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Taming the photons emitted by single molecules

Single-photon sources have been demonstrated in various systems ranging from atoms and ions in the gas phase to quantum dots, defect centers and molecules in the solid state. However, experiments, which go beyond the pure demonstration of the anti-bunched nature of the emission, are rare. One reason is that most sources are inefficient due to the low overall efficiency of the collection optics. Another one is the difficulty to realize indistinguishable single-photon sources, a key requirement for more complex experiments involving several single emitters.
In this talk I will first review our current experiments where we couple single molecules to metallic or dielectric antenna structures in order to control and to improve their emission properties. For example, by using a dielectric antenna we could realize a single-photon source with near-unity collection efficiency and a count rate of 50×10^6 photons per second. With the current design we collect 96% of the photons emitted by a single molecule.
In the second part I will present experiments where we exploit interactions, either between photons or between photons and a single molecule. By tuning the frequencies and spectral widths of two individual remote molecules, we can explore various aspects of two-photon interference. If we focus the photons emitted by one of the molecules onto the other we can directly observe the absorption of single photons by a single molecule.

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