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Experimental Evidence for Quantized Vortices and Superfluidity of Semiconductor Excitons in a Trap ROMAIN ANANKINE , MUSSIE BEIAN, SUZANNE DANG, MATHIEU ALLOING, FRANOIS DUBIN, Univ Pierre et Marie Curie, EDMOND CAMBRIL, KAMEL MERGHEM, CARME GOMEZ, ARISTIDE LEMAITRE, CNRS, INSTITUT DES NANOSCIENCES DE PARIS COLLABORATION, LABORATOIRE DE PHOTONIQUE ET NANOSTRUCTURES COLLABORATION — Semiconductor excitons are electron-hole pairs bound by Coulomb attraction. Composed by two fermions, excitons undergo Bose-Einstein condensation (BEC) in an original fashion. Combescot et al. showed that quantum statistics leads to a grey condensate made by a dominant fraction of dark excitons coherently coupled to a weaker population of bright excitons. Thus, the condensate emits a weak coherent photoluminescence (PL) that can be experimentally used to probe the phase coherence of this "grey" condensate. Recently, we have reported the first signatures for a grey condensate signaled by the macroscopic spatial coherence of a confined dark gas of excitons, below a critical temperature of 1K.

The PL radiated by the grey condensate is strongly inhomogeneous spatially. Dark spots are identified in the emission profile, signaling the local damping of bright excitons by over 50%. Using spatial interferometry, we reveal that the dark spots observed in a grey condensate are quantized vortices with a phase singularity of the coherent PL emission due to a 2π phase winding around the core of one quantized vortex. We then discuss the role of disorder for the localization and the formation of vortices across BEC of excitons.

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