Synthetic nanoscale quantum emitter rings for efficient excitation transport

Arpita Pal[*1], **Raphael Holzinger**[1], **Maria Moreno-Cardoner**[2], **and Helmut Ritsch**[1]

1. Institut für Theoretische Physik, Universität Innsbruck, Technikerstraße 21a, A-6020 Innsbruck, Austria.

2. Departament de Física Quàntica i Astrofísica and Institut de Ciències del Cosmos, Universitat de Barcelona, Martí i Franquès 1, E-08028 Barcelona, Spain.

Nature is abundantly engineering complex rings of chromophores in light- harvesting complexes (LHCs) utilized for photosynthesis. They absorb and transport solar energy to the photosynthetic reaction centers with high efficiency. These bio-rings could be modeled as sub-wavelength rings of optical dipoles that support extremely sub-radiant collective eigenmodes and show efficient excitation energy transfer [1], [2], [3], [4]. To explore possibilities for synthetic LHCs, we will present a theoretical investigation tackling bio-inspired state-of-the-art nanoscale coupled ring geometries of quantum emitters, featuring the signature optical properties of the natural LHCs. Our study expects to find promising applicability in the thrust areas of artificial light harvesting and designing inter-node lossless links utilized in quantum networks.

References

[1] M. Moreno-Cardoner, D. Plankensteiner, L. Ostermann, D. E. Chang, and H. Ritsch, Phys. Rev. A **100**, 023806 (2019).

[2] J. A. Needham, I. Lesanovsky, and B. Olmos, New J. Phys. **21**, 073061 (2019).

[3] M. Moreno-Cardoner, R. Holzinger, and H. Ritsch, Opt. Express **30**, 10779 (2022).

[4] V. Scheil, R. Holzinger, M. Moreno-Cardoner, and H. Ritsch, Nanomaterials **13**, 851 (2023).

[*]arpita.pal@uibk.ac.at