Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

A Phonon Gap in Solid Helium HANS JOCHEN LAUTER, Oak Ridge National Laboratory, JOHN GOODKIND, UC San Diego, KENNETH HERWIG, Oak Ridge National Laboratory, ECKHARD KROTSCHECK, University at Buffalo-SUNY, EFIM KATS, Landau Institute for Theoretical Physics, ANDREY PODLESNYAK, ANDREII SAVICII, DIALLO SOULEYMANE, JUSTIN CARMICHAEL, Oak Ridge National Laboratory — Using inelastic neutron scattering, we have found an energy gap of about 0.15 meV in a phonon-like spectrum of solid 4He at temperatures below about 0.5 K and pressures near 30 bar. The solid He sample was formed in a stressed, non-equilibrium state, using rapid cooling with the blocked-capillary method. We interpret the gap as evidence for excitations along the edge dislocations according to the Frenkel-Kontorova [1] model. The energy of the excitations is a linear function of q above the gap and can be related to the stress distribution around the dislocation line. Other interpretations are possible e.g. the creation of kinks on dislocation [2]. The energy of the gap is close to the value of a thermal activation energy measured by ultrasonic attenuation in unstrained solid 4He [3] crystals. If the two are measuring the same excitations, they constrain possible models for the cause. The gap may also be related to dislocations in quantum crystals [4].

[1] T. Kontorova, Y.I. Frenkel, Zh. Eksp. Teor. Fiz. **8**, 1349 (1938)
[2] I. Iwasa, H. Suzuki, J. Phys. Soc. Jpn. **49**, 1722 (1980)
[3] G.A. Lengua, J.M. Goodkind, J. Low Temp. Phys. **79**, 251 (1990)
[4] D. Aleinikava, E. Dedits, A. B. Kuklov, D. Schmelzer, EPL **89**, 46002 (2010)

Hans Jochen Lauter
Oak Ridge National Laboratory

Date submitted: 15 Nov 2013 Electronic form version 1.4