

**Relation between magnetization and internal energy in  $3d$  ferromagnetic metals: experimental facts linked by a theoretical model appropriate for long-range exchange interactions**

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**Abstract**

Measurements of the magnetization  $M(T)$  and the specific heat allow one to relate  $M(0) - M(T) \equiv \Delta M$  and  $E(T) - E(0) = \Delta E$ , where  $E(T)$  is the internal energy, for some  $3d$  ferromagnetic metals. The early low temperature theoretical result of Grout and March that  $\Delta E \propto \Delta M^{4/3}$  is thereby confirmed. Additional theory is reported over a wide temperature range using a model appropriate for long-range magnetic exchange interactions. The predictions of the model yield insight into the experimental relation between magnetization and internal energy over a wide temperature range.