Condensed Matter - HW 8 :: Dielectric function.

PHSX 545

Problem 1

Collaborative effort: form a team that includes 'theorist' and 'experimentalist' (several people on the team is OK):

Tasks:

Theory: Find the imaginary part of dielectirc function $\varepsilon''(\mathbf{q}, \omega)$ in RPA for classical electron gas obeying Maxwell-Boltzmann statistics.

Experiment: provided formula from theory, create a 3D (or better, 2D color plot) of $\omega\varepsilon''$ and $-\chi''$ in q, ω-plane and interpret them. Choose convenient dimensionless units in terms of temperature.

Problem 2

Calculate $\varepsilon(\mathbf{q}, \omega)$ in RPA for the two-dimensional electron gas at zero temperature. Show that susceptibility can be given by analytic expression (hint: treat the two Dirac-Fermi distributions in χ_0 separately). Find the explicit expression for two non-vanishing terms of the plasmon dispersion $\omega(q)$ in the long wavelength limit.

(You may again form theory and experiment collaboration: the experimental people can plot the imaginary part of the susceptibility to determine where the plasmon mode is damped, and also graphically find the exact plasmon dispersion.)