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Path Integral Simulations of Solid ^{4}He[1]

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Kim and Chan have found indications that solid ^{4}He is a supersolid by measuring the period of a torsional oscillator. To understand the state of solid ^{4}He at low temperature, we [1] have calculated tunnelling frequencies for ring exchanges in bulk solid helium with Path Integral Monte Carlo by finding the free energy of a path that begins with the atoms in one configuration and ends with a permutation of those positions. The exchange frequencies are found to be described by a lattice model which does not show superfluid behavior. However, simulations [2] of ^{4}He absorbed in Vycor find that ^{4}He forms a layered structure with the first layer solid-like and highly localized, the second layer disordered with some atoms delocalized and possibly superfluid. This persistent liquid layer mechanism can only be relevant for bulk ^{4}He in a very disordered crystal. New calculations [3] of the single particle density matrix, (the fourier transform of the momentum distribution) to measure ODLRA will also be discussed.

[1] D. M. Ceperley and B. Bernu, Phys. Rev. Letts. 93, 155303(2004).
[2] S. A. Khairallah and D. M. Ceperley, Phys. Rev. Letts. 95, 185301 (2005).
[3] B. Clark and D. M. Ceperley, unpublished.

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