# On-line SPICE-SPIN+X Seminars

**Wednesday, 29th June 2022, 15:00 (CET)**

**The seminar will be via Zoom (**Meeting ID: 890 1348 5223**) and live streamed in the SPICE YouTube Channel.**


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## How to engineer non-equilibrium crystal and magnetic structures with light


The crystal structure is a key ingredient determining the macroscopic properties of any solid. In the context of magnetism, the local moments, anisotropy, and exchange parameters are all strongly dependent on the bonding environment and the symmetry of the lattice, which can be tuned, for example, by chemical composition or external pressure. Such quasi-static approaches are limited in their speed and efficacy, however. In this talk, I describe how we can instead manipulate the crystal structure of materials dynamically using light, which enables one to induce, enhance, and control magnetic states in ways not possible in equilibrium. The approach is based on selectively exciting optical phonons with resonant THz pulses and exploiting nonlinearities of the crystal lattice [1]. We used this approach to realize a light-induced transition to a ferrimagnetic phase in the antiferromagnet CoF2 [2]. The resultant non-equilibrium magnetization is optically switchable and has a magnitude 100-fold larger than achievable via strain. More recently, we demonstrated the ability to strengthen magnetic order in the strongly correlated ferromagnet YTiO3 [3]. By driving specific lattice distortions, the low-temperature moment was enhanced and a non-equilibrium ferromagnetic state was stabilized even at temperatures well in excess of the equilibrium Tc. These experiments show that optically engineering the crystal structure provides a versatile and powerful tool for emerging magnetic and spintronic technologies.



[1] A.S. Disa, T.F. Nova, A. Cavalleri, Nature Phys. 17, 1087 (2021)
[2] A.S. Disa, et al., Nature Phys. 16, 937 (2020)
[3] A.S. Disa, et al., arXiV: 2111.13622