Quantum Monte Carlo study of quantized vortices in two–dimensional solid Helium

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Quantum vortices have been invoked to explain some aspects of supersolidity in ^{4}He but no microscopic study of such vortices has been published yet. A vortex state can be addressed by Quantum Monte Carlo using the fixed–phase approximation: for a given phase one is led to solve a ground state problem of a suitable inhomogeneous many–body system. We solve exactly this last problem by using the Shadow Path Integral Ground State method. At the simplest level one can use the Onsager–Feynman (OF) phase and in this case the vortex acts as a static external potential. For solid ^{4}He in two dimensions with the OF phase the vortex core is found to sit in an interstitial site and a very weak relaxation of the lattice positions away from the vortex core position has been observed. Also other properties like Bragg peaks in the static structure factor or the behavior of vacancies and dislocations are very little affected by the presence of the vortex. No evident spatial correlations among the vortex and the positions of the mobile defects has been observed. We have computed also the one-body density matrix in perfect and defected Helium crystals finding that the vortex has only a weak effect on the off-diagonal long range tail of the density matrix. These findings suggest that it is important to include backflow terms in the phase and work along these lines is under way.