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Hole doping in frustrated spinels, $ZnCr_2O_4$ and $MgCr_2O_4$, and their two dimensional analogue SCGO, $SrCr_8Ga_4O_{19}$[1]

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Recent experiments on the complex geometrically frustrated magnet, β-$CaCr_2O_4$, clearly illustrate the divergent effect of hole and static doping on the magnetic properties [1]. Given the complex parent state of β-$CaCr_2O_4$ this is not an ideal system for studying perturbations to the magnetic interactions. However, the onset of ferromagnetic fluctuations and ferrimagnetic ordering in β-$Ca_{1-y}Cr_2O_4$ suggests that other hole doped $Cr^{3+/4+}$ systems may be of interest. The extreme sensitivity in the balance of competing magnetic interactions in geometrically frustrated magnets is illustrated clearly in Cr^{3+} spinels, ACr_2O_4. Antiferromagnetic (AFM) ordering in ACr_2O_4 occurs at a spin-Peierls transition. Both the low temperature magnetic and structural regimes are found to be highly sensitive to the A cation. In the case of $ZnCr_2O_4$ we find that very fine control of the reaction conditions is necessary to make stoichiometric $ZnCr_2O_4$, rather than hole doped $Zn_{1+x}Cr_{2-x}O_4$ (x $\leq$ 0.04). From analysis of magnetic measurements, specific heat and neutron diffraction we have probed the nature of the transitions at T_N [2]. How hole doping effects the low temperature properties and the role of the d^2 Cr^{4+} cations on the isotropic d^3 Cr^{3+} magnetic lattice will be discussed. Our results on the more robust $MgCr_2O_4$ spinel will also be presented. A 2D analogue of the 3D pyrochlore magnetic lattice in the ACr_2O_4 spinels is found in SCGO, $SrCr_8Ga_4O_{19}$. In hole doped SCGO, $SrCr_8M_xGa_{4-x}O_{19}$ (M = Zn, Mg, Cu), a larger fraction of the Cr^{3+} can be oxidized. Hole doping is found to have a significant effect on the magnetic fluctuations, how this depends on the nature of the dopant cation will be addressed [3].

[1] S. E. Dutton, C. L. Broholm, and R. J. Cava, Journal of Solid State Chemistry **183**, 1798 (2010).
[2] S. E. Dutton *et al.*, Physical Review B **83**, 064407 (2011).
[3] S. E. Dutton *et al.*, Journal of Physics-Condensed Matter **23**, 386001 (2011).

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