Coexistence of stable limit cycles in a generalized Curie-Weiss model with dissipation

Luisa Andreis* Daniele Tovazzi*

Living systems are characterized by the emergence of recurrent self-organized collective behaviors in large communities, such as polarization and synchronization. The attempt of modeling these non linear macroscopic behaviors in complex systems leads often to the choice of mean field models, since they give analytically tractable equations that may explain features which are not displayed at microscopic level. In particular, toy models in this class have been recently used to understand how macroscopic rhythmic behavior may appear in systems where single units have no tendency to behave periodically.
Following this approach, in this poster we modify the Langevin dynamics associated to the generalized Curie-Weiss model by introducing noisy and dissipative evolution in the interaction potential. We focus on a Gaussian single-site distribution of spins, that let us explicitly analyze the nonlinear dynamics of the macroscopic system. Depending on the form of the interaction function, the system shows several phase transitions at different critical temperatures and, thanks to the mechanism of dissipation, we see the magnetization displaying self-sustained periodic behavior at sufficiently low temperature. We also show that, with a suitable choice of the interaction function, any (finite) number of stable limit cycles coexist in certain regimes.

*Dipartimento di Matematica "Tullio Levi Civita", Università degli studi di Padova, via Trieste 63, 35121 Padova (Italy). E-mail addresses: {andreis, tovazzi}@math.unipd.it