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Magnetization dynamics studied by x-ray microscopy

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Abstract

Our knowledge of micro- and nanomagnetism is largely based on magnetic imaging. Magnetic domain images showing the local magnetic order provide essential information on ordering mechanisms and local interactions. The visualization of dynamic processes is particularly important for a better understanding of magneto-electronic devices, such as magnetic memories. As these devices are getting smaller and faster down to a few tens of nanometer and a few hundreds of picosecond, the observation of magnetization dynamics in space and time became a challenge for microscopy.

X-ray based imaging techniques, such as full-field transmission microscopy (TXM), scanning transmission microscopy (STXM), or photoemission electron microscopy (PEEM), offer a unique toolbox for studying magnetism on the micro- and nanometer scale. They provide element-specific and quantitative magnetic contrast at a resolution in the range of a few ten nanometer. Magnetization dynamics can be studied with a time resolution down to several picoseconds exploiting the pulse structure of synchrotron radiation. New x-ray sources like the emerging free electron lasers can improve the time resolution down to a range below 100 femtoseconds.

This lecture will introduce the concepts of x-ray microscopy and give some examples exploring the time and length scales of magnetism by x-ray microscopy.