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I. 6. Measurement of the Nuclear G-factor of the 27^- High-spin Isomer State of ^{152}Dy

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The g-factor of the 27^- isomer state of ^{152}Dy has been measured using the Time-Integral Perturbed Angular Distribution (TIPAD) method. The high-spin states of ^{152}Dy have been populated by ^{141}Pr(^{16}O,p4n)^{152}Dy reaction at E = 115 MeV from the new AVF cyclotron at CYRIC. An enriched ^{141}Pr target of 6 mg/cm^2 thickness was placed in an external magnetic field (B_{ext}) of 20.3 kG applied perpendicularly to the beam-detector plane. Figure 1 shows the time-integral perturbed angular distributions of γ-rays emitted from the 27^- state.

In the case of paramagnetic materials, such as rare earth elements, the effective magnetic field at the nucleus (B_{eff}) is obtained from the relation $B_{\text{eff}} = \beta\ B_{\text{ext}}$,where β is called the paramagnetic correction factor, and must be measured independently to obtain the g-factor.

The paramagnetic factor of Dy ions in Pr target has been determined to be 4.2(5) by the Time-Differential Perturbed Angular Distribution (TDPAD) measurement of the 21^- state of ^{152}Dy. Because the g-factor of this 21^- isomer state has been known to be +0.55(6)[1)], we could deduce the effective magnetic field in case of this experimental condition by measuring the Larmor frequency of the nuclear spin precession of this state. Fortunately since both of high-spin isomer states of ^{152}Dy have been populated simultaneously. Figure 2 shows a TDPAD spectrum of this state and the effective magnetic field has been obtained to be 8.50(95) T, which corresponds to $\beta = 4.2$.

As a result, the g-factor of the 27^- isomer state of ^{152}Dy has been obtained to be +0.09(5) and has been found to be much smaller than the expected value of +0.39. It has been deduced from a fully aligned configuration of $\pi(h^2_{11/2}) \otimes \nu(f^2_{7/2}\, h_{9/2}\, i_{13/2})$[2], which is expected as an yrast state as a result of Deformed Independent Particle Model (DIPM)[3] calculation. As seen in Table 1, present data suggest the configuration of $\pi(h_{11/2}\, d_{3/2}) \otimes \nu(i^2_{13/2}\, h_{9/2} f_{7/2})$, however the excitation energy of this configurations has been expected to be more than 2 MeV higher than that of the yrast state in the DIPM calculation. Systematic measurements in the high-spin isomer states of Dy isotope are needed to understand this contradiction, so we are planning to measure the g-factor of the high-spin state in other Dy isotopes.

References

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2) Cerkaski M. et al., Nucl. Phys. **A315** (1979) 269.
3) Døssing T., Neergård K. and Sagawa H., Phys. Scr. **24** (1981) 258.

Table 1. Expected g-factors for possible configurations.

configuration	g (expected)	*E*x (MeV)	deformation
$\pi(h^2_{11/2}) \otimes \nu(f^2_{7/2}\, h_{9/2}\, i_{13/2})$	+ 0.36 (5)	6.79	–0.097
$\pi(h_{11/2}\, d_{3/2}) \otimes \nu(i^2_{13/2}\, h_{9/2} f_{7/2})$	+ 0.15 (5)	9.02	–0.091

