Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **648** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

# Magnets have Two Longitudinal Degrees of Freedom

*Tuesday 8 June 2021 17:00 (15 minutes)*

We argue that the usual magnetization $\vec{M}$, which represents a correlated property of $10^{23}$ variables, but is summarized by a single variable, cannot diffuse; only the non-equilibrium *spin accumulation* magnetization $\vec{m}$, due to excitations, can diffuse. For *transverse* deviations from equilibrium this is consistent with work by Silsbee, Janossy, and Monod (1979), and by Zhang, Levy, and Fert (2002).

We examine the corresponding theory of *longitudinal* deviations for a ferromagnet using $M$ and the longitudinal spin accumulation $m$. If an initial longitudinal magnetic field $H$ has a frozen wave component that is suddenly removed, the system approaches equilibrium via two exponentially decaying coupled modes of $M$ and $m$, one of which includes diffusion. If the system in a slab geometry is subject to a time-oscillating spin current, the system approaches equilibrium via two spatially decaying modes, one associated with spacial decay away from each surface. We also explore the possibility that decay of $M$ directly to the lattice is negligible, so that decay of $M$ must be mediated through decay to $m$ and then to the lattice.

**Authors:** SASLOW, Wayne (Texas A&M University); Prof. SUN, Chen (Hunan University); Prof. XU, Shenglong (Texas A&M University)

**Presenter:** SASLOW, Wayne (Texas A&M University)

**Session Classification:** TS-8 Magnetic North VII / Nord magnétique VII

**Track Classification:** Magnetic North/Magnétisme Nord