Magnons in the multiferroic phase of cupric oxide

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Cupric oxide (Cu(II)O) has attracted renewed interest over the last years after the existence of a high-temperature multiferroic phase was discovered. Unlike other multiferroics with phase transition temperatures well below 50 K, CuO shows multiferroic behaviour in the incommensurate antiferromagnetic phase between 230 and 213 K. The magnetic structure is characterised by a cycloidal spin arrangement in contrast to the collinear antiferromagnetic low-temperature phase. However, not much is known about the magnetic dynamics of the multiferroic phase, since only magnons at temperatures below 213 K were studied so far.

We therefore present the first spectra of magnons in the multiferroic phase ever observed. In addition to this we also performed comparative measurements in the low-temperature phase. The new polarisation analysis of PUMA@FRMII provides a new, powerful tool for a better understanding of the individual excitations. With this setup, it is possible to detect both spin states of the neutron beam simultaneously. As an example Fig. 1 (left) shows the results of a constant-Q-scan up to 25 meV at the position of the magnetic satellites within the (002) Brillouin zone in the multiferroic phase. The red circles (spin-flipped neutrons) correspond to a magnon polarised perpendicular to the cycloidal plane with a pronounced spin band gap of about 4 meV. This gap is considerably smaller compared to the low-temperature phase (fig.1 right). An additional magnon appears in the modulated phase that is polarised within the cycloidal plane since it is observed in the non-spin flip channel (black squares). Within the experimental resolution it exhibits no sign of a spin gap. This magnon can be attributed to a phason mode of the spin cycloid.

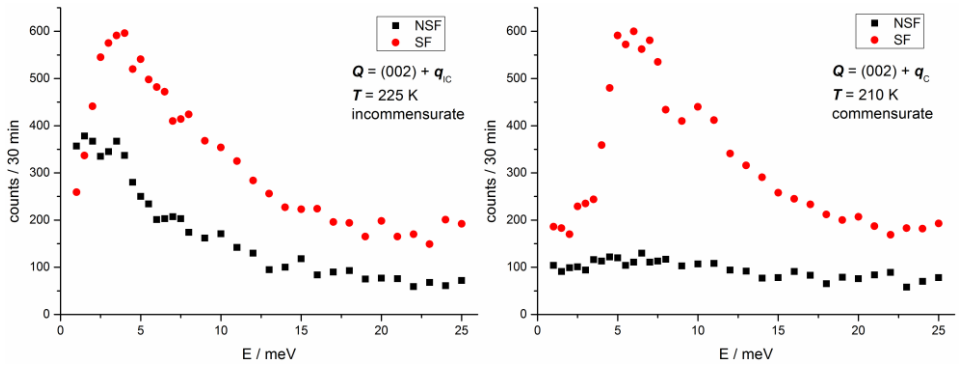

Fig. 1. Constant-Q-scan at the magnetic zone center in the multiferroic (left) and low-temperature phase (right), respectively.