Seminar/Talk

Minimalistic efficient quantum devices build of dipole coupled nano arrays of quantum emitters

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An array of closely spaced, dipole coupled quantum emitters exhibits collective energy shifts as well as super- and sub-radiance with characteristic tailorable spatial radiation patterns. In particular optical absorption and emission properties of ring shaped sub-wavelength nanoscopic quantum emitter structures are unique. As striking example we identify a sub-wavelength sized ring of exactly 9 identical dipoles with an extra identical emitter with a extra loss channel at the center as the most efficient configuration to deposit incoming photon energy to center without reemission.The enhancement is most pronounced a given resonance frequency but still stays visible for broadband light absorption. For very tiny structures below a tenth of a wavelength a full quantum description exhibits an even larger enhancement than predicted from a classical dipole approximation.The origin of the effect can be tied to a specific geometric property of nonagons allowing for the appearance of a special collective dark state with dominant center occupation. By special design of the center absorber one can harness the same efficiency enhancement also at different wavelengths and for other geometric structures.On the one hand this could be the basis of a new generation of highly efficient and selective nano antennas for single photon detectors for microwaves, infrared and optical frequencies as used e.g. in quantum information processing or single molecule spectroscopy, while on the other hand it could be an important piece towards understanding the surprising efficiency of natural light harvesting molecules.Adding gain to such systems allows to design minimalistic classical as well as non-classical light sources.References:Holzinger, Raphael, Mariona Moreno-Cardoner, and Helmut Ritsch. "Nanoscale continuous quantum light sources based on driven dipole emitter arrays, Appl. Phys. Lett. 2021Holzinger, Raphael, et al. "Nanoscale coherent light source." Physical Review Letters 124.25 (2020): 253603Moreno-Cardoner, Maria, Raphael Holzinger, and Helmut Ritsch. "Efficient frequency-selective single-photon antennas based on a bio-inspired nano-scale atomic ring design with 9-fold symmetry." arXiv preprint arXiv:2010.09771 (2020).

Wednesday, May 4, 2022 11:00am - 12:00pm
Heinzel Seminar Room / Office Bldg West (hybrid enabled) (I21.EG.101)

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