ABSTRACT

Effect of rough walls on transport in mesoscopic ^{3}He films

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We discuss the mass transport of a degenerate Fermi liquid ^{3}He film over a rough surface, and the film momentum relaxation time, in the framework of theoretical predictions. In the mesoscopic regime, the anomalous temperature dependence of the relaxation time is explained in terms of the interplay between elastic boundary scattering and inelastic quasiparticle-quasiparticle scattering within the film. We exploit a quasiclassical treatment of quantum size effects in the film in which surface roughness, whose power spectrum is experimentally determined, is mapped into an effective disorder potential within a film of uniform thickness. Confirmation is provided by the introduction of scattering centres within the film. We model further studies on ^{3}He confined in nanofluidic sample chambers with lithographically defined surface roughness. The improved understanding of surface roughness scattering suggests routes to improve the conductivity of thin metallic films.