Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

A common magnetic origin for the Invar effects in fcc iron-based ferromagnets CHRIS HOOLEY, University of St Andrews, U.K., FRANCOIS LIOT, Max Planck Institut fur Eisenforschung, Germany — Using first-principles calculations, in conjunction with Ising magnetism, we undertake a theoretical study to elucidate the origin of the experimentally observed Invar effects in disordered fcc iron-based ferromagnets. First, we show that our theory can account for the Invar effects in iron-nickel alloys, the anomalies being driven by the magnetic contributions to the average free energies. Second, we present evidence indicating that the relationship between thermal expansion and magnetism is essentially the same in all the studied alloys, including those which display the Invar effect and those which do not. Hence we propose that magnetism plays a crucial role in determining whether a system exhibits normal thermal expansion, the Invar effect, or something else. The crucial determining factor is the rate at which the relative orientation of the local magnetic moments of nearest-neighbor iron atoms fluctuates as the system is heated.

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Date submitted: 19 Nov 2010 Electronic form version 1.4