Fluids of light in disordered environment

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Nonlinear photonics has opened up a fascinating field known as "Quantum Fluids of Light." In this realm, photons take on unique properties, essentially acquiring an effective mass and engaging in precisely controlled effective repulsive interactions. This behavior bears a striking resemblance to how particles behave in quantum fluids, such as Helium-4 [1,2] or atomic Bose-Einstein condensates [3]. It's this intriguing parallel with such original physical systems that has ignited a surge in exploration of the field. The growing interest in this field is fueled by the versatility and adaptability of photonic experimental platforms, giving access to features unreachable in genuine systems.

Indeed, different setups, including semiconductor microcavities [4] and propagating geometries [5], offer the means to control and manipulate the behavior of photons in the fluids of light framework. At INPHYNI, we focus on the latter approach, using a photorefractive crystal [6-8] that allows us to manipulate the optical index in a highly flexible and reconfigurable manner [9]. In a significant recent development, our group successfully reported a direct experimental observati- on of the transition to superfluidity of a fluid of light past an obstacle.

Looking ahead, our research is set to explore the transition from spatial localisation to superfluidity in complex, but fully controlled environ- ments. This transition promises to yield strong turbulence in the system and it will be investigated as well.

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