Studies of ferromagnetic domains using STEM-DPC with fast pixelated direct electron detectors

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In recent years, one of the big improvements in Transmission Electron Microscopy (TEM) has been the electron detectors. These new direct electron detectors are faster, more robust and have better signal-to-noise ratio compared to older types of detectors. This has been especially important for Scanning TEM (STEM), where the diffraction patterns created by the electron probe can be acquired for every scan position.

One use for this is STEM – differential phase contrast (STEM-DPC). Here, small shifts of the electron beam is used to image magnetic and electric fields, via (classically) the Lorentz force. Thanks to the aforementioned direct electron detectors, this shift can be directly imaged, allowing for both the direction and magnitude of the in-plane magnetic and electric fields to be extracted.[1]

This presentation will go through how these new fast pixelated direct electron detectors enable us to study ferromagnetic domains at the nanoscale. It will cover both the practical microscopy aspects, the data processing challenges related to the very large data sizes, and show some recent material results.

[1] M. Krajnak, Ultramicroscopy 165, 42 (2016).

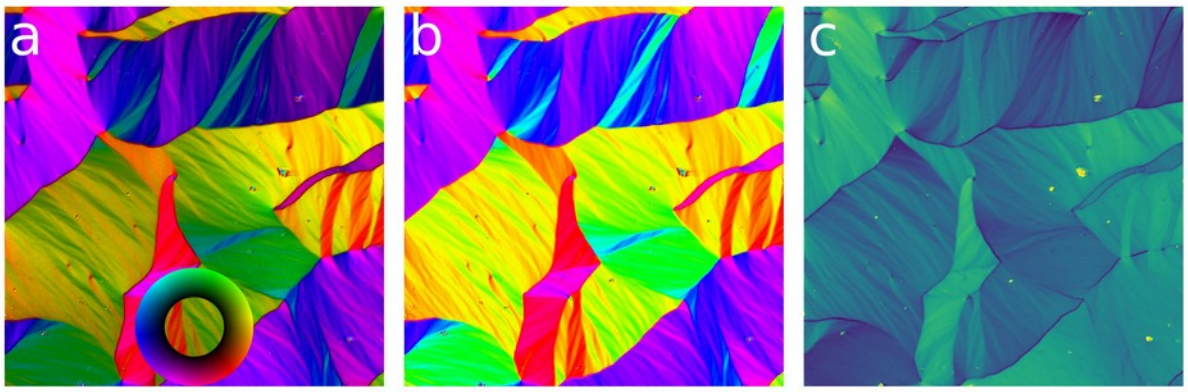

Figure 1: Example of STEM-DPC imaging of a ferromagnetic magnetic sample, showing the in-plane domain structure. a) Magnitude and direction of the magnetization, with the color wheel indicating both the magnitude and direction. b) Only the direction, and c) the magnitude.