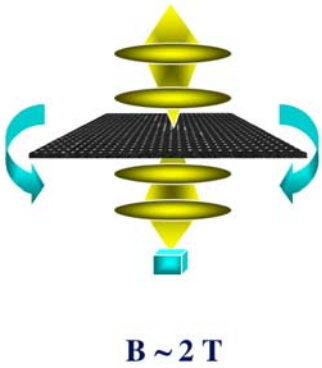
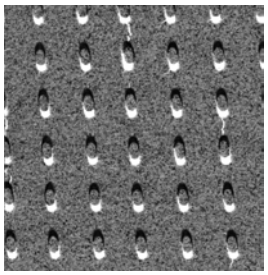
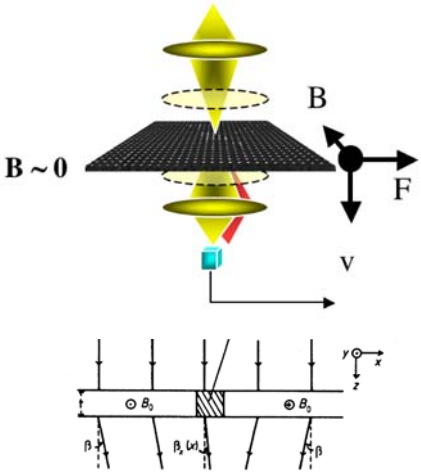
# *Imaging of Nanoscale Magnetic Domains Using Position Resolved Diffraction*

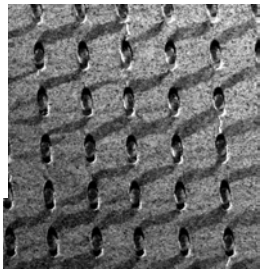
**N. J. Zaluzec, U. Welp, V. Vlasko-Vlasov, M. Grimsditch**

**Traditional imaging of magnetic domains using transmission electron microscopy is limited due to the strong B fields present in the instrument. These fields at the specimen are typically 1-2 Tesla and saturate the internal fields of the film destroying the any preexisting domain distributions. This is illustrated in figure at the right, where no domain structure is visible.**



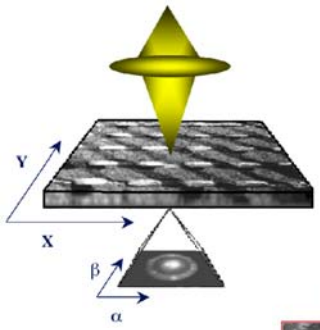


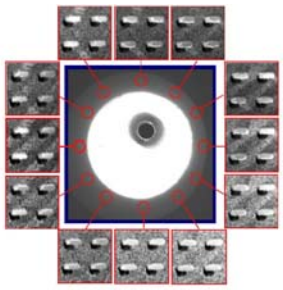



$$\beta = \frac{4\pi}{c}\left(\frac{e}{m}\right)\left(\frac{B_o t}{v}\right)$$

**Using a modified operational mode of the ANL AAEM we have developed a methodology by which the field at the specimen can be reduced to zero, yet permits direct in-focus imaging of in-plane magnetic domain structure. This is accomplished by combing scanning transmission mode and taking advantage of the Lorentz Force which subtly changes the angular distribution of electron scattering from one domain to another.**

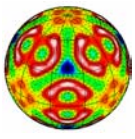
**Because the in-plane Lorentz force is a vector quantity, the images may be measured which vary directly with the orientation of the in-plane fields. This is accomplished by utilizing the fact that at each point on the specimen the diffracted intensity undergoes a Lorentz deflection. This Lorentz scattered intensity is measured in k-space which can also be used to form an image. This yields a direct one to one mapping of the domains distribution. The image at the right illustrates how this manifests itself by simply selecting in k-space the desired orientation.**



**Quantitative measurements of the local B field magnitude follow directly from a direct measurement of the Lorentz deflection angles, which albeit small, are measurable.**

**Currently this methodology is being used to study the domains in a variety of lithographically patterned magnetic film and structures.**



**BES - DOE**

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