Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Skyrmion Gas Manipulation for Unconventional Computing DANIELE PINNA, Unite mixte de physique CNRS/Thales, JOO-VON KIM, CNRS, Universit of Sud, Universit Paris-Saclay, VINCENT CROS, Unite mixte de physique CNRS/Thales, DAMIEN QUERLIOZ, CNRS, Universit of Sud, Universit Paris-Saclay, PAUL BESSIERE, JACQUES DROULEZ, Universit Pierre et Marie Curie, JULIE GROLLIER, Unite mixte de physique CNRS/Thales — In this talk we will discuss how the collective variable Thiele dynamics can be used to simplify the dynamical study of interacting skyrmions. We will show under what limits the many-particle interactions can be reduced to sums of two-particle interactions as well as how to characterize boundary repulsions. After justifying our results through micromagnetic simulations, we will demonstrate our approach by simulating a chamber of mutually interacting skyrmions by means of coupled Thiele equations. The parallelized simulation of the dynamics allows for a detailed study of ensemble repulsion and thermal diffusion over long timescales. Our toy model lays the groundwork for a novel device capable of reshuffling electrical signals as well as emulating neuromorphic behavior. By using input telegraph noise to inject a skyrmion gas into our toy chamber, we can successfully decorrelate the input signal while preserving statistical coherence through particle number conservation. Numerical simulations will justify the proposition and show how chamber size, temperature and spin-current intensities can be tuned to influence the correlations between input and output signals. Such a device, with no analogues as of date, allows for the cascading of multiple stochastic computing gates.

Daniele Pinna
Unite mixte de physique CNRS/Thales

Date submitted: 12 Nov 2016 Electronic form version 1.4