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| | Experiment title: Resonant magnetic x-ray scattering at the K edge of manganese in RbMnF_3 | Experiment number: HC-384 |
| Beamline ID20 | Date of experiment: from: Feb. 4, 1997 to: Feb.9, 1997 | Date of report: Mar. 14, 1997 |
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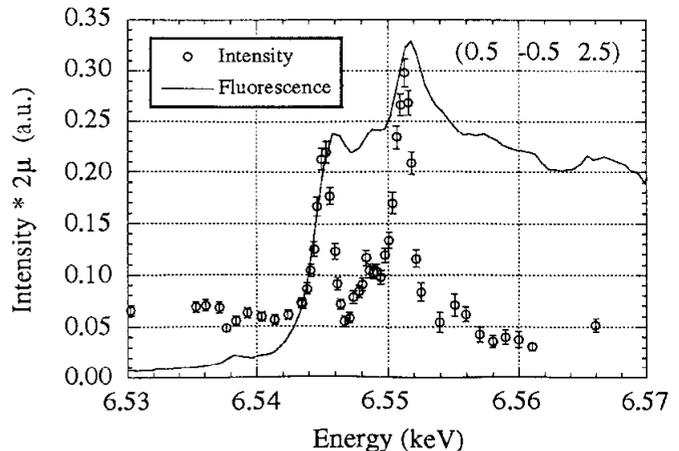
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In order to understand the enhancement of x-ray magnetic scattering at the K edge of Manganese, RbMnF_3 has been studied at ID20. RbMnF_3 has a simple cubic structure and orders antiferromagnetically below $T_N = 83.6$ K. The magnetic scattering reflections occur at $(h/2 \ k/2 \ l/2)$ positions in the reciprocal space. The studied sample had its face cut perpendicular to the $(0 \ 0 \ 1)$ 4-fold axis. It was mounted in a closed-cycle refrigerator. The scattering plane was vertical, corresponding to σ -polarized incident x-ray beam. The integrated intensities - rocking curves of the sample - were measured for the four reflections $(0.5 \ 0.5 \ 2.5)$, $(0.5 \ -0.5 \ 1.5)$, $(0.5 \ -0.5 \ 2.5)$ and $(0.5 \ -0.5 \ 3.5)$ without polarization analysis. The intensities could be corrected for absorption using some measurement of the transmitted intensity through a powder, performed during the same experiment. The results are qualitatively similar for all four reflections and are presented for one of them in figure 1, after the absorption correction has been performed. The measured fluorescence is also shown in the figure

The raw data presented a two-fold enhancement at the maximum of the absorption. As seen on the figure, it becomes a five-fold enhancement, once the absorption corrections have been performed. The important feature is that the line shape of this resonance is very different from what has already been observed in rare earths or actinides, as it presents several enhancements, each of them corresponding to a local maximum of the absorption.

One more feature is also to be noted below the edge, around 6.538 keV, corresponding to another local maximum of the absorption that is attributed to quadrupolar resonance $1s-3d$, as in NiO [1]. The other maxima of the absorption have already been attributed to dipolar transitions to some exciton levels in the p-shell [2], which makes the enhancements observed here quite unexpected.

Fig.1: $(0.5 \ -0.5 \ 2.5)$ magnetic reflection, without polarization analysis.



The (0.5 -0.5 2.5) and (0.5 -0.5 3.5) reflections has also been studied in polarlzation analysis. The results, after absorption corrections, are presented in figure 2 for (0.5 -0.5 2.5).

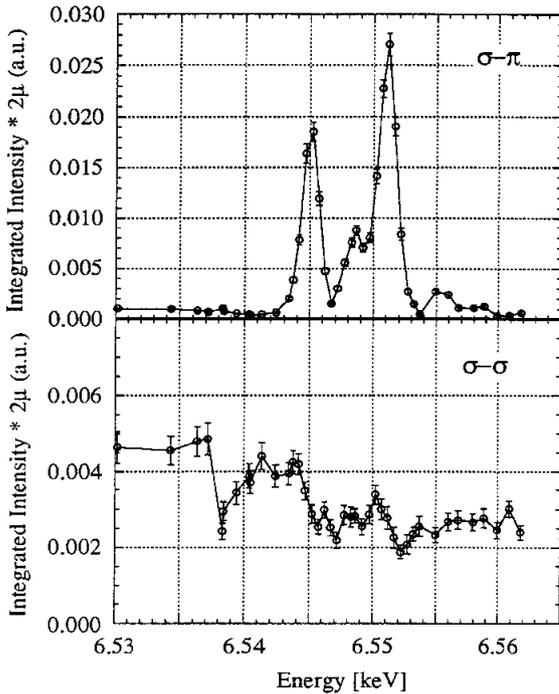


Fig.2: polarization analysis at the (0.5 -0.5 2.5) magnetic reflection. The main enhancements are only present in the rotated channel $\sigma-\pi$. Their absence in the unrotated channel $\sigma-\sigma$ is consistent with their interpretation in terms of dipolar transitions, following the white line.

The temperature dependence of the (0.5 -0.5 2.5) magnetic reflection has been measured in the s-p channel at three energies: 6.52keV, 6.545keV and 6.551 keV, corresponding respectively to the non resonant regime and to the highest two resonances. The results are shown in figure 3

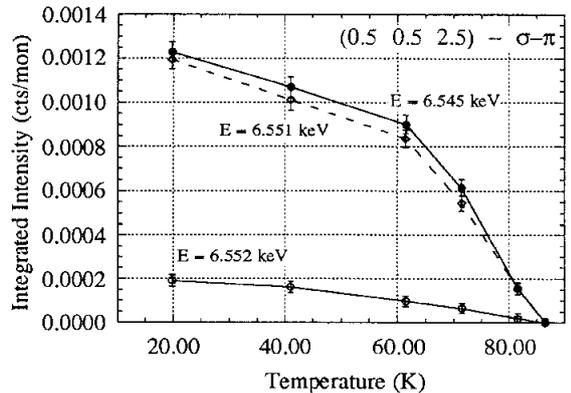


Fig.3: Temperature dependence in $\sigma-\pi$ of the (0.5 -0.5 2.5) reflection for several energies: all intensities vanish at T_N .

The phenomenological analysis of the line shape of the resonance is now under investigation. It implies some careful considerations on the nature of the excited states of the Manganese ions.

References:

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