**Excitations of the transversely polarized spin density
waves in chromium**

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Abstract

Inelastic neutron scattering measurements across the TSDW satellites of chromium were performed at $\Delta E = 5, 20$ meV, both under zero field and 5T magnetic field. Analysis concerning the transverse magnetic excitations (T_1 , T_2) and the longitudinal magnetic excitations (L) indicates that T_1 and L are equally intense while T_2 dominates and becomes more so at higher energies.

keywords: inelastic neutron scattering, magnetic excitations, spin density wave,
chromium, itinerant magnetism.

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ORNL is managed by Lockheed
Martin Energy Research Corp. under
Contract No. DE-AC05-96OR22464
for the U.S. Department of Energy.

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The magnetism of BCC chromium metal is characterized by its spin density waves (SDW) [1] which can be thought of as incommensurate sinusoidal modulations on the antiferromagnetic spin arrangement. In a stress-free, single magnetic domain, single-crystal of chromium, the SDW appears as satellites at $\mathbf{Q}=(1\pm\delta,0,0)$ from the nuclear sites in the reciprocal space (Fig. 1a). At temperatures between 311K and 122K, the SDW is polarized transversely to $\mathbf{Q}$ (TSDW). This paper reports an inelastic neutron scattering experiment done at the High Flux Isotope Reactor at the Oak Ridge National Laboratory on the magnetic excitations associated with the TSDW [2-5].

Neutron scattering probes the target's magnetic components that are perpendicular to the momentum transfer. Three Goldstone magnetic excitation modes are associated with each polarization $\mathbf{m}$ of the TSDW (Fig. 1b) [3]: two spin wave modes transverse to $\mathbf{m}$ in directions perpendicular to $\mathbf{Q}$ (T_1) and parallel to $\mathbf{Q}$ (T_2), and the phason mode (L) which is the longitudinal magnetic excitation parallel to $\mathbf{m}$. Consider the $(\delta,1,0)$ satellite with $\mathbf{m}$ parallel to (010), the three modes are: T_1 along (001), T_2 along (100), and L along (010). Since L is nearly parallel to the momentum transfer $\mathbf{K}=(\delta,1,0)$, only T_1 and T_2 contribute to the inelastic scattering. Taking into account those associated with $\mathbf{m}$ parallel to (001), the inelastic scattering intensity at $(\delta,1,0)$ equals T_1+2T_2+L .

When 5T magnetic field is applied along (001), the TSDW polarization is confined to be along (010) [4]. The inelastic scattering at $(\delta,1,0)$ under the field becomes $2T_1+2T_2$. Listed below is a summary of the preceding analysis.

Satellite	H=0	H=5T
$(1\pm\delta,0,0)$	$2T_1+2L$	$2T_1+2L$
$(\pm\delta,1,0)$	T_1+2T_2+L	$2T_1+2T_2$

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Fig. 1. (a) TSDW satellites in reciprocal space; (b) The magnetic excitations associated with the TSDW.

Fig. 2. Scans across the TSDW satellites. The solid lines are curve fits of Gaussians.

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Figure 2