

Appunti di Fisica '23

8 marzo ore 15:00

su Microsoft Teams "Seminari di Appunti di Fisica"

Sculpting light and matter in non-perturbative coupling regimes

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Cavity quantum electrodynamics (CQED) is the study of the interaction between photon confined within cavity mode volumes and quantum emitters. By optimising certain features of the CQED system, the strength of the interaction between single photons and matter can increase up to a point in which novel phenomenology can be explored [1]. The recent technological advances in nanophotonics have allowed scientists to reach and investigate ever stronger light-matter coupling regimes leading to groundbreaking achievements of fundamental and applied nature. [2]

In particular, we found intriguing the possibility of exploiting light-matter interaction in confined systems to controllably modify materials properties, thus turning CQED into a tool for material science.

The talk will start from a general introduction on perturbative and non-perturbative CQED. Later, we will explore some recent demonstrations of how the coupling with the photonic field of a microcavity can substantially modify electronic [2] and photonic [3] wavefunctions, leading to photon-stabilized electron bound states [4,5], plasmonic Landau damping [6]. At the end, we will discuss my most recent results about a newfound connection between CQED and positronium research.

- [1] A. Frisk Kockum *et al.*, *Nature Reviews Physics* **1**, 19 (2019)
- [2] S. Brodbeck *et al.*, *Physical Review Letters* **119**, 027401 (2017)
- [3] E. Cortese *et al.*, *Optica* **10** (1), 11-19 (2023)
- [4] E. Cortese *et al.*, *Optica* **6**, 354 (2019)
- [5] E. Cortese *et al.*, *Nature Physics* **17**, 31 (2021)
- [6] S. Rajabali *et al.*, *Nature Photonics* **15**, 690 (2021)
- [7] E. Cortese *et al.*, *Physical Review A* **107** (2), 023306 (2023)