

Spin dynamics in $\text{Sr}_3\text{Ir}_2\text{O}_7$

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Ruddelsden-Popper series ($\text{Sr}_{n+1}\text{Ir}_n\text{O}_{3n+1}$) compounds containing iridium based oxides are drawing more interest recently due to their rather unusual electronic ground state. $\text{Sr}_3\text{Ir}_2\text{O}_7$ ($n = 2$) and Sr_2IrO_4 ($n = 1$) have antiferromagnetic insulating ground states despite the presence of Ir^{4+} ions with extended 5d orbitals [1-3]. There are two competing proposals regarding the insulating ground states of these materials: (a) Strong spin-orbit interactions supported by electron-electron correlations make the effective bandwidth smaller resulting in a correlated driven $J_{\text{eff}} = 1/2$ Mott insulator [2], and (b) the onset of magnetic ordering continuously opens up a gap resulting in a trivial band insulator where correlation effects are secondary [4]. To have a clear picture of the electronic ground state it is very important to know about strength and anisotropy of exchange interactions between spins.

We performed an inelastic neutron scattering experiment looking for spin dynamics in $\text{Sr}_3\text{Ir}_2\text{O}_7$ on the C5 spectrometer at Canadian Neutron Beam Centre. Given the magnetic ordering temperature of 285 K and small ordered magnetic moment, our goal was to identify any low energy (less than 20 meV) spin excitations around the magnetic zone centers (10L). Previous Resonant Inelastic X-ray Scattering (RIXS) reports had uncovered a ~ 100 meV spin gap in this material; however theoretical proposals suggested that a smaller spin gap may underlie this much larger, single-magnon gap. We investigated the presence of excitations around the known the AF ordering wave vectors aiming to resolve any lower energy spin gap. For our scans looking at energy transfers ranging from 2 meV to 20 meV, we were unable to conclusively resolve any spin excitations near the AF zone center. Our investigation of this material continues however and our study on C5 provided an important constraint on our model of the spin dynamics in this material.

References

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