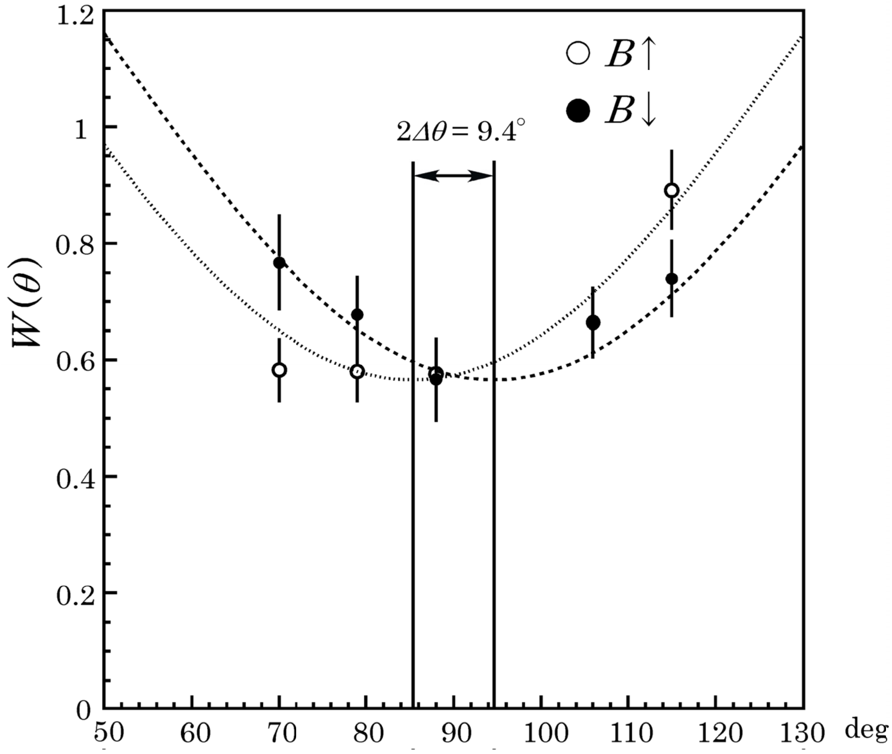

Figure 1. A TIPAD spectrum of 220.6 keV γ-ray emitted from 27^- high-spin isomer state of ^{152}Dy

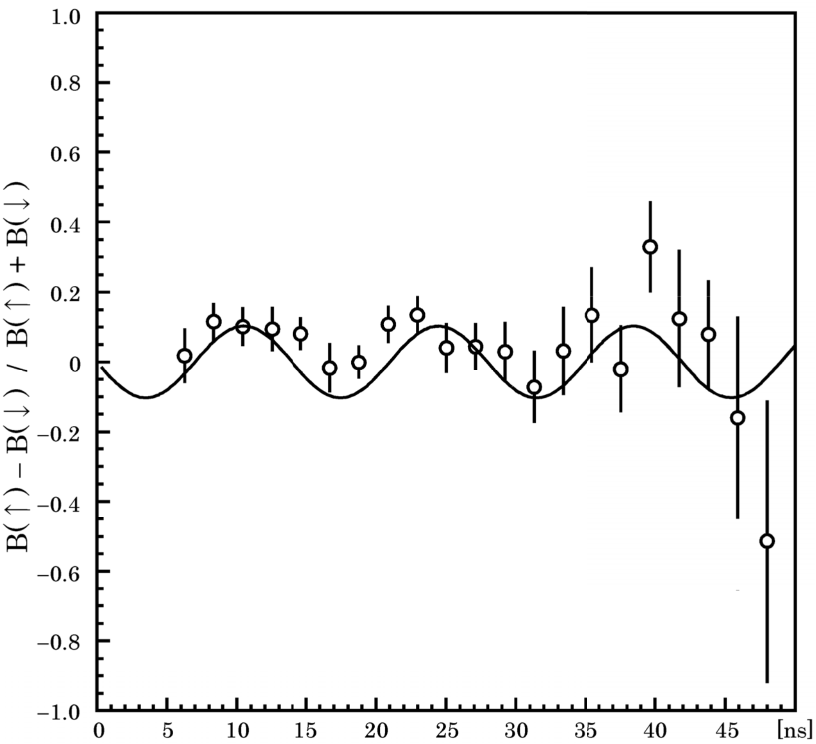

Figure 2. A TDPAD spectrum of 262.4 keV γ-ray emitted from 21^- high-spin isomer state of ^{152}Dy