Helium-4 crossover from a 3d superfluid to a 1d Luttinger liquid in a nanopore

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Quantum Monte Carlo studies of helium-4 at low temperatures show that when it is confined to flow in narrow cylindrical pores with nanometer radii, it tends to form concentric shells around a possible inner core. The latter potentially represents an experimental playground for exploring the implications of Luttinger liquid theory for one dimensional quantum fluids. We have performed large scale numerical simulations investigating the crossover from a bulk three dimensional superfluid to a one dimensional Luttinger liquid as the nanopore radius is reduced. Measurements of heat capacity and entropy provide new insights in the thermodynamic signatures of the dimensional crossover of strongly interacting confined fluids.

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