# Challenges in Probing and Analyzing Spin and Charge Dynamics in Stripe "Ordered" Systems

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**Abstract**

It is, by now, well established that in certain layered cuprates and nickelates, hole-doping of the parent antiferromagnetic insulator results in the formation of charge stripes that separate antiphase magnetic domains[1]. While there have been various theoretical approaches to stripes, there is as yet no consensus on the minimal Hamiltonian required to give a realistic description of the stripes observed in cuprates. Furthermore, there are only limited predictions for the detailed charge and spin dynamics of a stripe ordered (or nearly ordered) system. Thus, there are challenges in choosing how to experimentally characterize these excitations.

Neutron scattering measurements on diagonal-stripe–ordered $La_{2-x}Sr_xNiO_4$ indicate that the spin excitations resemble spin waves in an incommensurate magnet[2], although analysis of new data taken on the MAPS instrument at ISIS may reveal some distinctions[3]. At high enough temperatures the stripes melt into a liquid phase, as indicated by measurements of the spin excitations, which remain incommensurate[4]. These have been analyzed in terms of overdamped spin waves, but the damping should result from the fluctuations of the charge stripes. In an attempt to probe the coupling of the charge stripes to the lattice, the dispersion of bond-stretching optical phonon modes have been measured[5]. While interesting anomalies were observed, the nature of the coupling remains puzzling. Studies of the optical conductivity have provided complementary information on the charge dynamics[6].

The dynamics of vertical stripes are under investigation in the cuprate compound $La_{1.875}Ba_{0.125}CuO_4$[7]. The charge stripes are pinned at low temperature due to coupling to a small distortion of the $CuO_2$ planes. The stripes evolve continuously to a dynamic phase as the lattice distortion changes. Intriguingly, the dispersion of the spin excitations differs somewhat from a simple spin-wave analogy, and the average stripe spacing varies with temperature in the stripe-liquid phase.

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## References

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