

# 731<sup>th</sup> ASRC Seminar

Date: Sep. 25 (Tue), 13:30~

Location: Room 302, ASRC Bldg.

Speaker: Mr. B. F. Mckeever

(Johannes-Gutenberg Univ. Mainz, Germany)

Title:

Simple theory of a skyrmion excitation

## Abstract:

During the “breathing” modes of chiral skyrmions/antiskyrmions in ferromagnets the core of the spin structure periodically grows and shrinks in time. We present a Hamiltonian formulation for collective coordinate magnetization dynamics and use it to establish that skyrmion breathing modes are accurately described with a two-mode approximation, that breathing modes of skyrmions and antiskyrmions obey the same dynamical equations, and that these excitations do not require an inertial mass term. The analysis is supported by comparison to full micromagnetic simulations of the Landau-Lifshitz-Gilbert field equation. We identify two regimes with different kinds of breathing oscillations and derive the periods and amplitudes for both of them. The motion can be understood intuitively from the view of an effective energy landscape. In a high energy rotating regime the skyrmion breathes along with a non-uniform precession of the skyrmion phase where the total energy dissipates slowly on average (linearly). In comparison in the low energy oscillatory regime the skyrmion phase does not precess but oscillates around the stable equilibrium and we find a hallmark exponential energy decay associated with damped harmonic oscillations. This is loosely analogous to a damped pendulum that fully rotates around its suspension point until it eventually does not possess enough energy to fully rotate past the “upside-down” unstable fixed point and after which only oscillates.

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