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Superfluid phases of ^{3}He in a periodic confined geometry[1]

JOSHUA WIMAN, J.A. SAULS, Northwestern University — We report theoretical and computational results on the phases of superfluid ^{3}He confined by a two-dimensional periodic array of square boundaries ("posts") with maximal pair-breaking on the boundaries and translational invariance in the third dimension. We obtain a phase diagram by numerically minimizing the Ginzburg-Landau free energy functional. Results are reported for the pressure range $P = 0 - 34\,\text{bar}$, based on material parameters that include strong-coupling corrections that account for the bulk ^{3}He phase diagram, and for lattice periods, $L \leq 30\xi_0$ and post dimensions, $0.5\xi_0 \leq d < L$. At all pressures we find a transition from the normal state to a periodic polar phase with $T_{c1} < T_c$ for bulk superfluid ^{3}He, for all d for which a superfluid transition occurs. For lower temperatures and sufficiently small post dimensions we find a sequence of symmetry breaking phase transitions from polar to a low temperature periodic "B-like" phase. At high pressures we find two chiral phases with different point symmetries that are energetically stable at intermediate temperatures and confinement, $D = L - d$. We report theoretical predictions for the NMR frequency shifts which provide fingerprints for each of these broken symmetry phases.

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