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Quantum plasmonics of a metal nanoparticle array for on-chip nanophotonic network CHANGHYOUP LEE, CHANGSUK NOH, DIMITRIS ANGELAKIS[1], Centre for Quantum Technologies, National University of Singapore, Singapore, MARK TAME, QOLS, The Blackett Laboratory, Imperial College London, United Kingdom, JAMES LIM, JINHYOUNG LEE, Department of Physics, Hanyang University, Korea — With the advancement of nanofabrication techniques, metallic nanoparticles have been attracting significant attention due to their novel capabilities offering the prospects of miniaturization, scalability, and strong coherent coupling to single-emitters that conventional photonics cannot achieve. In this work, we investigate an array of metal nanoparticles for on-chip quantum networking, quantum computation and communication on scales far below the diffraction limit. For this purpose, we first consider the transfer of quantum states, including single qubits as plasmonic wave packets, and explore the interference of single plasmons associated with the quantum properties of the plasmon excitation. In addition, we study dipole induced reflection effects in the plasmonic setting. The results seem promising for quantum control applications such as single-photon switching and slow light in the nanoscale. We also propose a scheme of entanglement generation between distant emitters embedded in the array of metal nanoparticles. The techniques introduced in this work may assist in the further theoretical and experimental studies of plasmonic nanostructures for quantum control applications and probing nanoscale optical phenomena.

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