MAR09-2008-000315

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

The role of dislocations in supersolid Helium-4

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Disorder and crystallographic defects play a major role in the supersolid phase of ^{4}He. Monte Carlo simulations addressed the physics of vacancies [1], grain boundaries [2] and dislocations [3], which are the focus of this talk. We find that certain types of edge and screw dislocations are superfluid while other remain insulating, depending on their orientation, Burgers vector and possible splitting of the core. The mechanism for superfluidity is provided by the strain near the core of the defect exceeding a threshold value [4]. Superfluid dislocations can build a network of phase coherent tubes (the so-called Shevchenko state) [3], which might lead to an observable mass decoupling in experiment. I will also look at the interactions between a Helium-3 impurity atom and a screw dislocation [5] and make contact with recent experiments.

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[2] L. Pollet, M. Boninsegni, A. B. Kuklov, N. V. Prokof'ev, B. V. Svistunov, and M. Troyer, *Superfluidity of Grain Boundaries in solid* ^{4}*He*, Phys. Rev. Lett. **98**, 135301 (2007).

[3] M. Boninsegni, A. B. Kuklov, L. Pollet, N. V. Prokof'ev, B. V. Svistunov, and M. Troyer, *Luttinger Liquid in the Core of Screw Dislocation in Helium-4*, Phys. Rev. Lett. **99**, 035301 (2007).

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[5] P. Corboz, L. Pollet, N. V. Prokof'ev, and M. Troyer, *Binding of a* ^{3}*He impurity to a screw dislocation in solid* ^{4}*He*, Phys. Rev. Lett. **101**, 155302 (2008).