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Supersolid behavior from superfluidity along extended defects

Two studies of supersolid behavior arising from the occurrence of superfluidity along extended crystalline defects, such as dislocation lines and grain boundaries, will be discussed.
We first consider a two-dimensional polycrystalline system of bosons and show, using a standard mapping between the zero-temperature properties of this system and the statistical mechanics of interacting vortex lines in the mixed phase of a type-II superconductor, that this system exhibits nonclassical rotational inertia (NCRI) arising from superfluidity along the grain boundaries. A calculation of the NCRI from the equations of superfluid hydrodynamics shows that it increases very abruptly as the superfluid regions form a connected, system-spanning structure with one or more closed loops.
In the second study, the thermodynamics of superfluid ordering along a random network of dislocation lines is analyzed using coupled spin models in which the system of dislocation lines is represented by the line defects of one spin system and a second spin system represents the superfluid order parameter. In particular, we examine how the superfluid ordering is affected by the motion of the line segments that form the network.