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Quantum Electrodynamics of Surface Plasmons

JÉRÉMIE CHOQUETTE, PETER MARZLIN, RENÉ STOCK, BARRY SANDERS, IQIS, University of Calgary — Surface plasmons are electromagnetically induced charge-density waves that appear at the interface between dielectrics and a thin metal film and can enhance optical field intensities by two to three orders of magnitude. Despite their fast decay surface plasmons have been shown to preserve optical entanglement and may be useful for optical quantum information. We present a detailed theoretical analysis of the interaction of photons and atoms in the presence of a dielectric interface permitting surface plasmons. We use a Green's function technique to quantize the electromagnetic field in planarly multi-layered lossy and absorbing dielectrics to give an accurate description of the noise induced near the metal film. We calculate the modified spontaneous emission rate of an atom near the interface and study the radiation characteristics of the emitted light. Furthermore we analyze the propagation of a single photon pulse through the interface. We discuss applications of our results to enhance nonlinear effects in quantum optics.

☐ Prefer Oral Session
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