Indirect exciton transport in high magnetic fields

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We present simulations and first measurements of the transport of cold bosons in the high magnetic field regime using a system of indirect excitons in GaAs coupled quantum wells. Such a regime is realized when the cyclotron splitting is comparable or larger than the exciton binding energy, achieved in a perpendicular magnetic field B of a few Tesla.

A model based on indirect magnetoexciton (IMX) energy relaxation and effective mass enhancement is used. Energies and wave functions of IMX states with in-plane momentum $k = 0$ are calculated using a multi-sub-level approach [1,2]. The calculated and measured energies are shown in Figures 1a and 1b, respectively. Treating k as a perturbation, we use perturbation theory to 2$^{\text{nd}}$ order to find the IMX mass renormalization due to an arbitrarily strong B-field [1,2]. By solving coupled equations that describe transport, cooling and optical decay of an IMX gas, we reproduce the ring shaped emission pattern around the excitation spot observed by optical imaging [2]. Zeroth Landau level IMXs travel tens of micrometers with the transport distance decreasing with increasing B. This is quantified by the HWHM of the exciton cloud, shown in Figures 1c and 1d. A decrease in transport is explained by IMX effective mass enhancement which decreases mobility.

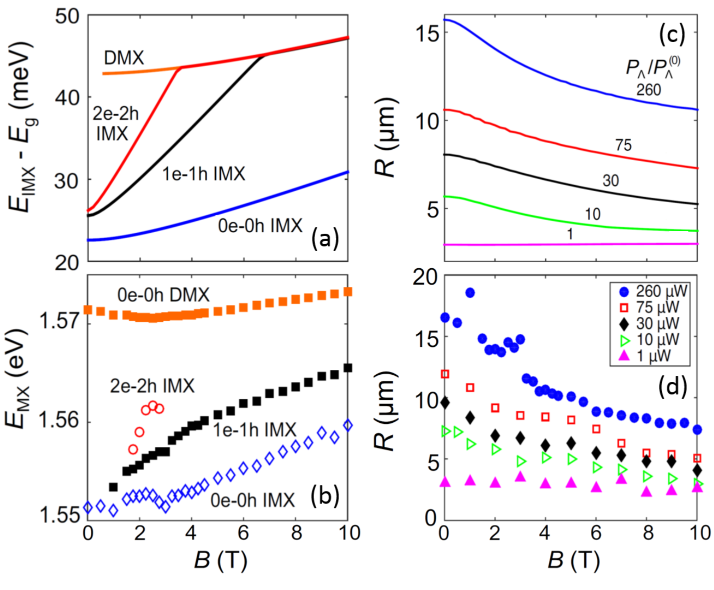

Figure 1: Calculated (a) and measured (b) IMX energies vs B. E_g is the GaAs bandgap. Simulated (c) and measured (d) inner ring radius R, defined as the HWHM of the emission pattern, vs B at different excitation powers. $P_\Lambda^{(0)} = 0.58\,\text{ns}^{-1}$ is a fit parameter.

[1] Y. Y. Kuznetsova *et al.*, *Phys. Rev. B* **95**, 125304 (2017).
[2] J. Wilkes and E. A. Muljarov, *New J. Phys.* **18**, 023032 (2016).