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POS-G64 – The Kosterlitz-Thouless transition in a finite 2D magnetic film with fourfold anisotropy

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The Kosterlitz-Thouless (KT) transition is a topological transition in a model where magnetic vortex and antivortex spin structures are created in an infinite, isotropic, 2D magnetic system. The transition occurs when bound vortex-antivortex pairs unbind due to thermal energy at the temperature T_{KT}, and is marked by a magnetic susceptibility that diverges at low temperature, and decreases exponentially with temperature above T_{KT}. When the infinite system has fourfold in-plane anisotropy, the transition is no longer of the KT type, but has non-universal critical exponents that depend upon the strength of the anisotropy. More recent work has shown that the logarithmic dependence of vortex sizes and energy scales imply that real 2D isotropic magnetic films will exhibit a *finite-size* KT transition instead. The susceptibility then displays a broad peak that rises above T_{KT} and then falls with the characteristic exponential form predicted for the infinite system. Our recent experimental measurements on Fe/W(100) films have confirmed this high temperature behaviour. In order to understand the behaviour of the susceptibility across the broad transition, the renormalization group equations have been re-solved for the case of a system of finite size L with fourfold anisotropy $\lambda = K/J\ 10^{-3} - 10^{-2}$ appropriate to metallic magnetic films. The anisotropic film continues to exhibit a finite-size KT transition, with an effective exchange coupling that moves to zero asymptotically, and an anisotropy that is exponentially screened by the formation of a free vortex gas. The resulting susceptibility compares very well with experiment across a wide temperature range, and allows quantitative fitting of the finite size L of the experimental system. Questions remain concerning the relative size of the low temperature spin wave and high temperature vortex contributions to the susceptibility.

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