Arrays of plasmonic nanoparticles, so-called plasmonic lattices, when combined with an emitter material (gain medium), provide a versatile platform for studies on light-matter interaction in the nanoscale, including collective coherent phenomena as well as topological photonics. We have experimentally realized a new type of condensate: a BEC of hybrids of surface plasmons and light in a nanoparticle array, with unique polarization and coherence properties [1-4]. We observe the BEC both in the weak [1] and strong [2-4] light-matter coupling regimes. The spatial and temporal coherence show a change from Gaussian/exponential to power law decay at the transition from polariton lasing to BEC [4]. In the lasing regime, we have observed bound states in continuum (BIC) modes with different topological charges [5,6]. By tuning the size of a hexagonal unit cell, we can realize lasing that shows transitions between states of topological charges zero, one, and two [6]. We found that the transitions are driven by losses, determined by the geometric structure of the modes of different topological charges. Recently, we have experimentally observed non-zero quantum metric and Berry curvature along the diagonals of the Brillouin zone of a square lattice of gold nanoparticles [7]. By a theoretical analysis, we show that the Berry curvature originates solely from non-Hermitian effects [8]. In this talk, an introduction to these topics, and a discussion of the key results will be given.

References: