Nuclear Spin Relaxation of Very Dilute ^{3}He in Solid ^{4}He

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We report measurements of the nuclear spin-lattice and nuclear spin-spin relaxation times of very dilute ^{3}He in solid ^{4}He in the temperature range $0.01<T<0.5$ K, and for densities where anomalies have been observed in torsional oscillator and shear modulus measurements. We compare the results with the values of the relaxation times reported by other observers for higher concentrations and compare the results with the theory of Landesman[1] that takes into account the elastic properties of the ^{4}He lattice. For high concentrations, $x>50$ ppm, the ^{3}He impurities are in a constant interaction regime because of the relatively long range of the elastic deformation surrounding each ^{3}He impurity. For very dilute concentrations the ^{3}He atoms are in a gas-like regime and the relaxation times are determined by the cross-section for their mutual scattering. A sharp increase in the magnitude of the nuclear spin-lattice relaxation times compared to the classical Landesman theory are observed close to the temperatures where the torsional and shear modulus anomalies are observed. The NMR results imply that an additional relaxation process occurs in series with the usual processes that is related to the observed change in the dissipation of the elastic modulus of the lattice.

[1]A. Landesman, Physics Letters, **A54**, 137 (1975).