LIFSHITZ TRANSITION IN THE DOUBLE-CORE VORTEX IN ^{3}He-B

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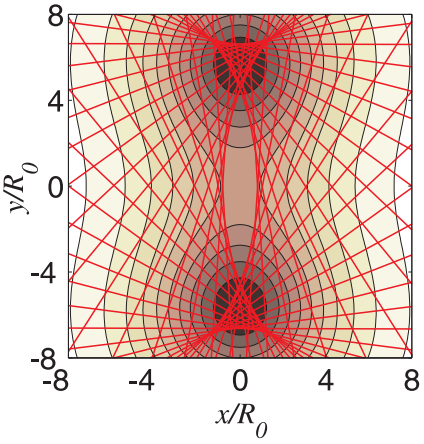
The vortex stable in the major, low-pressure part of the phase diagram of superfluid ^{3}He-B has been identified to have a double core structure, where the vortex core is split into two "half cores". We calculate the low-energy fermionic excitation spectrum of the double-core vortex. We find that the low-energy excitations mostly are localized in the two half cores. We can interpret the two half cores as potential wells for quasiparticles. The motion of the excitations between the wells depends on the potential barrier between them. We find that this barrier changes essentially as the distance of the wells changes as a function of pressure and temperature. This implies a transition from excitations that circle both half cores to separate excitations that circle only a single half core. We predict that this should be observable in the time scales of rotational dynamics. Comparing our calculations with the experiment by Kondo et. al. reveals a serious disagreement in the model used to interpret the experimental data [1]. Based on our calculation of the vortex parameters, we construct a different model. Besides being consistent with the same observations as the model of Kondo et. al., it provides explanation for the observed slow mode of vortex dynamics, which remained unexplained in previous models. Details are given in Ref. [2].

The figure shows a bunch of quasiclassical trajectories (straight lines), whose energy corresponds to the Fermi level. The background shows a contour plot of the pair density of the double-core vortex in the x-y plane perpendicular to the vortex axis. The dark shading indicates the suppression of the pair density at the two half cores. As the trajectory precesses, the quasiparticle amplitude jumps periodically from one half core to the other. For larger half-core distance Landau-Zener transitions on the circling trajectory makes the quasiparticle localized in one of the half cores.



[1] Y. Kondo, J.S. Korhonen, M. Krusius, V.V. Dmitriev, Y.M. Mukharsky, E.B. Sonin, and G.E. Volovik, Phys. Rev. Lett **67**, 81 (1991).

[2] M. A. Silaev, E. V. Thuneberg and M. Fogelström, Phys. Rev. Lett. **115**, 235301 (2015).