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Detecting the Majorana fermion surface state of ^{3}He-B through spin relaxation[1] SUK BUM CHUNG, SHOUCHENG ZHANG, Stanford University — The concept of the Majorana fermion has been postulated more than eighty years ago; however, this elusive particle has never been observed in nature. The non-local character of the Majorana fermion can be useful for topological quantum computation. Recently, it has been shown that the 3He-B phase is a time-reversal invariant topological superfluid, with a single component of gapless Majorana fermion state localized on the surface. Such a Majorana surface state contains half the degrees of freedom of the single Dirac surface state recently observed in topological insulators. We show here that the Majorana surface state can be detected through an electron spin relaxation experiment. The Majorana nature of the surface state can be revealed though the striking angular dependence of the relaxation time on the magnetic field direction, $1/T_1 \propto sin^2\theta$ where θ is the angle between the magnetic field and the surface normal. The temperature dependence of the spin relaxation rate can reveal the gapless linear dispersion of the Majorana surface state. We propose a spin relaxation experiment setup where we inject an electron inside a nano-sized bubble below the helium liquid surface.

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