

## Seminar

10 May 2026

Aula E, Via Archirafi 36, 12:00-13:00

### *Light-matter interaction in the strong-field QED regime*



**Antonino Di Piazza, University of Rochester, USA**

Strong-field QED; Intense laser fields; Vacuum polarization; Electron–positron pair production

#### **Abstract**

Quantum electrodynamics (QED) is a well-established physical theory and its predictions have been confirmed experimentally in various regimes and with extremely high accuracy. However, there are still areas of QED that deserve theoretical and experimental investigation, especially when physical processes occur in the presence of intense background electromagnetic fields, i.e., of the order of the so-called “critical” field of QED or *Schwinger field*, a regime known as *strong-field QED* regime [1-3].

After a broad introduction on the electromagnetic interaction, I focus on some representative examples of currently open problems in the case of strong-field QED in intense laser fields [1-3]. First, I will discuss how quantum effects modify the radiation by ultrarelativistic electrons, a process which has a classical counterpart. Then, I will move to two phenomena, which are purely quantum mechanical: vacuum polarization and pair production. These phenomena have changed our perception of the quantum vacuum as they occur due to the fact that quantum mechanically electromagnetic fields do also interact in vacuum. Related to this, I will mention some recent investigations on the so-called QED cascades, where a plasma of electrons, positrons, and photons can be produced if two counterpropagating ultra-intense laser beams are focused onto a solid or gaseous target. Finally, I will present NSF OPAL, a multipetawatt laser facility currently under design in Rochester.

---

<sup>1</sup> A. Di Piazza, C. Mueller, K. Z. Hatsagortsyan, and C. H. Keitel, *Rev. Mod. Phys.* **84**, 1177 (2012).

<sup>2</sup> A. Gonoskov, T. G. Blackburn, M. Marklund, and S. S. Bulanov, *Rev. Mod. Phys.* **94**, 045001 (2022).

<sup>3</sup> A. Fedotov, A. Ilderton, F. Karbstein, B. King, D. Seipt, H. Taya, and G. Torgrimsson, *Phys. Rep.* **1010**, 1 (2023).