Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Dislocation networks in helium-4 crystals[1] ANDREW FEFFERMAN, FABIEN SOURIS, ARIEL HAZIOT, Laboratoire de Physique Statistique de l'ENS, JOHN BEAMISH, University of Alberta, SEBASTIEN BALIBAR, Laboratoire de Physique Statistique de l'ENS — The mechanical behavior of crystals is dominated by dislocation networks, their structure and their interactions with impurities or thermal phonons. However, in classical crystals, networks are usually random with impurities often forming non-equilibrium clusters when their motion freezes at low temperature. Helium provides unique advantages for the study of dislocations: crystals are free of all but isotopic impurities, the concentration of these can be reduced to the ppb level, and the impurities are mobile at all temperatures and therefore remain in equilibrium with the dislocations. We have achieved a comprehensive study of the mechanical response of ^{4}He crystals to a driving strain as a function of temperature, frequency and strain amplitude. The quality of our fits to the complete set of data strongly supports our assumption of string-like vibrating dislocations. It leads to a precise determination of the distribution of dislocation network lengths and to detailed information about the interaction between dislocations and both thermal phonons and ^{3}He impurities. The width of the dissipation peak associated with impurity binding is larger than predicted by a simple Debye model, and much of this broadening is due to the distribution of network lengths.

[1]This work was supported by grant ERC-AdG 247258 SUPERSOLID and by a grant from NSERC Canada.

Andrew Fefferman
Ecole Normale Superieure

Date submitted: 14 Nov 2013 Electronic form version 1.4