Quantum Criticality of ^{4}He in Nanoporous Media: Effects of Confinement and Disorder

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Recent discovery of a quantum phase transition (QPT) in ^{4}He confined in nanoporous media has opened new avenue for studying strongly correlated Bose systems [1]. It has been revealed that the superfluid phase is terminated by two quantum critical points (QCPs), the critical coverage n_c in the adsorbed film state and the critical pressure P_c in the pressurized liquid state. Here we report recent studies to pursue the nature of the two QCPs: (1) Eggel and Oshikawa [2] showed that the QPT in the pressurized state is the consequence of quantum fluctuation, and is described by the 4D XY universality class. This means that disorder does not play a crucial role except the very vicinity of the QCP. (2) We have found a supersolid-like behavior in a torsional oscillator study for the thin ^{4}He films adsorbed on a nanoporous glass [3]. The coverage dependence of the frequency shift accompanied with a dissipation peak can be related to the divergence of characteristic times and their distribution at the film QCP (n_c). We propose that the behavior is the consequence of a dynamical quantum critical phenomenon of disordered solid ^{4}He.

[1] K. Yamamoto *et al.*, Phys. Rev. Lett. **93**, 075302 (2004); Phys. Rev. Lett. **100**, 195301 (2008). [2] Th. Eggel, M. Oshikawa, K. Shirahama, arXiv:1004.4004. [3] T. Kogure *et al.*, in preparation.

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