ESRF	**Experiment title:** Diffraction imaging investigation of the magnetoacoustic focusing effects in IronBorate	**Experiment number:** *HE69*
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Report: The application of an alternating magnetic field is an alternative, contactless way to excite ultrasonic waves in certain magnetic crystals (weak ferromagnets, ferrimagnets). The vibration of the magnetic moments (magnons) can lead, through the magnetoelastic coupling, to lattice waves (phonons). A good candidate to investigate this effect is Iron Borate, which is available as a very perfect crystal and displays easy plane weak ferromagnetism and a strong magnetoacoustic coupling [l]. Synchrotron Radiation Diffraction Imaging ('Topography') is a unique tool to visualize the periodic distortion produced in this way within the sample.

Ultrasonic waves were introduced in an $FeBO_3$ (111) platelet shaped crystal using a very simple device schematized in fig. 1. A constant field Ho ($\approx 10^3$ A/m), allowed to remove the domains and an a.c. magnetic field Hac was varied in the range. of l-2.5 MHz in order to find the frequencies where the induced vibration excited a resonance of the crystal.

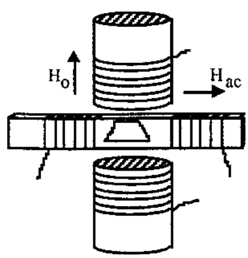

Fig.1: Experimental Set-up

Fig.2 shows the white beam topographs obtained at a resonance (≈ 1.3 Mhz) when varying the crystal-to-film distance d. The standing-waves-related contrast is hardly visible for the shorte, distance (fig.2a), is very sharp around 45 cm (figs 2b and 2c), and the image broadens with further increase f d (fig.2d).

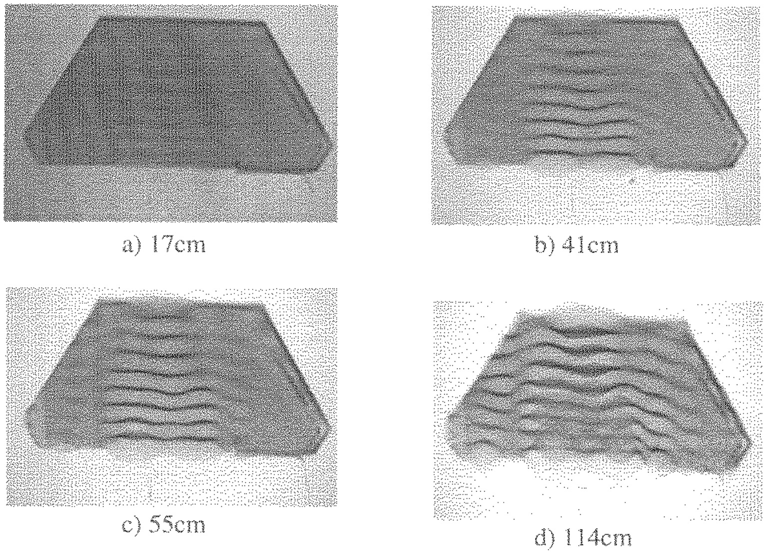

Fig.2: White beam topographs of the (-1,2,-1) reflection as a function of the sample-to-film distance

A model was produced which accounts for this unusual membrane type X-ray focusing effect. A first 'physical' approximation, allows to understand the effect: the two extreme positions of the vibration are mainly imaged as they correspond to zero velocity and produce the focusing. A complete calculation of the intensity as a function of the position on the detector, which includes spatial and time integrations at the sample level, allows a precise determination of the details of the vibration [2]

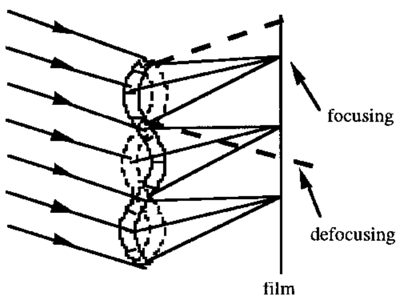

Fig.3: Diffraction from a vibrating crystal and focusing effect.

It has to be noted that Synchrotron Radiation Topography not only allows the visualization of the magnetoacoustic standing waves, but also the measurement of the sound velocity and, through the recording of images as a function of distance, the determination of the amplitude, shape and polarization of the magnetoacoustic vibrations, which are very difficult to characterize otherwise.

Publications:

(1) V. Kvardakov , V.V. Somenkov , J. Phys. Soc. Moscow 72 (1992) 311.

(2) I. Matsouli , V. Kvardakov , L Chabert, J. Espeso , J. Baruchel , to be published