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Quantum Plasmonics REINIER HEERES, LEO KOUWENHOVEN, VALERY ZWILLER, TU Delft — Surface plasmon polaritons allow confinement of light to sub-wavelength length-scales. Due to the confinement the electro-magnetic fields involved are stronger, which can be used to enhance optical interactions. We use this fact to realize a plasmonic beam-splitter based on a directional-coupler geometry, i.e. two waveguides close to each other coupled by their evanescent fields. This beam-splitter can be much smaller than conventional dielectric structures. Integrated Niobium-Nitride superconducting single-photon detectors (SSPDs) allow to probe the plasmons directly in the near-field. This makes it possible to study the structure on the quantum level using photon pairs created in a spontaneous parametric down-conversion process. Our aim is to observe Hong-Ou-Mandel interference, a true quantum effect which causes indistinguishable photons arriving at the same time at both inputs to exit through the same port, i.e. bunch. This will prove the quantum nature of surface plasmons and could be used to build sub-wavelength quantum logic gates. We also show that resonant plasmonic antennas can greatly enhance the absorption and therefore detection efficiency of SSPDs.

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