Magnetic Moment of the 9.3-keV Nuclear Level of Kr^{83}†

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The magnetic moment of the 9.3-keV nuclear level of Kr^{83} was obtained by measuring the Zeeman splitting of the Mössbauer lines in an external magnetic field. Experiments with a Kr clathrate source and absorber in a longitudinal field and a ZnSe source with a solid Kr absorber in a transverse field yielded a magnetic moment of $(-0.99\pm0.08)\mu_N$.

IN this paper we report the measurement of the magnetic moment of the 9.3-keV spin-$\frac{7}{2}$ nuclear level of Kr^{83}.

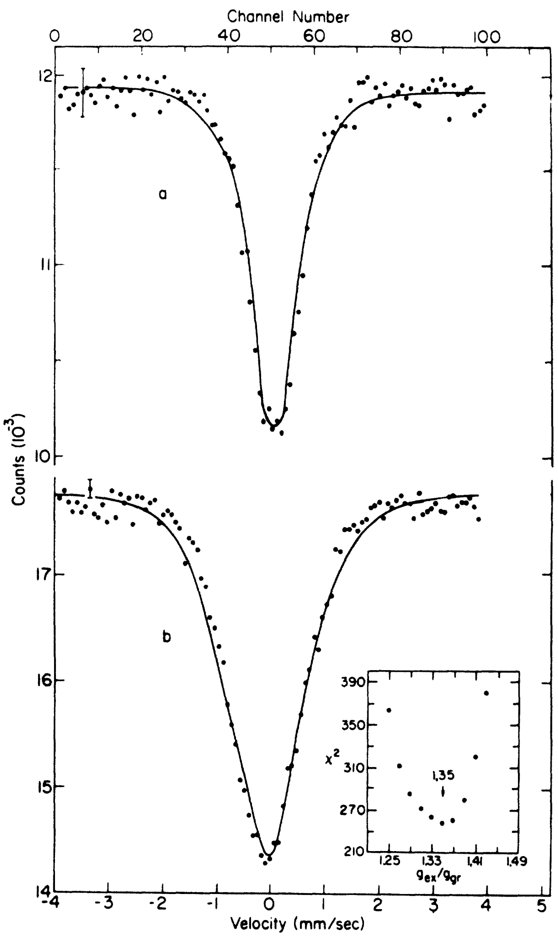

FIG. 1. Absorption of the clathrate-clathrate experiment: (a) without magnetic field; (b) with magnetic field (the solid line is a computer fit). Inset: calculated χ^2 versus g_{ex}/g_{gr}. The areas of the absorption dips are not significant because the background was changed during the experiment.

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Two different measurements were carried out. In the first experiment a source and absorber of Kr hydroquinone clathrates at liquid-helium temperature and a

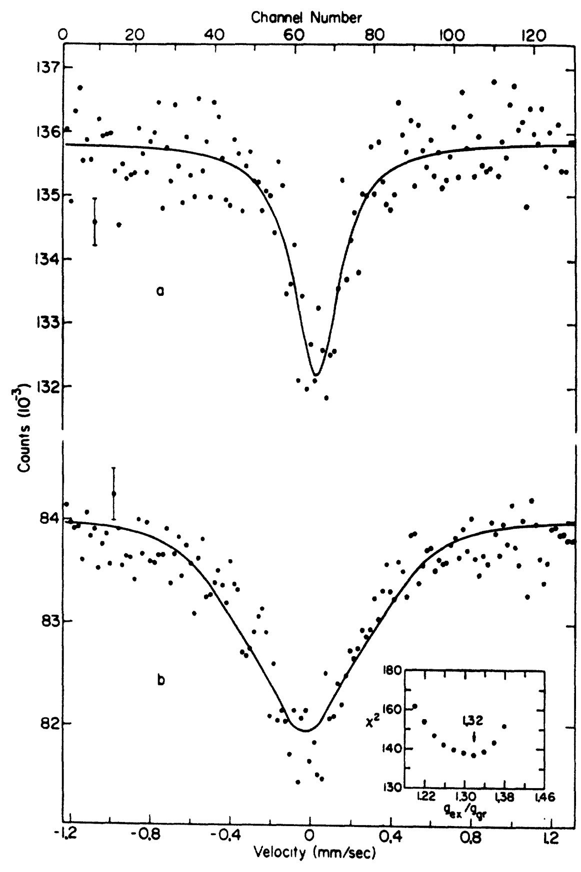

FIG. 2. Absorption spectra of the ZnSe-solid Kr experiments: (a) without magnetic field; (b) with magnetic field (the solid line is a computer fit). Inset: calculated χ^2 versus g_{ex}/g_{gr}. The areas of the absorption dips are not significant because the background was changed during the experiment.

superconducting magnet with a magnetic field in the direct of emission of the γ rays were employed.

The intensities of the field at the source and the absorber were 33 ± 1 and 28 ± 2 kG, respectively. The application of the magnetic field caused a broadening of the absorption line as shown in Fig. 1. The relatively broad line which was obtained without the magnetic field ($\Gamma=10.4\Gamma_{nat}$) is explained as being due partly to an unresolved quadrupole splitting in the clathrates[1,2] and partly to self-absorption in the source and to absorber thickness.

Later, a second experiment was performed using a $ZnSe^{83}$ source at room temperature and a solid Kr absorber at liquid-helium temperature. Such a combination of source and absorber was found[2] to produce the narrowest absorption pattern ($\Gamma=2.5\Gamma_{nat}$) in Kr^{83} experiments.

A magnetic field $H=19\pm1$ kG produced by a Varian 4-in. magnet was applied to the ZnSe source only, in the direction perpendicular to the emission of the γ radiation. Absorption spectra with and without a magnetic field are given in Fig. 2. Here the width of the line without the field ($\Gamma=5\Gamma_{nat}$) is due to absorber thickness.

The experimental results were compared with spectra synthesized for various g factors. The computer program took into account the quadrupole splitting for the case of the clathrates.[1] The best-fit curves, which are given by the solid lines in Figs. 1 and 2, yielded ratios of g_{ex}/g_{gr} of 1.35 ± 0.09 and 1.32 ± 0.06, respectively. This value was obtained using $\mu_{gr}=-0.970\mu_N$.[3] The mean-square deviation of the theoretical curves from the experimental results versus different values of g_{ex}/g_{gr} are given in the insets in Figs. 1 and 2.

The obtained value of the magnetic moment $\mu_{ex}=-0.99\pm0.08=\mu_N$ agrees very well with the theory of Blin-Stoyle and Perks,[4] which takes into consideration configuration mixing in the shell model.

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