OBSERVATION OF THE SPIN 20 LEVEL IN THE GROUND STATE ROTATIONAL BAND OF 158Dy

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OBSERVATION OF THE SPIN 20 LEVEL IN THE GROUND STATE ROTATIONAL BAND OF ^{158}Dy (*)

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Résumé. — La bande de rotation bâtie sur l'état fondamental du ^{158}Dy a été peuplée jusqu'à l'état de spin 20 au moyen des réactions ^{150}Nd(^{12}C, 4 n)^{158}Dy et ^{150}Nd(^{13}C, 5 n)^{158}Dy. Le comportement du « moment d'inertie » aux grandes fréquences de rotation en a été déduit.

Abstract. — The ground state rotational band of ^{158}Dy was populated up to the spin 20 level by means of the ^{150}Nd(^{12}C, 4n)^{158}Dy and ^{150}Nd(^{13}C, 5n)^{158}Dy reactions and the behavior of the « moment of inertia » at large rotational frequencies was deduced.

The ^{150}Nd(^{12}C, 4n)^{158}Dy and ^{150}Nd(^{13}C, 5n)^{158}Dy reactions initiated by carbon ions from the B. N. L. 3-stage MP Tandem Van de Graaff facility has been used to populate the ^{158}Dy rotational band to spin 20. The γ-rays belonging to ^{158}Dy cascades were identified on the basis of high resolution γ-γ coincidence measurements involving known low-lying ^{158}Dy states. These measurements were made with two large-volume Ge-Li detectors using event-mode recording on magnetic tape with 4 096 × 4 096 channel dispersion, on line with the B. N. L. Σ-7 computer. Identification of the observed coincident γ-rays with the ground state band of ^{158}Dy and their placement within the cascade was made on the basis of relative γ-ray intensities, excitation function measurements with C^{13} ions to 72 MeV, and by γ-ray angular distribution measurements relative to the beam direction. All coincident γ-rays exhibit angular distributions which are consistent with the « stretched » $L = 2$ angular distributions from highly aligned states. The observed γ-rays and their placement in the rotational cascade are listed in Table I (**).

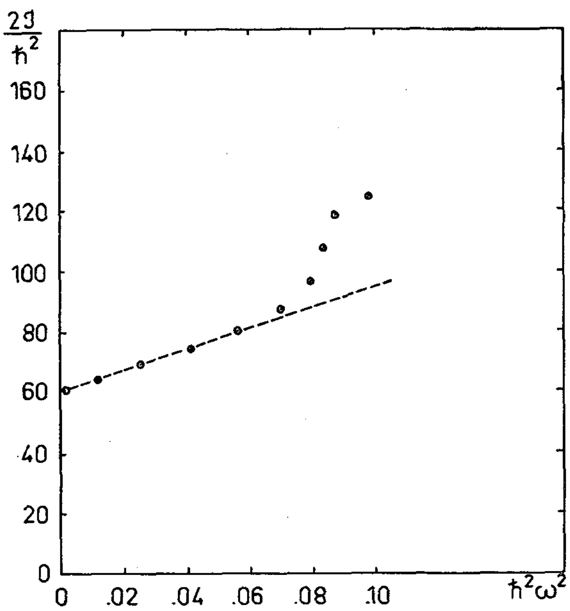

FIG. 1. — Plot of $\frac{I}{\hbar^2} = \frac{4I-2}{E_I - E_{I-2}}$ versus

$$(\hbar\omega)^2 = \left[\frac{E_I - E_{I-2}}{\sqrt{I(I+1)} - \sqrt{(I-2)(I-1)}}\right]$$

for the ground state rotational band of ^{158}Dy. The dotted line represents the VMI model fit to the first five excited states of the band.

TABLE I

Transition Energy (keV)	$I_i \to I_f$	State Energy E_{I_i} (keV)
98.9	$2^+ \to 0^+$	98.9
218.3	$4^+ \to 2^+$	317.2
320.6	$6^+ \to 4^+$	637.8
406.2	$8^+ \to 6^+$	1 044.0
475.8	$10^+ \to 8^+$	1 519.8
529.3	$12^+ \to 10^+$	2 049.1
563.5	$14^+ \to 12^+$	2 612.6
578.0	$16^+ \to 14^+$	3 190.6
590.8	$18^+ \to 16^+$	3 781.4
625.8	$20^+ \to 18^+$	4 407.2

Figure 1 shows the variation of the « moment of inertia » with rotational frequency for the ^{158}Dy ground state band plotted for purposes of comparison in a manner similar to that previously used [1] for

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(**) The energy values obtained in this work are in excellent agreement with values obtained by Johnson, Ryde, and Hjorth up to the spin 16 level in their Gd^{158}(α, 4 n)Dy^{158} experiments (private communication).

the ^{160}Dy rotational band. The moment of inertia increase up to spin 12 follows the prediction of the VMI model [2]. From spin 14 to spin 18, the moment of inertia increases sharply in a manner similar to that exhibited [1] by ^{160}Dy. The change in the moment of inertia from spin 18 to spin 20 indicates a departure from this trend, the moment of inertia tending to change more slowly with angular velocity.

References

[1] JOHNSON (A.), RYDE (H.) and SZTARKIER (J.), *Phys. Letters*, 1971, **34B**, 605.

[2] MARISCOTTI (M. A. J.), GOLDHABER (G. S.) and BUCK (B.), *Phys. Rev.*, 1969, **178**, 1864.