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**Report:**

Self-organized nanoscaled $^{57}$Fe island on W(110) have been the subject of research using the technique of synchrotron-based nuclear forward scattering. The island system has been produced by thermal evaporation of iron onto a clean W(110) single crystal under ultrahigh vacuum conditions. When annealing the iron film to about 550°C for several minutes 3D islands are formed ontop of a pseudomorphic iron monolayer. The iron islands are clearly oriented along the W[001] axis as has been observed in STM studies. In our case, these islands have a typical width of 200nm, a length of about 3μm and a height of about 5nm. It should be mentioned that the islands are epitaxially ordered and atomically flat on top. For our ex-situ investigations the system has been capped with a thin carbon layer against oxidation.

At the ESRF nuclear resonance beamline we have used different experimental geometries in order to obtain a maximum of information and to be able to test our model simulations well. The technique of nuclear forward scattering is sensitive to magnetic fields at the nuclei via the hyperfine interaction. The sample was illuminated in grazing incidence close to the critical angle of tungsten and oriented carefully using Bragg diffraction. The experimental data (see figure) clearly show different quantum beat patterns when the sample is rotated with respect to the surface normal.

As observed in an earlier measurement [1] the internal magnetic field is equal to the bulk value of iron (33.3T). From our additional data (cf. angles ϕ between 0° and 60° in the figure shown below) we can rule out the assumption of an easy magnetization direction rotated by 33° with respect to the W[001] axis. Instead, the evaluation of our experimental data clearly indicate that the magnetic moments of the iron islands are pointing along the W[001] direction, but we observe an additional in-plane contribution orthogonal to the main component. The ratio between both is in order of 4:1. This demonstrates that an unique determination of the magnetic field distributions requires data taken at various azimuthal orientations for both incident s- and p-polarizations (sample mounted horizontally and vertically, respectively). The origin of the orthogonal component is not fully understood yet, possible explanations are closure domains or structural inhomogeneities. There are indications for a non-magnetic iron monolayer at the W-interface at room temperature [2].

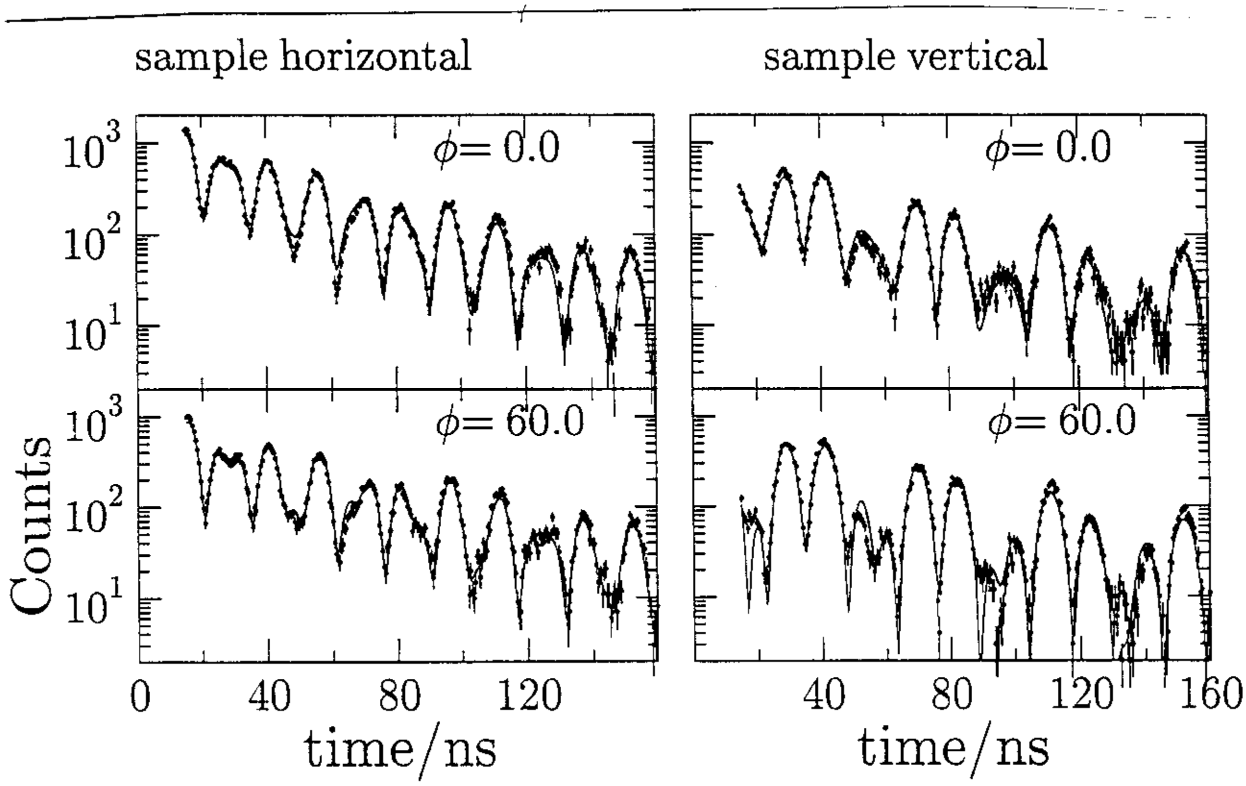


Figure: Experimental data and simulation calculations (thin solid lines) taken for two different angles ϕ in both geometries.


References:

[1] J. Bansmann et al., ESRF Experimental report SI-321 (1997).

[2] M. Przybylski and U. Gradmann, Phys. Rev. Lett. 59 (1987) 1153