

Bose-glass Phase in Liquid Helium in Disorder

J. Bossy, J. V. Pearce, H. Schober, and H.R. Glyde

In bulk liquid ^4He , there is a direct transition from the superfluid to the normal liquid phase at a temperature T_λ (see phase diagram opposite). In bulk ^4He , the Bose-Einstein Condensation (BEC) and the well defined phonon-roton modes that give rise to superfluidity all vanish at T_λ . In normal phase there is no BEC, no well defined modes, no superflow.

When liquid helium is confined in porous media (in disorder), we have shown [1,2] that there is a Bose-glass (BG) phase separating the superfluid and normal liquid. In the BG phase, there is BEC but it is localized to islands separated by normal liquid. These islands are indicated by shaded patches in the phase diagram opposite for "Helium in Gelsil". In the BG, localized BEC phase, the phases of the BEC in the islands are uncorrelated. There is no phase coherence across the sample (as in extended BEC) required for superflow. However, the localized BEC supports phonon-roton modes that we can observe with neutrons. A BG phase between the superconducting and insulating phases in high T_C superconductors is indicated.

[1] Glyde et al., Phys.Rev.Lett. **84**, 2646 (2000), [2] Bossy et al., Phys.Rev.Lett., **101**, 025301 (2008), Phys.Rev.B, **78**, 224507 (2008)

