Scaling laws in the $alpha-$XY model

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The $\alpha-$XY model generalizes the well known Hamiltonian Mean Field model by introducing an interaction term decaying with the distance among rotators as $r^{-\alpha}$, with $\alpha>0$ being the range of interaction. In the long-range regime, $\alpha/d < 1$, d being the dimension, the model presents a quasistationary state (QSS) at a temperature T_{QSS} before attaining the Boltzmann-Gibbs temperature.

We have studied T_{QSS} as well as the duration t_{QSS} of the QSS, as a function of parameters (N, α, d, U), with N the number of rotators and U the total energy per particle, and found the scaling relations i) $t_\text{QSS}\propto N^{A(\apha/d)}e^{B(N)(\alpha/d)^2}$, ii) $t_QSS\sim (U_c - U)^{\xi}$ with a critical exponent $\xi\simeq 5/3$ independent of α/d and iii) $T_{\text{QSS}} - T_{\infty} \sim N ^{-\beta}$, with $T_{\infty} = 2U - 1$ and the critical exponent β decaying from 1 to 0 as α/d goes from 0 to 1.