SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

07.07.2026 / 10 Uhr c.t., Raum MG 272
Campus Duisburg

The rise of nonlinear X-ray spectroscopy with X-ray free electron lasers

Prof. Dr. Iwao Matsuda

University of Tokyo

There are various types of spectroscopies to characterize or to understand materials. Interpretations have naturally been made based on a linear response in the light-matter interaction, where amounts of the signal are proportional to the incident intensity. However, there are varieties of the optical phenomena in nature that show nonlinear responses. Moreover, they are associated with events, such as second harmonic generation, that are unusual in everyday life but very useful for our scientific research. These special phenomena are typically induced with the ultrashort pulse light source, i.e. laser, and the recent technical innovations have pushed the controllable photon energy up to the X-ray region. “X-ray” was named after a ray of “something unknown (X)” by Röntgen and it has been a significant experimental probe to investigate structure and electronic states of materials. Today, we are able to conduct the nonlinear X-ray experiments.

In this talk, I would like to present such a rise of the nonlinear X-ray spectroscopy for materials science [1]. I will introduce nonlinear optical phenomena in X-ray region and then, describe our spectroscopy of X-ray second harmonic generation, developed at the X-ray free electron laser facility SACLA [2]. After showing some of our scientific achievements [3-6], I will discuss the future prospects of this new X-ray methodology.

[1] I. Matsuda, R. Arafune ed., Nonlinear X-ray Spectroscopy for Materials Science (Springer, 2023).
[2] Sh. Yamamoto, IM et al., Phys. Rev. Lett. **120**, 223902 (2018).
[3] Can B. Uzundal, IM et al, Phys. Rev. Lett. **127**, 237402 (2021).
[4] C. Woodahl, IM et al., Nat. Mater. **22**, 848 (2023).
[5] T. Sumi, IM et al., Appl. Phys. Lett. **122**, 171601 (2023).
[6] M. Horio, IM et al., Appl. Phys. Lett. **123**, 031602 (2023).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

Contact: Prof. Dr. Björn Sothmann, Faculty of Physics
Phone: +49 (203) 37-93330 / Mail: bjoerns@thp.uni-due.de