PROBING SPIN EXCITATIONS USING MAGNETO-RAMAN SPECTROSCOPY.

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One of the very elusive and intriguing states of matter is a quantum spin liquid (QSL) where quantum fluctuations hinder long range order at low temperatures. Recently, it was suggested that a two-dimensional QSL might manifest in a spin-orbit coupled Mott insulator such as $\alpha$-RuCl$_3$ with honeycomb lattice.\cite{1}

Optical spectroscopy and Raman scattering studies on $\alpha$-RuCl$_3$ performed at low temperatures identified elementary excitations due to electronic correlations and spin-orbit coupling.\cite{2}

In particular, low temperature Raman scattering revealed a broad continuum of magnetic scattering at very low energies (below 25 meV) which was found to persist at temperatures much higher than the magnetic ordering temperature suggesting the presence of frustrated magnetic interactions.\cite{2}

Furthermore, specific heat and magnetic susceptibility measurements also found evidence for unconventional magnetism driven by spin-orbit coupling and electronic correlations.\cite{3} The observations appear to be consistent with theoretical expectations for Heisenberg-Kitaev model for QSL.\cite{4}

The underlying mechanism for magnetism in $\alpha$-RuCl$_3$ was further investigated by probing the effect of external magnetic field on the Raman spectroscopic signatures. Raman scattering experiments were performed at temperatures down to 5 K and magnetic fields up to 10 T. Among the Raman-active phonons (see Figure 1), the intensity of strongest $A_{1g}$ phonon mode at about 312 cm$^{-1}$ was found to decrease with increasing magnetic field strength. This suggests the presence of strong magnetic interactions. The experimental observations and its implications will be presented and discussed in detail.

\cite{1} K.W. Plumb, \textit{et al.}, Phys. Rev. \textbf{90}, 041112 (2014).\cite{1}
\cite{3} J.A. Sears, \textit{et al.}, Phys. Rev. \textbf{91}, 144420 (2015).\cite{3}

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