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Quantum droplets of light in the presence of synthetic magnetic fields. KALI WILSON, NICLAS WESTERBERG, MANUEL VALIENTE, CALLUM DUNCAN, Heriot-Watt University, EWAN WRIGHT, University of Arizona, PATRIK OHBERG, DANIELE FACCIO, Heriot-Watt University — Recently, quantum droplets have been demonstrated in dipolar Bose-Einstein condensates, where the long range (nonlocal) attractive interaction is counterbalanced by a local repulsive interaction. In this work, we investigate the formation of quantum droplets in a two-dimensional nonlocal fluid of light. Fluids of light allow us to control the geometry of the system, and thus introduce vorticity which in turn creates an artificial magnetic field for the quantum droplet. In a quantum fluid of light, the photons comprising the fluid are treated as a gas of interacting Bose-particles, where the nonlocal interaction comes from the nonlinearity inherent in the material, in our case an attractive third-order thermo-optical nonlinearity. In contrast to matter-wave droplets, photon fluid droplets are not stabilised by local particle-particle scattering, but from the quantum pressure itself, i.e., a balance between diffraction and the nonlocal nonlinearity. We will present a numerical and analytical investigation of the ground state of these droplets and of their subsequent dynamics under the influence of a self-induced artificial magnetic field, and discuss experimental work with the possibility to include artificial gauge interactions between droplets.

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