Abstract Submitted
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Superfluidity of Grain Boundaries in Solid ^{4}He[1] NIKOLAY PROKOFIEV, Department of Physics, University of Massachusetts, Amherst, LODE POLLET, Theoretische Physik, ETH Zurich, MASSIMO BONINSEGNI, Department of Physics, University of Alberta , Edmonton, ANATOLY KUKLOV, Department of Engineering Science and Physics, CUNY, Staten Island, BORIS SVISTUNOV, Department of Physics, University of Massachusetts, Amherst, MATTHIAS TROYER, Theoretische Physik, ETH Zurich — Superfluid grain boundaries (GB) were proposed as a plausible scenario of the effect discovered by Kim and Chan, and have now been experimentally observed (at the melting point) by Sasaki, Ishiguro, Caupin, Maris, and Balibar [Science **313**, 1098 (2006)]. We report results of large-scale quantum Monte Carlo simulations (up to ≈ 14000 atoms) of GB in ^{4}He crystals at the melting pressure, as well as deep inside the solid phase. We find that generically GB are superfluid, with transition temperatures about ~ 1 K–0.5 K (we estimate the maximum T_c at about 1.50(5) K). At the melting point, the density of particles in the GB is slightly higher than that of a crystal and the GB width is about 3 interatomic spacings. We also observe insulating grain boundaries which typically occur at special orientations of the two crystallites. By simulating GB in direct contact with the superfluid liquid and observing that the system of two liquid-solid and one solid-solid interfaces is mechanically stable we prove that the phenomenon of GB-superfluidity is not related to the close vicinity of the melting line.

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