ESRF

Experiment title: Magnetic Compton **profile** of $CeRh_3B_2$	**Experiment number:** HE162

Beamline: ID15A	**Date of Experiment:** from: 24th February 97 to: 4th March 97	**Date of Report:** July 97
Shifts: *21*	**Local contact(s):** Th. Tschentschcr	*Received* at *ESRF:* 2 SEP. 1997

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Report :

The ternary cerium boride $CeRh_3B_2$, which crystallizes in the hexagonal $CeCo_3B_2$ structure (space group P6/mmm), has attracted considerable interest due to its anomalous ferromagnetism. Its Curie temperature T_C = 115 K is by far the highest Curie temperature of known Ce compounds with non-magnetic constituents. It is even beyond that of $GdRh_3B_2$(T_C = 90 K), in clear contrast to the de Gennes law prediction. Its saturation magnetization at low temperature is strongly reduced relative to the free ion value: μ_{bulk} = 0.42 μ_B/Ce. This moment lies perpendicular to the c axis. Photoemission spectroscopy, X-ray absorption spectroscopy as well as a La substitution study indicate that the Ce ions are in a trivalent state. According to a polarized neutron scattering study, the low temperature value of the total magnetic moment of the $4f$ electrons is $\mu^T_{Ce}(4f)$ = 0.56 μ_B[1]. This study shows that both orbital and spin magnetic moments of the Rh ***4d*** electrons, $\mu^L_{Rh}(4d)$ and $\mu^S_{Rh}(4d)$ respectively, are very small.

Several models have been proposed to explain the magnetic properties of $CeRh_3B_2$. One of them supposes that its anomalous ferromagnetism originates from a strong hybridization between the Ce 4f and nearest-neighbor Ce 5d electrons. It is conceivable that a strong Ce 4f-5d hybridization can induce an appreciable polarixation of the Ce 5d electrons. Therefore it is of interest to perform an X-ray magnetic Compton scattering investigation. This technique probes only the distribution of the spin moments.

The measurements were performed at the ESRF using the end-station of the high energy beamline ID15A where best conditions for Compton scattering experiments can be achieved. We used a standard backscattering geometry. The sample was a single crystal. It had a thickness $\sim$ 1.5 mm and covering a surface of $\sim 6 \times 4$ mm^2. The X-ray beam probed only a surface of $\sim 3 \times 1$ mm^2. The data were recorded at 10 K. $\mathbf{B}_{ext}$ was applied perpendicular to the c axis with B_{ext} = 0.92 T.

In Fig. 1 we present the measured magnetic Compton profile of $CeRh_3B_2$. Its analysis shows that the Rh ***4d*** electrons carry a very small moment, in agreement with the neutron diffraction result. The spin magnetic moment of the Ce $5d$ electrons is antiparallel to the bulk magnetization and therefore to the Ce $4f$ orbital moment. In addition this moment is not small relative to the Ce $4f$ moment. These results are at variance with results obtained for numerous Ce compounds. They suggest that it is the strong hybridization between the Ce $4f$ and nearest-neighbor Ce 5d electrons rather than the Kondo effect which is at the origin of the anomalously large Curie temperature of $CeRh_3B_2$.

[l] J. A. Alonso et al, International Conference on Magnetism, Cairns, Australia, 1997.

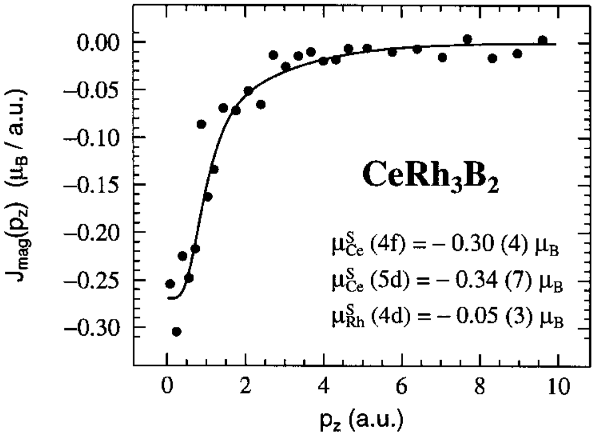

Figure : Magnetic Compton profile of $CeRh_3B_2$. ***The*** solid line is a fit which gives the values for the spin moments reported in the figure.