Structure Factor of Superfluid He II about Dispersion Minimum

J.X. ZHENG-JOHANSSON, IOFPR, SWE, P-I. JOHANSSON, Uppsala University, SWE — The SHM-RSB/∆b-dynamic scheme of He II has within the framework of the well established condensed matter theory facilitated the predictions of superfluidity, critical velocity, circulation quantization, and other key properties of He II in overall good agreement with experiments[1]. In relevance to neutron scattering this scheme leads to that at the dispersion minimum (qb, ∆s), the structure factor of He II contains an elastic and inelastic component: S(q) = Sel(q) + Sinel(q).

Here Sel(q) = \frac{N}{2\pi \hbar} e^{-2W} [1 + \int g(R)e^{i\mathbf{q}\cdot R}dR]f_0\delta(\omega - 0) probes the instantaneous configuration of the disordered superfluid atoms and is a broad function. Sinel(q) = \frac{1}{2\pi \hbar N}\delta(q - qb)f_b\delta(\omega - \frac{\Delta_s}{\hbar}) is due to scattering by the excitations of superfluid bond ∆b, at an energy cost ∆s. (Definitions for other variables are given e.g. in [1]2004b.) ∆b has its origin in many-quantum-atom correlation and thus has a well defined value through this many-atoms averaging operation. Accordingly Sinel(q) is a sharp function; it is related to the dynamic structure factor here as: Sinel(q)|q=qb = Sb(q, ω)|ω=Δs.