ECS 521/641: Spintronics and Nanomagnetics

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HW #7

Problem 1

Plot the energy dispersion relation for 1-DEG with the **numerically accurate procedure**. The nanowire is subjected to a magnetic field along the nanowire axis (x-axis). The rectangular cross-section of the nanowire is on the $y-z$ plane with $L_y \ll L_z \ll L_x$. Also, there is a symmetry breaking electric field along the y-axis inducing the Rashba spin-orbit interaction. Assume $m^* = 0.05m_0, g = 2, v = -\frac{\gamma_D}{\hbar^2}\langle p_y^2 \rangle = \gamma_D \langle \partial^2/\partial y^2 \rangle$, and the following cases.

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

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

Problem 2

Plot the energy dispersion relation as given in the above problem **using the variable separation approximation.**

Problem 3

For the 0-DEG, derive all the expressions in the lecture slides when the nanowire axis is changed from x-axis to z-axis, and the magnetic field is applied along the z-axis, i.e., use σ_z instead of σ_x.