SPECTROSCOPIC STUDIES OF ATOMS IN LIQUID HELIUM-4 AND HELIUM-3

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In the past decade, spectroscopic studies on foreign atoms and ions in liquid helium have greatly been developed. This is mainly because of the interest in static and dynamical behaviors of the foreign particles, but those studies can also give us useful information on the physical property of quantum liquid.

We have observed emission and absorption spectra of the $ns^2\,{}^1\mathrm{S}_0 \leftrightarrow nsn\mathrm{p}\,{}^1\mathrm{P}_1$ transitions of alkali earth atoms ($n = 3, 4, 5$ and 6 for Mg, Ca, Sr and Ba, respectively) in liquid ^{4}He and ^{3}He. We have found that the spectral widths and peak shifts are much smaller for liquid ^{3}He than for liquid ^{4}He. Our calculation based on a vibrating bubble model has shown that bubbles formed around impurity particles are larger (softer cavities) in liquid ^{3}He than those in liquid ^{4}He, reflecting the isotope effect and quantum statistics of each liquid. This fact can explain the smaller spectral widths and peak shifts for liquid ^{3}He.