ECS 521/641: Spintronics and Nanomagnetics

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HW #6

Problem 1

Plot the energy dispersion relation subjected to a magnetic field in the plane of 2-DEG ($x-z$ plane) with the **numerically accurate procedure**. Assume $m^* = 0.05m_0, g = 4, \nu = -\frac{\gamma_D}{\hbar^2}\langle p_y^2\rangle = \gamma_D\langle \partial^2/\partial y^2\rangle$, and the following cases.

(i) $B = 1\ T, B_x = B_z$ and (ii) $B = 0$

(1) $\eta = 10^{-11}eV - m, \nu = 2\eta$
(2) $\eta = 10^{-11}eV - m, \nu = \eta$
(3) $\eta = 10^{-11}eV - m, \nu = 0$
(4) $\eta = 0, \nu = 10^{-11}eV - m$

Problem 2

Plot the energy dispersion relation subjected to a magnetic field in the plane of 2-DEG ($x-z$ plane) **using the variable separation approximation**, and compare the results with the previous problem. Assume $m^* = 0.05m_0, g = 4, \nu = -\frac{\gamma_D}{\hbar^2}\langle p_y^2\rangle = \gamma_D\langle \partial^2/\partial y^2\rangle$, and the following cases.

(i) $B = 1\ T, B_x = B_z$ and (ii) $B = 0$

(1) $\eta = 10^{-11}eV - m, \nu = 2\eta$
(2) $\eta = 10^{-11}eV - m, \nu = \eta$
(3) $\eta = 10^{-11}eV - m, \nu = 0$
(4) $\eta = 0, \nu = 10^{-11}eV - m$

Problem 3

Derive the velocity versus wavevector relation, i.e., $v_x^{\pm}$ and $v_z^{\pm}$.