NOTIZEN

The Mössbauer-Effect of the 104 keV Transition in ^{180}W

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The Mössbauer effect of the 2+ (104 keV) 0+ transition in ^{180}W has been observed. The source was ^{180}Ta which was produced by irradiation of a foil of natural tantalum by fast neutrons: ^{181}Ta(n, 2n)^{180}Ta. The width of the resonance absorption line was (3.1 ± 0.8) mm/sec which corresponds to the linewidth derived from lifetime measurements.

Whereas Mössbauer measurements have been performed in the tungsten isotopes $^{182, 3, 4, 6}$W [1, 2], the ME in ^{180}W has not been observed previously. The expected linewidth of about 2.2 mm/sec of the 104 keV transition should open the possibility to study the electric and magnetic hyperfine interaction of this nucleus in various surroundings.

In order to obtain an unsplit source we used W in tantalum metal which has cubic symmetry. A Ta foil was irradiated by fast neutrons of about 15 MeV [3] which were produced by bombarding beryllium with 30 MeV deuterons in the Karlsruhe-Cyclotron. Neutrons with an energy of 15 MeV have a cross-section of 2 barn [4] for the desired process ^{181}Ta(n,2n)^{180}Ta. All other possible reactions are much weaker. The 2+ state in ^{180}W is populated only to 3% in the decay of ^{180}Ta ($T_{1/2} = 8.1$ h), while a 27% branch leads to the 93 keV 2+ state in ^{180}Hf.

For the absorber we used 50 mg/cm^2 W-metal powder (^{180}W enriched to 6.9%) which was obtained by reducing WO_3 in a hydrogen atmosphere at 900 °C.

For the detection of the 104 keV γ-line we used a Ge(Li)-detector with 1 keV resolution at 100 keV. In this way any background from other lines could be avoided. In particular the contribution of the 100 keV γ-rays of the ^{182}W produced by the weak (n,γ) reaction could be reduced to less than 0.1%.

Our experiment was performed by use of a standard Mössbauer transmission apparatus at a temperature of 20 °K.

Fig. 1 shows the observed single line spectrum of the 2+ → 0+ transition in ^{180}W with a least squares fitted Lorentzian. The total time for the measurement was two days and three different sources were used. The observed linewidth was (3.1 ± 0.8) mm/sec. After correction for the finite absorber thickness one obtains a lower limit for the half-life of the 2+ state of $T_{1/2} > (0.91 \pm 0.35)$ ns. This value is in agreement with lifetime measurements [5].

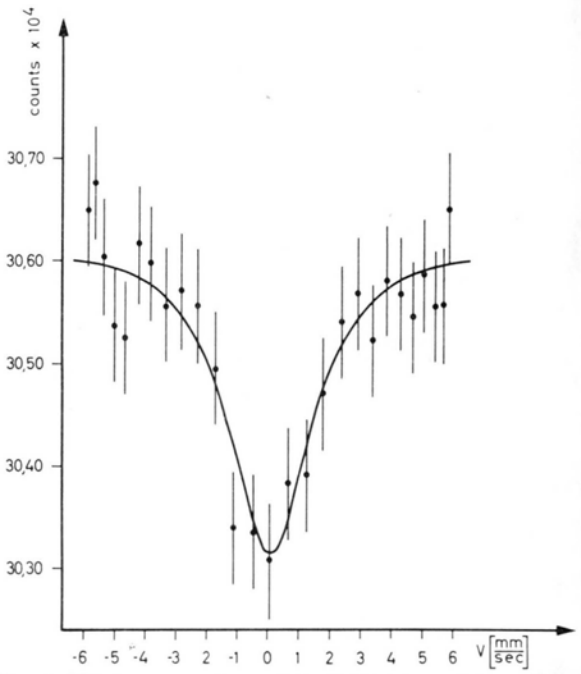

Fig. 1. Mössbauer spectrum of the 104 keV transition of ^{180}W at 20 °K.

The Mössbauer effect enables an accurate determination of the magnetic moment and the quadrupole moment of the 2+ level in ^{180}W. This would extend the systematics for the even tungsten isotopes towards the strongly deformed region which is of great theoretical interest [6–8].

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