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## KOLLOQUIUM der Forschungsplattform MMM

The research platform MMM „Mathematics-Magnetism-Materials” of Univ. Wien, together with the **Wolfgang Pauli Institut**

kindly invite you to the talk of **Massimiliano D’AQUINO** (Univ. Napoli Federico II)

**Time: Friday, 17. Jun 2025, 13h40 – 15h30**

**Place: MMM-WPI Seminarroom 8.135, 8th floor, Fak. Math.  
Oskar-Morgestern-Platz 1, 1090 Wien**

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1) 13h40 – 13h45 : **Introduction** : Lukas Exl (MMM @ U.Wien & WPI)

2) 13h45 – 14h30 : **Massimiliano D’AQUINO** (Univ. Napoli Federico II)

**„Micromagnetic modelling and simulation  
for inertial magnetization dynamics in ferromagnets“**



Abstract: The investigation of ultra-fast magnetization processes is crucial in spin dynamics due to their potential use in future generations of nanomagnetic and spintronic devices. Recently, experimental demonstration (Neeraj et al, Nat. Phys 17, 245 2021) of the presence of inertial effects in magnetization dynamics predicted several years ago (Ciornei et al., PRB 83, 020410, 2011) was achieved by direct detection of spin nutation in ferromagnets at terahertz frequencies.

From a theoretical perspective, inertial magnetization dynamics can be modelled by augmenting the classical Landau-Lifshitz-Gilbert (LLG) precessional dynamics with a torque term that considers angular momentum relaxation proportional to the second time-derivative of magnetization, leading to a higher-order dynamical system governed by the inertial LLG equation (iLLG).

In this presentation, we first derive and discuss the qualitative properties of the iLLG dynamics that profoundly differs from the classical LLG despite including remarkably similar conservation properties. Then, we develop analytical theory for inertial exchange spin-wave propagation in infinite thin-films. Finally, we propose and validate a couple of time-integration schemes for iLLG dynamics that allow to realize accurate and efficient inertial micromagnetic simulations.

3) 14h30 – 15h00 : **CoffeeTee & Cake**

*Norbert J Mauser*  
(head MMM and director WPI)