

Singular amplification of low-frequency fluctuations in optical spectra of ^4He quantum liquid

Vladimir Hizhnyakov, Vadim Boltrushko

Institute of physics, University of Tartu, 1 Ostwald Street, 50411, Tartu, Estonia

*Corresponding author E-mail: hizh@ut.ee

Abstract: The optical spectra of impurity atoms (molecules) in ^4He quantum liquid are considered. It is shown that the main distinguishing property of the liquid phase to maintain local pressure in all its macro- and meso-regions leads to a huge increase in the contribution of low-frequency density fluctuations to the electronic transitions of impurity atoms, diverging as ω^{-1} with a decrease of the frequency ω of fluctuations. As a result of this divergence, the zero phonon line (ZPL) in the optical spectrum of an impurity atom acquires finite broadening and asymmetric shape already in the limit of zero temperature. Another consequence of this divergence is an abnormally strong dependence on the width and shape of ZPL on the strength of the vibronic interaction of the electronic transition. The optical spectra observed in [1, 2] for impurity atoms of Au, Cu, Cs, and Dy in liquid ^4He at low temperatures are explained.

1. P. Moroshkin, V. Lebedev and A. Weis, EPL, 96, 26002 (2011).
2. P. Moroshkin, A. Borel, and K. Kono, PRB 97, 094504 (2018).

Keywords: Quantum liquids, density fluctuations, zero-phonon lines.