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Continuous transition from antiferro- to ferromagnetic state via moment canting in $Ni_{2-x}Co_xMnAl$

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The magnetic structure of matter, especially with regard to an application as functional materials, is often discussed only in terms of the classical concepts of ferromagnetism and antiferromagnetism. However, interesting phenomena can be expected when a system is driven to the boundary between these regimes by adjusting external parameters. The B2-ordered Heusler system $Ni_{2-x}Co_xMnAl$ is a case in point: Ni_2MnAl, a potential ferromagnetic shape-memory material, displays antiferromagnetism [1], while NiCoMnAl, predicted to be a halfmetal, is ferromagnetic [2].

We have studied this system for compositions of $0 \leq x \leq 0.8$ by temperature-dependent neutron powder diffraction at SPODI at the Heinz Maier-Leibnitz Zentrum (MLZ) Garching, observing antiferromagnetic ordering on the Ni-rich side that continuously decreases and vanishes at $x = 0.4$, while additional macroscopic magnetization measurements shows an increasing longitudinal component for all $x > 0$. We argue that this constitutes a continuous, spatially homogeneous transition from antiferro- to ferromagnetism via canted spins, resulting from the competition of the ferromagnetic Ni/Co-Mn interaction and the antiferromagnetic Mn-Mn interaction on the disordered Mn/Al sublattice. We reproduce our findings by a simple Heisenberg model.

[1] M. Acet et al., *J. Appl. Phys.* **92**, 3867 (2002)
[2] P. Neibecker et al., *Phys. Rev. B* **96**, 165131 (2017)

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