^{3}He in Aerogel: Engineering Superfluid States with Disorder

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Impurities strongly suppress superconducting states with non-zero orbital angular momentum, a fact that is important as a signature of their unconventional nature. Superfluid ^{3}He confined to high porosity silica aerogel has become a paradigm system for understanding impurity effects in unconventional superconductors. We have developed a new class of highly homogeneous aerogel materials to explore the role of engineered disorder on phase stability and orientation of the superfluid order parameter. Using pulsed nuclear magnetic resonance (NMR) we are able to definitively identify the superfluid states in aerogel and have discovered that anisotropic disorder, produced by growth-induced radial compression, stabilizes a chiral superfluid state that otherwise would not exist. Additionally, from the dependence of the NMR frequency shifts on temperature and tip angle, we have determined the orientation of the orbital angular momentum in this novel state.

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