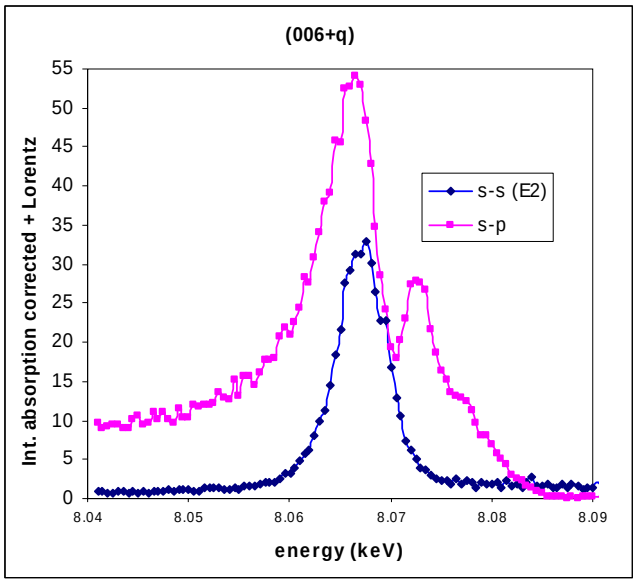
Experiment number HE-2058

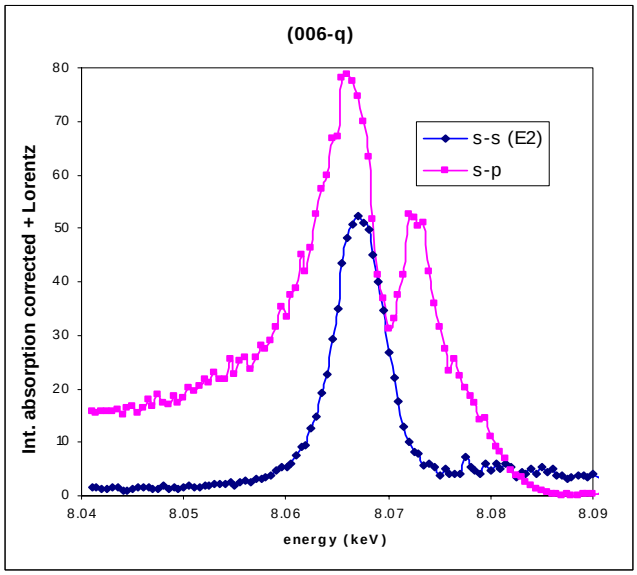
During in-house time, the spitting of the d-band was observed in holmium [1]. We extended the study to all the other heavy rare-earths (Gd, Tb, Dy, Er and Tm) at the L3 edge [2] and we saw the same d-band split which is characterized by a double peak in both the FM and AFM data. Both peaks are of dipole origin unlike what was published before [4-9]. Having established the split dipole resonances across the heavy RE, we decided to accurately quantify the quadrupole (E_2) resonances. We started the study with holmium in the AFM phase.

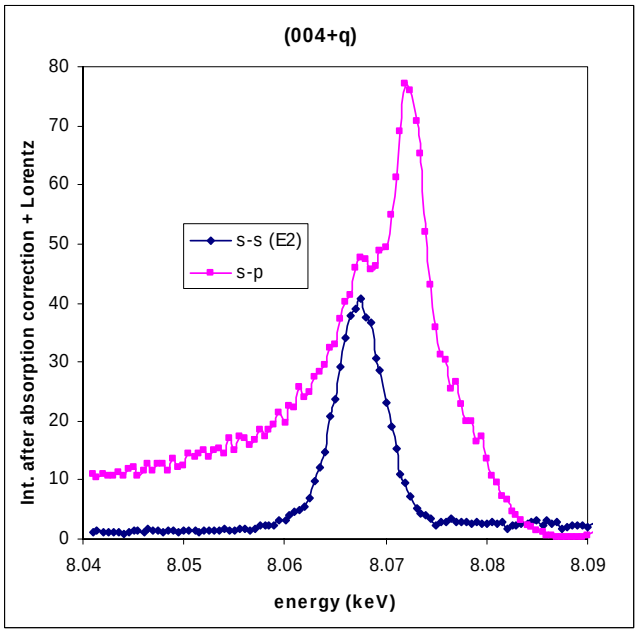
The experiment was carried out on the Ho (00 $l \pm \tau$) satellites with l =2,4 and 6 at the Ho L_3 edge scattering from horizontally and then vertically. Graphite (006) was used to analyse the polarization. The results are illustrated in the next two pages. Only one peak was observed in the sigma-sigma (s-s) channel and is attributed to quadrupole transition. Indeed, no dipole term exist in the cross-section [3] along the s-s. In all the other channels (s-p, p-p and p-s), two peaks appear in each channel. These is due to the fact that both E_1 and E_2 exist (see cross-section) which will make the analysis rather difficult. The measured intensity is proportional to the sum of the resonant scattering amplitudes squared. Thereby, a complex analysis will have to be performed to extract the E1 and E2 contributions which both contain positive and negative terms depending on the angles. The measurements were also performed with no analyzer crystal.

