Laser spectroscopy of Ba^+ ions in liquid He: Towards the detection of Majorana fermion surface state in superfluid ^{3}He-B

R. Batulin [a b], P. Moroshkin[a], D. Tayurskii[b], P. Blumhardt[a], P. Leiderer[c], and K. Kono[a]

[a]Low Temperature Physics Laboratory, RIKEN, Japan
[b]Institute of Physics, Kazan Federal University, Russia
[c]Department of Physics, University of Konstanz, Germany

Superfluid ^{3}He-B is predicted to have a gapless Majorana fermion surface state [1]. Recently, it was suggested that this state can be detected in a spin-relaxation experiment using free electrons trapped under the surface of ^{3}He-B [2]. However, the limitations of the method so far precluded the experimental detection of the Majorana fermion surface state.
We develop an alternative technique using the electron spin of the Ba^+ ion as a probe. The ions can be injected in liquid He and trapped in nanometer-sized cavities (atomic bubbles) under the free surface of ^{3}He-B. Our proposal relies on the technique of optically-detected magnetic resonance that is well established for impurity atoms in superfluid He [3]. Polarized resonant laser radiation can be used to spin-polarize the sample of Ba^+ ions. The achieved polarization and its decay caused by the interaction with the surface excitations will then be monitored via the laser-induced fluorescence.
We discuss the advantages and challenges of the proposed experimental approach and present the progress report of our project up to date.

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