ESRF	Dichroism in soft X-Ray Resonant Raman Scattering across the $M_{4,5}$ Edge of magnetic Gd and of $GdFe_2$ *and* Dichroic Inelastic Soft X-Ray Scattering at the $M_{4,5}$ Edge of magnetic Gd	Experiment number: HE 133 HE 134
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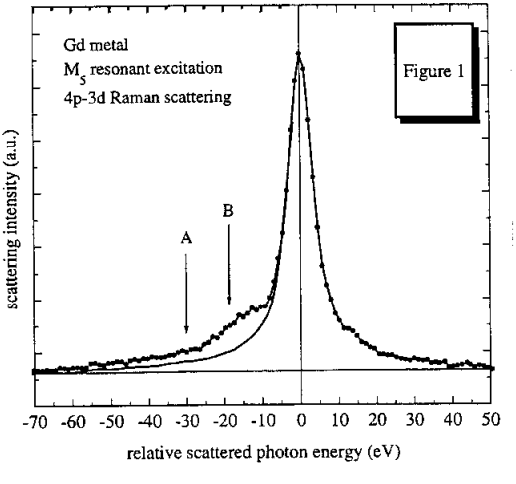
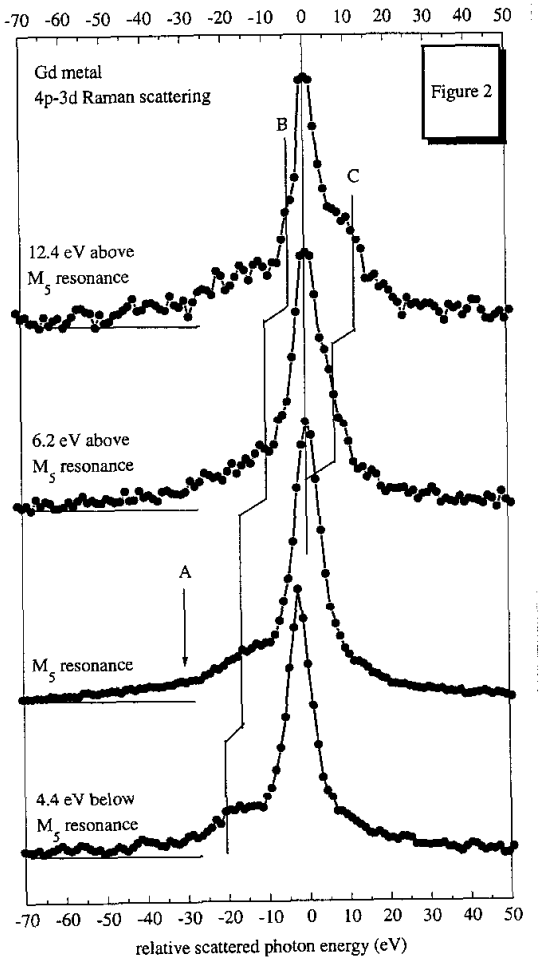
Names and affiliations of applicants (* indicates experimentalists):
L. Braicovich*, C. Dallera*°, G. Ghiringhelli*°, Politecnico Milano, Italy
° now at the ESRF, Grenoble
G. Kaindl*, E. Weschke*, K. Starke*, FU Berlin, Germany
N. Brookes*, ESRF, Grenoble

At the beginning of the experiment we found that the excitation at the M_5 threshold of Gd gives an unexpected spectrum in the process $(3d^{10}4p^64f^7)\rightarrow(3d^94p^64f^8)\rightarrow(3d^{10}4p^54f^8)$. The typical spectrum is shown in fig 1. The main peak is clearly seen and has a width dictated by the final state lifetime (4p hole). We see also features at lower energies extending along an extremely wide energy scale showing that the system can be left in very excited state after the scattering i.e. up to about 50 eV above the minimum excitation energy typical of the main peak (final 4p hole). This is the unexpected result which strongly suggests the presence of multiple excitations involving also another shell besides those assumed in the initial scheme. By considering the energy values one can guess that the main satellite B is due to a shake-up of 5p electrons leading to lower energy photons in the outgoing channel. In this scheme the long tail A could be attributed to shake-off but not necessarily of the 5p electrons. At present these assignments are to be considered tentative and further investigation is needed. The interest of this result is in the fact that these multiple excitations take place in the scattering with excitation at threshold. In a pictorial approximate scheme this means that the decay channel is responsible for the multiple excitations since there is no enough energy in the excitation channel. Thus this effect is peculiar of the resonant scattering regime. Due to the superposition of these many body effects it is premature to study scattering dichroism before clarifying this aspect. For this reason we have changed our working program and we have collected unpolarised data.



We summarize below (Fig.2) the spectra measured as in Fig 1 but at different excitation region as shown by the labels. It is clear that there are features displacing as the increm energy i.e. appearing at constant transferred energy as in a simple description with the I this seems to be the case also for the features attributed to multiple excitation at least in B. However the majority of the spectral intensity comes from the main peak at consta energy, typical of the characteristic fluorescence. This is another complication which m on the scattering dichroism premature.