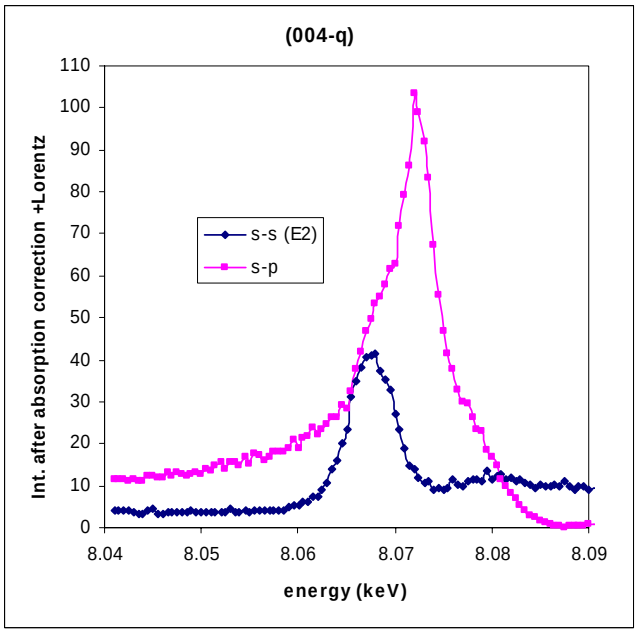
[1] private communication.
[2] experimental report 28-01-716
[3] experimental report 28-01-742
[4] Hill & McMorrow, Acta. Cryst. A **52**, 236 (1996)
[5] Gibbs *et al.*, Phys. Rev. B, **43** (1991) 5663
[6] Detlefs *et al.*, Phys. Rev. B, **55**, n°2 (1997) R680
[7] Hannon *et al.*, PRL vol 61, n°10 (1988) 1245
[8] Lang *et al.*, Phys. Rev. Lett. **74**, 4935 (1995); Carra *et al,*. Phys. Rev. Lett. **66**, 2495 (1991); Wende *et al,*. J. Appl. Phys. **91**, 7361 (2002)
[9] Bartolomé *et al.*, Phys. Rev. Lett. **79**, n°19, 3775 (1997);

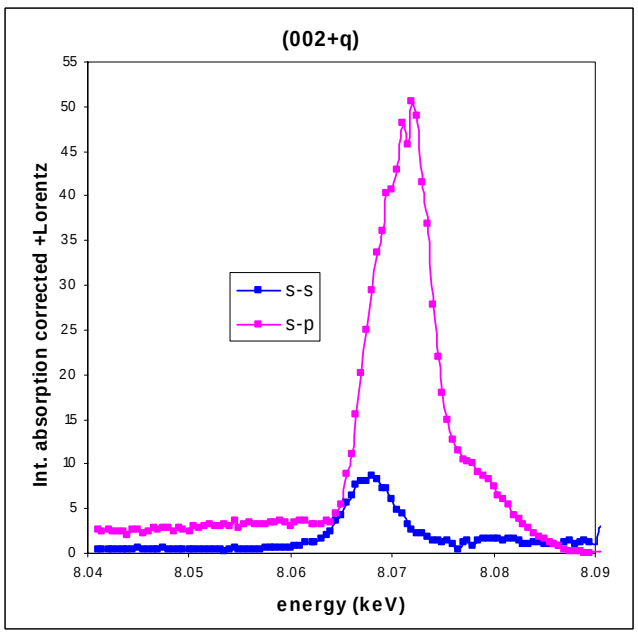
Vertical scattering geometry

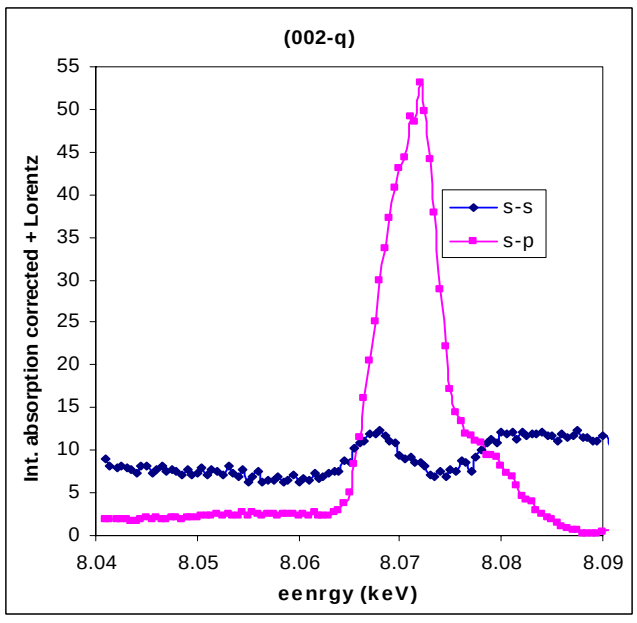












Horizontal scattering geometry