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Tracking spin and charge in time and space in halide perovskites

Halide perovskites are promising semiconductors for next-generation optoelectronic and spintronic applications. Yet, we still don't fully understand what governs the charge and spin dynamics in these materials. This is especially true when studying device-relevant thin films of halide perovskites, which lack single-crystalline perfection.
In this talk, I will give an overview of our recent efforts to understand the spin-optoelectronic performance of these films better by using time-, space- and polarization-resolved spectroscopy and microscopy. We will find that the energetically heterogeneous energy landscape in mixed-halide perovskites can lead to the local accumulation of charges, with unexpected consequences for devices [1]; how despite strong differences in vertical diffusivity and across grains charge extraction can remain very efficient [2], and how locally varying degrees of symmetry-breaking drive spin domain formation [3,4] in this fascinating class of solution-processable semiconductors.
Time permitting, I will conclude with briefly explaining the fundamentals and artifacts involved in measuring circularly polarized luminescence (CPL) reliably [4,5], and finally show our most recent development of full Stokes-vector polarimetry with unprecedented time- and polarization resolution to track the emergence of chiral light emission [to be submitted].

[1] *Nature Photonics* **14**, 123 (2020)
[2] *Nature Materials* **21**, 1388 (2022)
[3] *Nature Materials* **22**, 977 (2023)
[4] *Nature Reviews Materials* **8**, 365 (2023)
[5] *Advanced Materials* 2302279 (2023)

Background Information:

The Feldmann Lab at Harvard develops and employs ultrafast magneto-chiroptical spectroscopy to understand the next generation of soft semiconductors. The overarching goal is to maximize energy efficiency for a sustainable future by unlocking applications ranging from flexible light-weight solar cells & displays all the way to entirely new applications in quantum information processing.
Prior to starting his group at Harvard in 2022, Sascha studied Chemistry at Heidelberg University (Germany) and completed his Ph.D. in Physics at the University of Cambridge (UK) in 2020, where he continued to work as an independent EPSRC Doctoral Prize Fellow. In September 2023, Sascha was appointed tenure-track Assistant Professor and Head of the Laboratory for Energy Materials at EPFL (Switzerland), where his group will move to in 2024.