The Mößbauer Effect of the 129 keV Transition in ^{195}Pt

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The Mößbauer effect of the 129 keV transition in ^{195}Pt has been observed. By use of a Ge(Li) detector any contribution from the strong 99 keV Mößbauer line could be eliminated. The width of the resonance absorption line corresponds to the natural line width. We derived from the magnitude of the observed Mößbauer effect the branching ratio in the decay of the 129 keV level as $I(129)/I(31) = (5.7 \pm 1.6)\%$.

Several authors[1–3] have tried to detect the Mößbauer effect of the 129 keV transition in ^{195}Pt, which is expected to be very small because of the rather high energy and the unfavourable branching ratio. GERDAU[1] could not observe any effect greater than 0.03%. WILENZICK et al.[4] measured an effect of 0.16% uncorrected for background. This rather high effect was obtained by using a NaI(Tl) detector. With this arrangement it must be difficult, however, to avoid some background of the 99 keV line, the ME of which may be about 80 times greater than that of the 129 keV transition.

We have therefore repeated this investigation of the 129 keV Mößbauer line by use of a thin window Ge(Li) detector, the resolution of which is sufficient to eliminate any contribution of the intensive 99 keV line. Our experiment was performed by use of a standard Mößbauer transmission apparatus at a temperature of 20 °K.

Commercially obtained ^{195}Au in an iridium metal lattice was used as the source. The strength of the source was 5.5 mCi. In order to avoid pile-up effects of the very intensive X-rays at 130 keV we used a critical absorber of 0.5 mm Cd and 0.2 mm Cu. For the absorber we used 300 mg/cm^2 platinum metal powder with ^{195}Pt enriched to 60%.

Figure 1 shows the observed single spectrum of the 129 keV line with a least-squares fitted Lorentzian. This fit gave a line width of 2.6 ± 1.5 mm/s and an effect of $0.044 \pm 0.012\%$. The total time of measurement was two months.

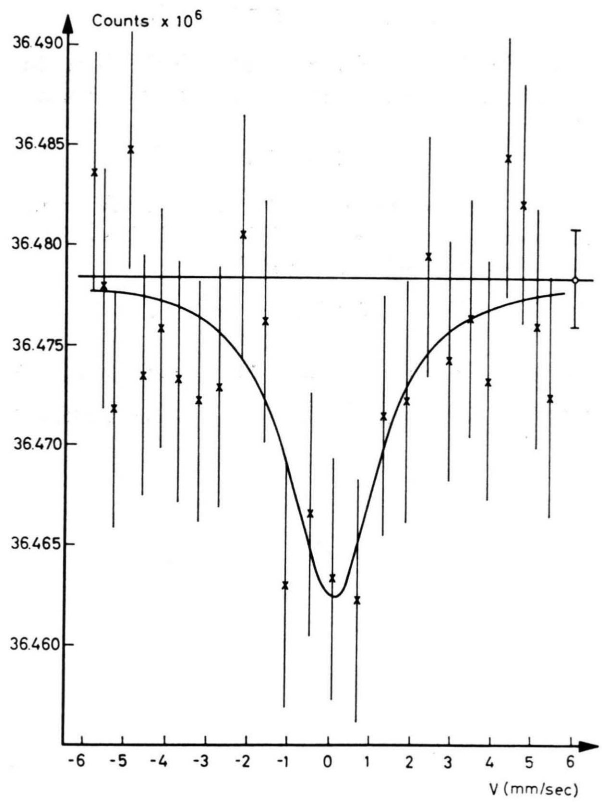

Fig. 1. Mößbauer spectrum of the 129 keV transition of ^{195}Pt at 20 °K.

Furthermore we observed the Mößbauer absorption line for the 99 keV transition. We derived from the Debye-Waller factor of this transition for our

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source also the Debye-Waller factor of the 129 keV transition by taking into account the known value of the Debye-Waller factor of platinum metal [6]:

With

$$f_{\text{abs}}(99) = 11.5\% \text{ and } f_{\text{source}}(99) = 5.23\% \text{ at } 20\ ^\circ\text{K}$$

we get for the 129 keV line:

$$f_{\text{abs}}(129) = 2.6\% \quad \text{and} \quad f_{\text{source}}(129) = 0.69\% .$$

With the calculated $f_{\text{abs}}(129)$, $f_{\text{source}}(129)$ and the observed Mößbauer effect we derived for the branching ratio of the 129 keV state:

$$I(129)/I(31) = (5.7 \pm 1.6)\% .$$

This value is in good agreement with the direct intensity ratio measurements by HARRIS et al. [2] which give

$$I(129)/I(31) = (5.2 \pm 1.0)\%$$

but it is in disagreement with the Coulomb excitation data [7, 8]. The lifetime of the 129 keV state has been measured by BLOESS et al. [8] as:

$$T_{1/2} = (6.2 \pm 0.7) \cdot 10^{-10} \text{ sec} .$$

This gives a natural line width of 3.4 mm/sec which agrees well with our observed line width.

The ME of the 129 keV transition opens the possibility to measure the g-factor of this state. One should expect from the small line width that the magnetic hyperfine splitting in a ferro-magnetic environment should be well resolved. By means of the known g-factor of the 99 keV Mößbauer transition in the same isotope [5] it is possible to calibrate the magnetic field at the site of the Pt-nucleus. Thus an accurate value of the $5/2^-$ g-factor should be obtainable. A measurement of the g-factor of the 129 keV level is in preparation.

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