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**Experimental Signatures for Bose-Einstein Condensation 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, LABORATOIRE DE PHOTONIQUE ET NANOSTRUCTURES COLLABORATION, INSTITUT DES NANOSCIENCES DE PARIS COLLABORATION — Semiconductor excitons, i.e. electron-hole pairs bound by Coulomb attraction, have been studied for long in the quest for Bose-Einstein condensation (BEC). Unfortunately, this had not led to clear success so far despite the expected critical temperature of about 1K. In 2007, M. Combescot et al. showed that the ground exciton state is optically dark so that the condensate is made of a macroscopic population of dark excitons. Quantum signatures can only be detected directly above a density threshold, when fermion exchanges between excitons can introduce coherently a small fraction of bright excitons to the dark BEC. The latter then becomes "grey" and is possibly studied through a weak and coherent optical signal.

Here we report experimental evidences for a grey BEC: We confine long-lived excitons in a trap where we probe a homogeneously broadened gas at controlled density and temperature. We show that the photoluminescence (PL) emitted from the trap anomalously decreases while excitons are cooled to the sub-Kelvin regime. The darkening marks the quantum condensation in the lowest energy dark states. We also reveal that the weak PL radiated from the trap exhibits both quantum spatial coherence and increased temporal coherence below 1K.

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