NMR OF SUPERFLUID ^{3}He-B

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Superfluid ^{3}He is a charge-neutral Fermi system with coherent motion of ^{3}He particles with nuclear spin $I = \frac{1}{2}$. Its state is described with a multi-component order parameter field which can be mapped with NMR. Thus superfluid ^{3}He and NMR have been intimately interconnected since the discovery of the different superfluid ^{3}He phases in 1972. They are renowned for a number of unique NMR phenomena. The spin dynamics is dominated by the dipolar spin-orbit interaction from the Cooper pairing in BCS states. In transverse linear NMR this gives rise to magnetic field independent, but temperature and density dependent frequency shifts. The NMR line shape also displays sharp non-local collective spin-wave resonances. A most unusual property of the spin-orbit interaction is a field-independent temperature-dependent longitudinal resonance, which is observed with rf excitation applied along the static polarization field. Of recent interest are the different modes of spatially coherent order parameter precession. In the modern picture these can be understood as condensation of particle-like spin-wave excitations or magnons to Bose-Einstein condensate states.

The multi-component coherent order parameter field gives rise to a wealth of topologically stable structure, starting from 3-dimensional textures to point-like defects. Since the early eighties the main technique to study vortices has been uniform rotation, for which a rotating sub-millikelvin cryostat is required. So far seven different quantized vortex structures and many other topological defects have been identified in various states of rotating flow, including a two-phase sample where the two major phases ^{3}He-A and ^{3}He-B are separated by a stable first order AB interface. A brief overview is presented of the techniques for studying with sensitive continuous-wave NMR the peculiar resonance properties of the ^{3}He superfluids and the topology, structure, and dynamics of their order parameter fields.