



Research project in **Photonics**

Research project in **Theoretical & Computational Solid State**

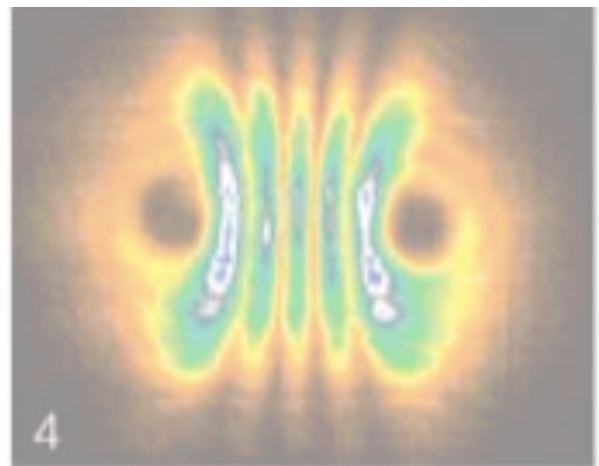
### Theory of quantum light and matter

**Research supervisor:** Prof. Paul Eastham

Advances in the areas of condensed matter, atomic physics, and optics, are uncovering new types of cooperative behaviour for electrons and photons. Examples are (a) the formation of new ordered states such as Bose-Einstein condensates; (b) the occurrence of exotic optical properties in photonic materials and structures; and (c) the disappearance of quantum coherence in complex systems such as solids. Understanding these effects teaches us how the deceptively simple laws of quantum mechanics generate a vast variety of electrical and optical properties, and leads to the creation of new technologies such as quantum computers.

My group makes theories to predict, describe, and understand these phenomena. We build and solve models, often in the form of quantum field theories, and work closely with experimentalists and theorists across the world- and we need students to join us, for projects on :

- "Can a single qubit be a refrigerator? Back-action and quantum state control of excitons"
- "Bose-Einstein condensation of polaritons in exotic geometries and topologies"
- "Orbital angular momentum, information capacity, and symmetry in optical systems"



Bose-Einstein condensation of polaritons in a semiconductor microcavity. Several thousand particles "condense" into a single wavefunction to generate these oscillations. From Tosi et al., "Sculpting oscillators with light within a nonlinear quantum fluid", *Nature Physics* 8, 190 (2012).

### Funding

Applicants should apply for funding from the following sources: TCD PG Scholarship and School of Physics Studentship schemes.

### Contact details

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### For more information

Drop me an email to arrange an informal discussion.