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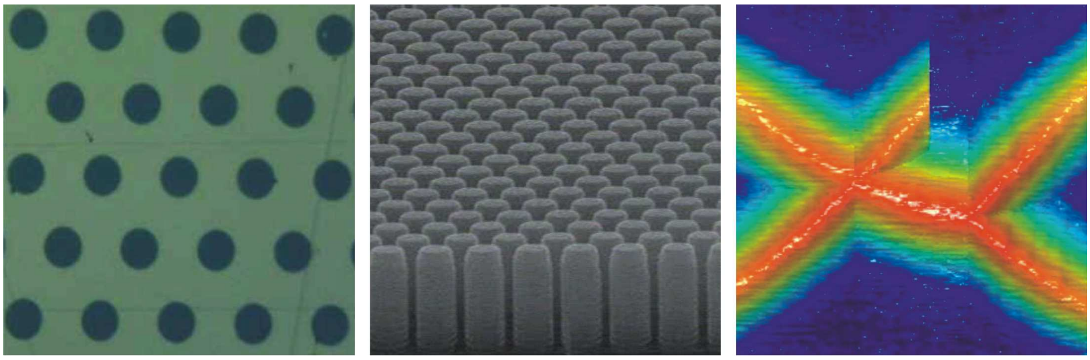
School of Physics and Astronomy
Quantum Physics and Quantum Engineering Group

PhD thesis

Polariton condensation in microcavity lattices

In 1928, Paul Dirac brilliantly derived a theory combining relativity and quantum mechanics by describing the relativistic motion of electrons with a massless linear dispersion relation. This recently gave great insight into the formation of Dirac fermions in condensed matter systems like graphene, carbon nanotubes or topological insulators by the observation of unique transport properties such as the anomalous quantum Hall effect or Klein tunneling. An outstanding platform to create and investigate bosonic Dirac-like particles and mimic the relativistic properties of real Dirac particles is given by the two-dimensional arrangement of polaritons in microcavity lattices. These two-dimensional polariton lattices create higher orbitals in the polariton band structure allowing the crossing of two degenerate polariton bands (Dirac points). Several lattice geometries such as honeycomb or triangular lattices have already been proposed for the formation of such Dirac points. The triangular lattice has already experimentally been proven to show Dirac bosons in higher order bands [1] therewith laying the ground for exciting more research.



Top (left) and side (middle) view of a triangular microcavity lattice. Right: experimental band structure of lower polaritons recorded along the three high-symmetry points Γ, M and K of the triangular lattice [1].

[1] N Y Kim *et al*, New J Phys **15**, 035032 (2013)

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