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Quantum Plasmonics with Graphene MICHAEL GULLANS, National Institute of Standards and Technology, Gaithersburg, MD, DARRICK E. CHANG, JAVIER GARCIA DE ABAJO, FRANK H.L. KOPPENS, ICFO-Institut de Ciencies Fotoniques, Castelldefels (Barcelona), Spain, MIKHAIL D. LUKIN, Department of Physics, Harvard University, Cambridge, MA, JACOB M. TAYLOR, National Institute of Standards and Technology, Gaithersburg, MD — Graphene has emerged as a powerful platform for plasmonics due to its high mobility, versatile fabrication, and the ability to tune the plasmon properties via external gate voltages. We consider several applications of graphene plasmonics to quantum information science. First, we show that one can take advantage of the strong electromagnetic field confinement and long lifetime of the plasmons to realize significant nonlinear optical interactions at the few photon level in graphene nanostructures. Such systems can be used to realize a single photon transistor. Second we consider a quantum network of graphene coupled to the hydrogen-like excited states of group-V donors in Silicon. The strong coupling of these dipole transitions to the graphene plasmons results in long-range interactions and superradiant transitions. We consider entanglement that can be generated using this collective decay process.

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