Contribution ID: **89** Type: **Oral**

# Magnetic Field Dependent Ultrafast Control of an Antiferromagnet

*Wednesday, 8 October 2025 15:25 (25 minutes)*

Antiferromagnetic (AF) spintronics is a promising route towards more efficient and stable devices, because antiferromagnets are less susceptible to external fields and foster a broad range of magnetic interactions with the potential for higher speeds and energy efficient manipulation. However, their self-cancelling magnetic moment makes the interaction with magnetic order challenging. One way to achieve this is to utilize the magnetic anisotropy (MA) to manipulate the spin arrangement which was demonstrated recently using ultrafast optical excitation [1]. External magnetic fields, as regularly used in ferromagnetic materials, can also have a strong influence on MA, providing an additional control knob on the AF magnetic order. Therefore, understanding the interaction of laser excitation induced transient MA with magnetic fields is of strong interest. To this end, we perform femtosecond time-resolved resonant soft X-ray diffraction (RSXRD) in the prototypical A-type antiferromagnet GdRh2Si2. Consistent with our previous study, we observe an ultrafast rotation of the AF arrangement of Gd 4f spins followed by coherent oscillations of the AF order as a consequence of a light-induced change in the MA potential.
Remarkably, while the AF order undergoes a spin-flop transition upon increasing magnetic field, the oscillations persist and their frequency increases while the amplitude of reorientation upon photoexcitation reverses its direction. To understand our observations, a phenomenological model is built based on the MA potential and Zeeman energy as two competing mechanisms, which reproduces the key features of the observed ultrafast dynamics. Our results demonstrate magnetic field control of the MA potential and may offer a new way towards deterministic control of spin order using combined electromagnetic and magnetic fields.
[1] Windsor et al. Commun Phys 3, 139 (2020)

**Primary author:** ARORA, Abeer (Fritz Haber Institut Berlin, Germany)

**Co-authors:** Dr WINDSOR, Yoav Will (Institut für Optik und Atomare Physik, TU Berlin, Germany); Dr LEE, Sang-Eun (Fritz Haber Institut Berlin, Germany); Dr SARKAR, Jit (Fritz Haber Institut Berlin, Germany); Dr KLIEMT, Kristin (Physikalisches Institut, Johann Wolfgang Goethe-Uni, Frankfurt am Main, Germany); Dr LANGEHEINE, Ch. Schüßler (Helmholtz Zentrum für Materialien und Energie, Berlin, Germany); Dr PONTIUS, Niko (Helmholtz Zentrum für Materialien und Energie, Berlin, Germany); Dr KRELLNER, Cornelius (Physikalisches Institut, Johann Wolfgang Goethe-Uni, Frankfurt am Main, Germany); Prof. VYALIKH, Denis (Donostia International Physics center, San Sebastián, Basque, Spain); Dr RETTIG, Laurenz (Fritz Haber Institut Berlin, Germany)

**Presenter:** ARORA, Abeer (Fritz Haber Institut Berlin, Germany)

**Session Classification:** Talks Wed Afternoon