Singlet-Triplet Excitations in the Unconventional Spin-Peierls System TiOBr

J.P. CLANCY, B.D. GAULIN, McMaster University, C.P. ADAMS, St. Francis Xavier University, G.E. GRANROTH, A.I. KOLESNIKOV, T.E. SHERLINE, Oak Ridge National Laboratory, F.C. CHOU, National Taiwan University — TiOBr belongs to a select group of quasi-one-dimensional materials which undergo a spin-Peierls (SP) phase transition and develop a dimerized singlet ground state at low temperatures. However, unlike conventional SP systems, TiOBr exhibits not one, but two successive phase transitions upon cooling: a continuous transition into an incommensurate SP state at $T_{C2} \sim 48$ K, followed by a discontinuous transition into a commensurate SP state at $T_{C1} \sim 27$ K. We have performed time-of-flight neutron scattering measurements on powder samples of TiOBr using the fine-resolution Fermi chopper spectrometer (SEQUOIA) at the Spallation Neutron Source. These measurements reveal two branches of magnetic excitations within the commensurate and incommensurate SP phases, which we associate with $n = 1$ and $n = 2$ triplet excitations out of the singlet ground state. This study represents the first direct measure of the singlet-triplet energy gap in TiOBr, which we have determined to be $E_g = 21.2 \pm 1.0$ meV.

J. Patrick Clancy
McMaster University

Date submitted: 28 Dec 2010

Electronic form version 1.4