JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN VOL. 34, SUPPLEMENT, 1973
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR MOMENTS AND NUCLEAR STRUCTURE, 1972

V–22

Quadrupole Moment for High Spin Rotational States

K. SUGAWARA-TANABE and K. TANABE†

College of General Education, University of Tokyo, Tokyo
†Department of Physics, Saitama University, Saitama

The asymmetric rotor model is proposed to explain the behaviors of high spin states,[1,2] where the pairing force has no significant effect and the asymmetric rotor is more stable than the symmetric one. Recently there comes a lots of experiments about the yrast line,[3] back bending curve,[4] and the rotational spectra of unique parity states in odd A nucleus.[5] All these phenomena, especially the fast E2-transition rate, which seems to be essential peculiarity in yrast region, are interpreted in terms of this model. The rotational Hamiltonian is diagonalized by Holstein-Primakoff transformation, and a physical quantity is expanded in powers of $1/I$ for the spin I state. The quadrupole moment is given by

$$Q=\frac{z}{m}\frac{1}{(I+1)(2I+3)}\sum_{n=0}^{2I}[A\{3(I-n)^2-I(I+1)\}G^I_{nk}(x)$$
$$+B\sqrt{(2I-n)(2I-n+1)(n+1)(n+2)}$$
$$\times G^I_{n+2,k}(x)]G^I_{nk}(x),$$

where $A=\mathscr{I}_x+\mathscr{I}_y-2\mathscr{I}_z$, and $B=3(\mathscr{I}_x-\mathscr{I}_y)$. In the above $\mathscr{I}$'s are the moments of inertia, Z is charge and m mass. Here the transformation coefficients $G^I_{kl}(x)$ are explicitly given by[6]

$$G^I_{kl}(x)=\frac{(-)^{[k/2]}}{\left(\frac{k+l}{2}\right)!}\left(\frac{k!l!}{2^{k+l}\cosh^{k+l+1}(2x)}\right)^{1/2}$$
$$\times\sum_{p=0}^{\min([k/2],[l/2])}(-4)^p\sinh^{[k/2]+[l/2]-2p}(2x)$$
$$\times\begin{pmatrix}\left[\frac{k}{2}\right]+\left[\frac{l}{2}\right]-2p\\ \left[\frac{k}{2}\right]-p\end{pmatrix}\times\begin{cases}\begin{pmatrix}\frac{k+l}{2}\\ 2p\end{pmatrix}, & \text{for } k,\ l \text{ even},\\ 2\begin{pmatrix}\frac{k+l}{2}\\ 2p+1\end{pmatrix}, & \text{for } k,\ l \text{ odd}.\end{cases}$$

A set of parameters which is consistent with the results of ref. 4| is| given by $\mathscr{I}_x=125$, $\mathscr{I}_y=25$ and $\mathscr{I}_z=0.9$ (in the unit of MeV^{-1}). Then, $Q^{\text{asym}}(20+)/Q^{\text{sym}}(20+)=2.7$. The calculated yrast line is shown in the figure.

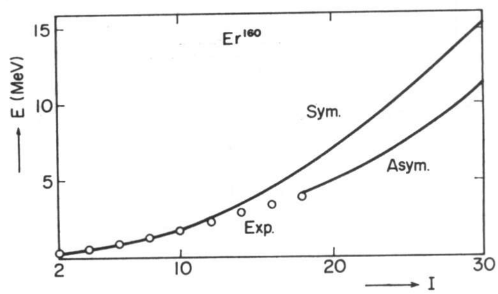

Fig. 1.

References

1) K. Tanabe and K. Sugawara-Tanabe: Phys. Letters **34B** (1971) 575.
2) K. Sugawara-Tanabe and K. Tanabe: to be published (1972).
3) J. O. Newton, F. S. Stephens, R. M. Diamond, W. H. Kelly and D. Ward: Nuclear Phys. **A141** (1970) 631.
4) A. Johnson, H. Ryde and S. A. Hjorth: AFI (1971) Ann. Rep., 3.1.30.
5) S. A. Hjorth, H. Ryde, K. A. Hagemann, G. Løvhøiden and J. C. Waddington: Nuclear Phys. **A144** (1970) 513.
6) K. Tanabe: preprint to be published (1972).