Ultraslow Waves and Photonic Quantum Dynamics on the Nanoscale

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ABSTRACT

Recent broad interest in the physics and applications of ultraslow waves in nanoscale structures range from light-waves or surface plasmons in nanoplasmonic devices to sound waves in acoustic-metamaterial waveguides, as well as plasmons and phonon polaritons in graphene and van der Waals crystals [1]. Combining ultraslow waves with active photonic quantum materials opens up new domains for science, materials physics and engineering, providing the foundation for novel photonic quantum and communication technologies and nanolasing.

The talk will review the underlying physics of ultraslow waves on the nanoscale and discuss far-reaching opportunities resulting from a combination of ultraslow waves and active photonic quantum materials enabling single quantum emitter strong coupling [3,4]. The ultrafast spatio-temporal dynamics of cavity-free stopped-light nanolasing [2] and surface plasmon polariton condensation in nanoplasmonic heterostructures are yet further reflections of the special properties of light in the vicinity of stopped-light singularities, while a combination of stopped-light modes with epsilon-near-zero [5] and topological materials [6] with vanishing refractive index offer further exciting possibilities for nanophotonics.

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