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Andreev-Lifshitz Theory Applied to Normal Solids under Pressure[1] MATTHEW SEARS, WAYNE SASLOW, Texas A&M University — On letting the superfluid density go to zero, the Andreev-Lifshitz hydrodynamic theory of supersolids becomes applicable to an ordinary solid.[2] Under applied pressure P_a, needed to produce solid He^3 and He^4 or to be of geophysical relevance, the system has both an elastic stress λ_{ik} and an internal pressure P, with $P\delta_{ik} = P_a\delta_{ik} + \lambda_{ik}$ in equilibrium. P may be thought of as being due to a vacancy fluid. For P_a small compared to the bulk modulus, Maxwell relations give $P \sim P_a^2$. The dynamical equations lead to three sets of propagating elastic modes (longitudinal and transverse sound) and two diffusive modes (one largely of entropy density and one largely of vacancy density – or, more generally, defect density), all of which we study for non-zero P_a.[3] The vacancy diffusion mode has diffusion constant $D_L \sim P_a^2$, and is diffusive because its associated internal pressure fluctuation P' nearly cancels its lattice stress fluctuation λ'_{ik}. This mode permits the system to respond differently to transducers with different surface treatments. We specifically have in mind solid ^4He, which requires $P_a \sim 25$ bars to solidify; however, the results should apply to any solid under pressure.

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[2]A. F. Andreev and I. M. Lifshitz, Sov. Phys. JETP 29, 1107 (1969).
[3]M. R. Sears and W. M. Saslow, Phys. Rev. B 82, 134304 (2010).

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