Spin waves as state variables for logic and analog circuits

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Summary

Spin-waves, or their quantized counterparts (magnons) are propagating waves formed by the collective spin excitations in a magnetic body. In standard magnetic thin films and devices, spin-waves have typically frequencies in the 1-50 GHz range and wavelengths from 10 nm to 10 μm. As spin-waves determine to a large extent the rate at which one can manipulate the magnetization, they are of central importance in various applications of spin electronics, e.g. solid state magnetic memories, microwave magnetic oscillators and magnetization-based rf devices.

In this seminar, I shall start with an introduction to spin-wave dynamics, spin-wave spectroscopy, and the potential applications thereof. While the generation, detection, propagation and phase manipulation of spin-waves in spintronics devices is now well understood, the implementation of magnon-based computing or spin-wave based manipulation of information requires now to design energy-efficient spin wave transceivers. I will review our effort on inductive transceivers, and detail how we can harness them to fabricate a micrometer-scale spin wave majority gate with frequency multiplexing capability. I will then describe our efforts in the search of more efficient spin-wave transceivers. This includes spin-transfer-torque emitters, as well as the coupling of spin-waves to acoustical waves.

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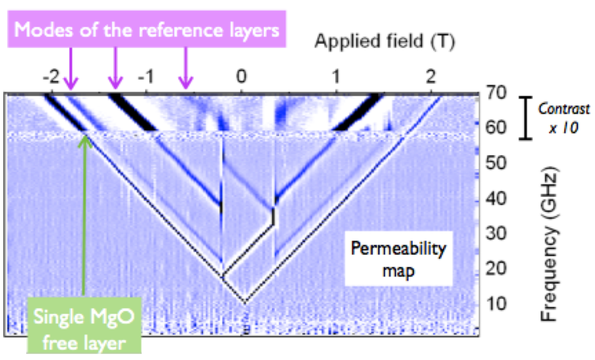
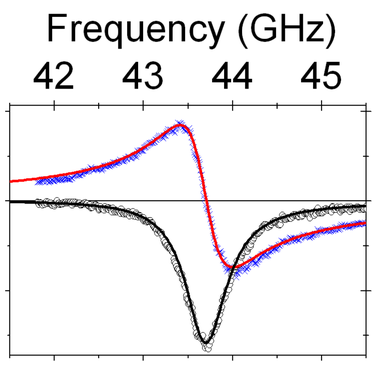
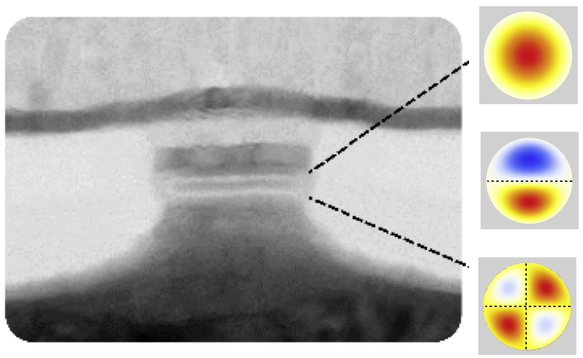
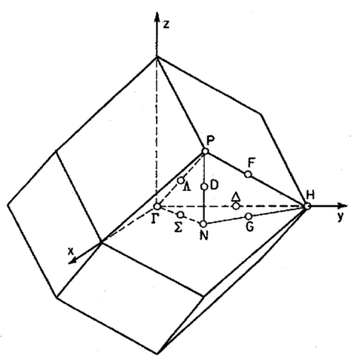
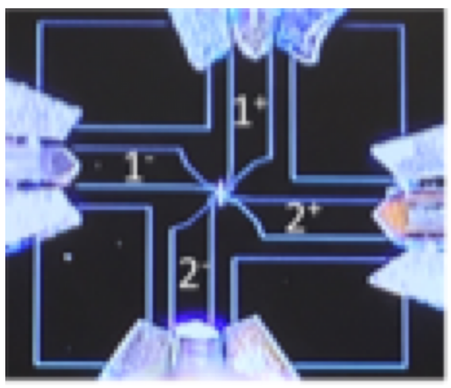


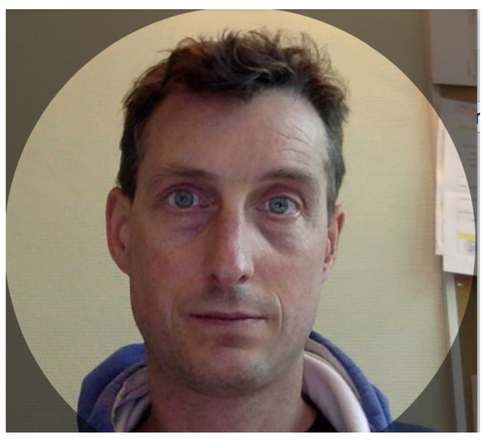








Speaker Biography:



Thibaut Devolder (CNRS research director, Université Paris-sud, France) heads a research team in charge of magnetization dynamics in nanomagnets and its applications, including spin-torque oscillators, STT-MRAM, domain wall dynamics and skyrmion dynamics. He has 20 years of experience in magnetic nanopatterning, material science, microwave magnetism, instrumentation and device design. After completing his studies at the École Polytechnique (France), he obtained his PhD in 2000 from the University Paris-XI (Orsay) in the field of material science and nanoprocessing. He then entered CNRS to conduct a project to study the physical phenomena relevant for the operation speed of magnetic random access memories. He was awarded his Habilitation in 2006 and then started his own group on novel magnetic devices. He has coauthored more than 150 scientific papers, with over 5700 citations for an h-index of 41.