Modelling and simulation of magnetic tweed

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Magnetic tweed is a modulation of the magnetization that develops in some ferromagnetic materials above the Curie temperature (T_C) as a precursor of the magnetic phase transition. We introduce a Ginzburg-Landau model which takes into account the coupling of the magnetic degrees of freedom to non-magnetic quenched disorder, and includes the long range dipolar interactions. Four different lengths are involved in the model: the size of the sample, the size of magnetic domains below T_C, the characteristic length of magnetic tweed above T_C, and the width of the magnetic interfaces. How we cope with all these length scales in a single numerical simulation is discussed. Moreover, we show the need of working simultaneously in real and Fourier space in order to develop an algorithm whose computation time scales linearly to the size of the sample.

Concerning the results of the numerical simulations, we first present the magnetization distribution, from which we obtain the Curie temperature and demonstrate the existence of magnetized regions above T_C. How the magnetization in these regions is correlated is given by the size distribution of magnetic domains that shows unambiguously the existence of a characteristic length for magnetic tweed. Finally, we present the results of the inverse magnetic susceptibility, that are consistent with the Curie temperature and the stability range of magnetic tweed obtained from the magnetization distribution.