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Use of Timepix chip for streak imaging in Transmission Electron Microscopy

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Lorentz microscopy is a specialised branch of TEM that enables observation of domains and domain wall structure for ferromagnetic samples and is used extensively at the University of Glasgow. Lorentz mode and TEM in general are imaging techniques with very good spatial resolution; however they are limited in temporal resolution for imaging dynamic processes. We have devised a technique for gaining temporal resolution based on streak imaging.

Specifically we are studying the injection of domain walls into nanowires by pulsed magnetic fields. This field serves a secondary purpose as it also deflects the electron beam producing a streak. This linear temporal modulation of the image allows us to gather information about the dynamic process.

Current TEM CCD cameras are typically limited to millisecond exposure times and add noise with every read; this makes them unsuitable for our use. The Timepix chip however can acquire images on microsecond time scales; this combined with its high detective quantum efficiency make it ideal for our purposes. In collaboration with the particle physics group at the University of Glasgow we have already demonstrated the use of this chip for static imaging at microsecond time scales and shown significant advantages over CCD type detectors. By using the Timepix chip we will present resultant streak images of the dynamic domain wall injection process. These should achieve sub microsecond temporal resolution. Going beyond this, we aim to exploit the unique time-of-arrival mode of the Timepix chip with the aim of reaching temporal resolutions of below 100ns.

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