure patterns can emerge in various observables reflecting pulse features. The trident process is interesting as first step in seeded cascades as well-controlled QED background.