Hydrodynamic modes and the density-density correlation function of a supersolid

CHI-DEUK YOO, ALAN DORSEY, Department of Physics, University of Florida — Recently Kim and Chan have observed the Non-classical Rotational Inertia of solid $^4$He in Vycor glass [1] and in bulk [2] below around 200mK, and have interpreted their results as the onset of a supersolid phase [3]. As an alternative to detecting the supersolid phase, it is interesting to see whether a supersolid has a second sound mode analogous to a superfluid. We have derived hydrodynamics for a supersolid, and calculated the hydrodynamic mode frequencies for an isotropic supersolid, obtaining a longitudinal second sound mode. In addition, we have calculated the density-density correlation function in linear response theory, and find that one of the central Rayleigh peaks of a normal solid splits into two Brillouin peaks at $\omega = \pm c_2 q$ in supersolid phase, where $c_2$ is the second sound speed of a supersolid. This behavior could be revealed in a light scattering experiment from the solid.