Single-photon source over the THz regime

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Terahertz (THz) radiation (lying at frequencies from 0.1 THz to 70 THz) has sparked a broad interest recently due to its potential application in a wide array of areas, primarily related to imaging and spectroscopy [1]. We present the design strategy for a tunable source of single photons operating in the terahertz regime. Our proposal transforms incident visible photons into output THz ones through three elements: an optical laser, a nanophotonic THz cavity, and a single polar quantum emitter. The dressing of the latter by the laser fields gives rise to THz transitions in the system, which are coupled to the THz cavity through the emitter permanent dipole moment [2,3]. However, to the best of our knowledge, only classical properties of the THz radiation generated---such as the emission spectrum---or semi-classical lasing limits have been considered. We demonstrate that this scheme can produce strongly antibunched THz radiation with considerable brightness, offering optical tunability of properties such as the frequency of the emission or its quantum statistics by modifying the intensity and frequency of the drive. Beyond antibunching, we show that the emission features a rich landscape of quantum correlations, also featuring multi-photon emission and non-classical cross-correlations among different spectral frequencies. We demonstrate that the implementation of this scheme is feasible with current state-of-the-art photonics technology.

References

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Figures

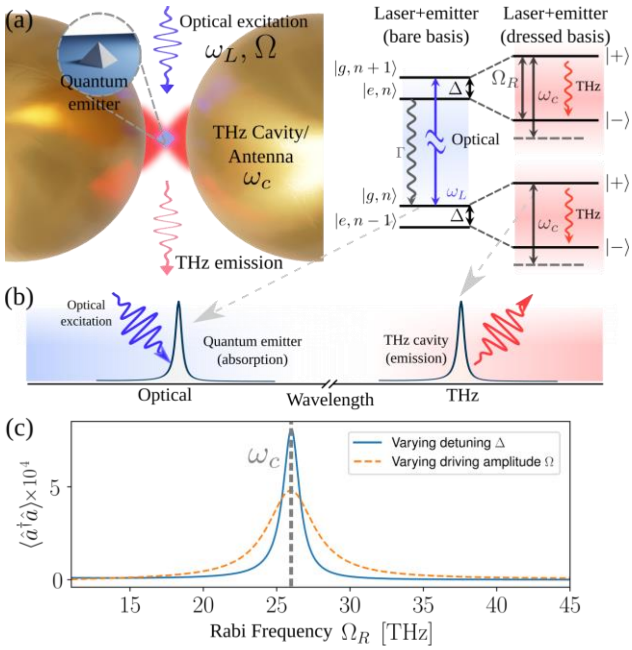

Figure 1: (a) Sketch of the experimental implementation (left) and energy level structure (right): left part represents the bare states basis highlighting energy differences in the optical domain (blue); right side represents the dressed-state basis highlighting THz transitions (red). (b) Absorption and emission properties in the THz and the optical domain. (c) Resonance in the cavity population as the Rabi frequency crosses the cavity frequency.