

Università degli Studi di Milano
Physics, Astrophysics and Applied Physics Ph.D. School

Ph.D. Defense

Time-resolved probing of magneto-elastic excitations in magnetic materials

Candidate: Pietro Carrara

Supervisor: Prof. Giorgio Rossi

Co-supervisor: Dr. Riccardo Cucini

External Members: Prof. Renato Torre

Prof. Stefano Bonetti

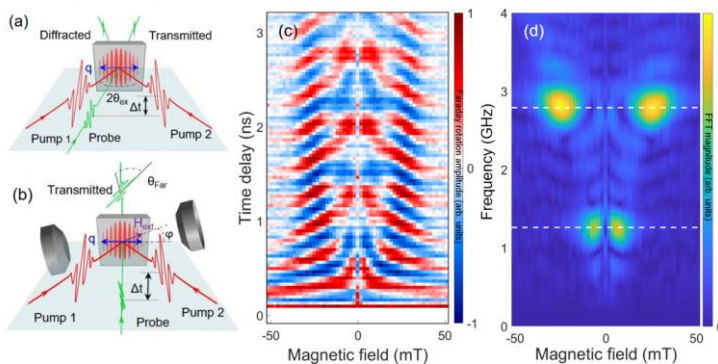


Dipartimento di Fisica
Aula Consiglio
Via Celoria 16, Milano



2 p.m.

Hybrid quasi-particles in condensed matter systems are observed at the degeneracy points between different degrees of freedom exhibiting non-zero coupling. These solid-state chimeras could be exploited in a wealth of applications, ranging from transducers to sensors, to memory and logic units. In particular, when the dispersion relation of phonons and of magnons are degenerate, magnetostriction can allow for efficient cross-talk between lattice and spin reservoirs in the few gigahertz range. Notably, such degeneracy can take place at finite wavevector: suitable experimental methods to investigate the dispersion relation in the vicinity of the mode crossing are called for.



(a-b) Sketch of the setup for TG and for TG-pumped optical polarimetry. (c-d) Time domain and FFT maps of the Faraday rotation signal providing evidence of TG-pumped magneto-acoustic dynamics.

I will present results from my Ph.D. activity on finite-wavevector magneto-acoustics in ferromagnetic thin film and nanostructures. The systems have been investigated via optical Transient-Grating (TG) spectroscopy and time-resolved MOKE at NFFA-SPRINT laboratory (Trieste); correlative characterization of the samples further confirm the observed dynamics and allow to draw the boundary for reliable data interpretation. Hamiltonian modelling of the mode crossing allows to quantify the magnon-phonon coupling strength and the degree of coherence in the coupling.

Impulsive photon-driven triggering of finite-wavevector excitations can be fruitfully extended down to the mesoscopic scale, e.g. by FEL-based TG spectroscopy, a technique that is getting growing attention from the scientific community. I will present experiments conducted in collaboration at FERMI FEL (Trieste) and EuXFEL (Hamburg) which aim at establishing X-ray TG spectroscopy as a routine tool for condensed matter physics.

Live streaming will be available:

<https://fisica-unimi.zoom.us/j/93672400653?pwd=RldzUzkwOU1EbzcK2w0V1IUNkV0UT09>