

Vacancies and ^3He atoms in solid ^4He

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We present the recent activity of our group in the microscopic study of solid ^4He using quantum Monte Carlo methods. In the limit of zero temperature, we have calculated the vacancy formation energy and enthalpy from the melting pressure up to ~ 160 bar. The vacancy formation volume shows a maximum at $P \simeq 60$ bar which is coincident with a minimum of the vacancy formation energy at fixed pressure. Close to this pressure, experimental data shows an enhancement of the superfluid fraction. At finite temperatures, we have studied the physics of solid ^4He with vacancies. For different vacancy concentrations, we have estimated the onset temperature at which the vacancy becomes delocalized and off-diagonal long range order starts to appear. This onset temperature approaches the range of temperatures ~ 100 mK where a supersolid fraction has been experimentally observed. Finally, we report preliminary results of a microscopic description of the role of ^3He impurities in hcp ^4He with and without vacancies.

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