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

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

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

The  $^{150}\text{Nd}(^{12}\text{C}, 4n)^{158}\text{Dy}$  and  $^{150}\text{Nd}(^{13}\text{C}, 5n)^{158}\text{Dy}$  reactions initiated by carbon ions from the B. N. L. 3-stage MP Tandem Van de Graaff facility has been used to populate the  $^{158}\text{Dy}$  rotational band to spin 20. The  $\gamma$ -rays belonging to  $^{158}\text{Dy}$  cascades were identified on the basis of high resolution  $\gamma$ - $\gamma$  coincidence measurements involving known low-lying

$^{158}\text{Dy}$  states. These measurements were made with two large-volume Ge-Li detectors using event-mode recording on magnetic tape with  $4\,096 \times 4\,096$  channel dispersion, on line with the B. N. L.  $\Sigma$ -7 computer. Identification of the observed coincident  $\gamma$ -rays with the ground state band of  $^{158}\text{Dy}$  and their placement within the cascade was made on the basis of relative  $\gamma$ -ray intensities, excitation function measurements with  $\text{C}^{13}$  ions to 72 MeV, and by  $\gamma$ -ray angular distribution measurements relative to the beam direction. All coincident  $\gamma$ -rays exhibit angular distributions which are consistent with the « stretched »  $L = 2$  angular distributions from highly aligned states. The observed  $\gamma$ -rays and their placement in the rotational cascade are listed in Table I (\*\*).

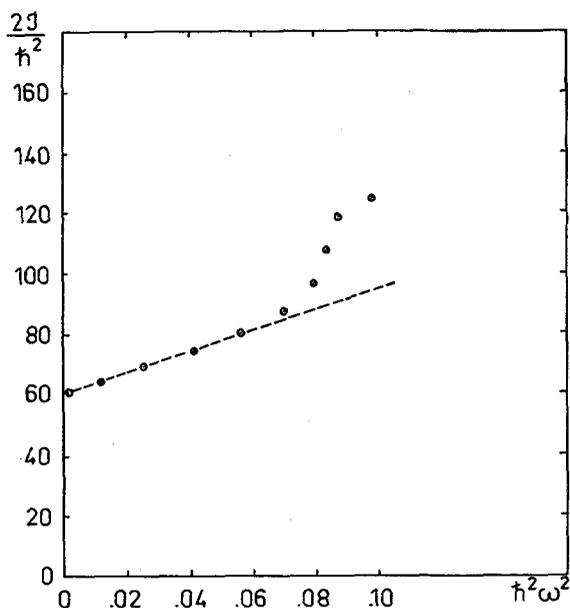


FIG. 1. — Plot of  $\frac{I}{\hbar^2} \equiv \frac{4I-2}{E_I - E_{I-2}}$  versus

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

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

(\*) Work performed under the auspices of the U. S. Atomic Energy Commission.

TABLE I

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

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

(\*\*) 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  $\text{Gd}^{158}(\alpha, 4n)\text{Dy}^{158}$  experiments (private communication).

the  $^{160}\text{Dy}$  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  $^{160}\text{Dy}$ . 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.