in which

$$A = \sum_{MK} f_K(\varepsilon) \int |D_{MK}|^2 d\Omega = \frac{16\pi^2}{5}(f_{\uparrow\uparrow} + f_\perp), \tag{8}$$

$$B_m = 8\pi^2 \sum_{MK} (-1)^{M-K} f_K(\varepsilon) \begin{pmatrix} 2 & 1 & 1 \\ -m & -M & M \end{pmatrix} \begin{pmatrix} 2 & 1 & 1 \\ 0 & -K & K \end{pmatrix} \delta_{m_0} = \\ = 16\pi^2 (0,1825)^2 (-2f_{\uparrow\uparrow} + f_\perp). \tag{9}$$

Here $f_{\uparrow\uparrow}$ corresponds to oscillation along the axis of symmetry, $f_\perp$ to oscillation perpendicular to that axis, and $\begin{pmatrix} j_1 j_2 j_3 \\ m_1 m_2 m_3 \end{pmatrix}$ are (3 – j) symbols [2].

We have $\beta \approx 0.15$ for heavy strongly deformed nuclei; (7) gives the greatest anisotropy for isolated peaks at about 5%.

We can find f_K as a function of ε from experiment (no satisfactory theoretical relation is available). All of the above formulas correspond to a single γ-ray energy, but the γ-ray source may be a betatron, in which case the angular distribution is governed by the maximum energy $E_{\gamma m}$:

$$w(\varepsilon_m, \vartheta) = C'\{J_{\uparrow\uparrow}(1 - 0{,}33\,\beta Y_{20}) + J_\perp (1 + 0{,}17\,\beta Y_{20})\},$$

in which

$$J_{\uparrow\uparrow} = \int_{E_t}^{E_{\gamma m}} \frac{f_{\uparrow\uparrow}(\varepsilon)\, d\varepsilon}{\varepsilon}, \quad J_\perp = \int_{E_t}^{E_{\gamma m}} \frac{f_\perp(\varepsilon)\, d\varepsilon}{\varepsilon}.$$

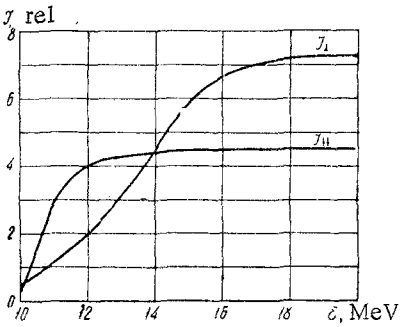

Fig. 1

Figure 1 shows $J_{\uparrow\uparrow}$ and $J_\perp$ as functions of $E_{\gamma m}$ for typical values of the position and width of the giant resonance in strongly deformed nuclei. Here the anisotropy is about 3% in the most favorable cases.

Nuclei near A = 25 have marked deformation, the most deformed being Mg-24 (ratio of semiaxes 1.8 : 1) [3], with $\beta = 0.67$. The anisotropy is about 27% for a line spectrum and 7% for a betatron spectrum ($E_{\gamma m}$ at the maximum of the giant resonance). The smallness of the effect for heavy nuclei (about 3%) makes it difficult to observe, whereas for A ≈ ≈ 25 the effect is large enough (about 7%) to be observable.

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SELECTION OF AN ABSOLUTE INTENSITY SCALE FOR RAMAN LINES

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Bernstein and Allen's formula [1] $S = \frac{(5b'^2 + 7g'^2)_{\Delta\nu}}{(5b'^2 + 7g'^2)_{459}}$ for the standard intensity is used for determining absolute Raman intensities; b' is the trace of tensor α' for the derivative of the polarizability with respect to the normal coordinate, g' being the anisotropy of that tensor. The unit of intensity on this scale is the quantity $(5b'^2 + 7g'^2)_{459}$ found for the 459 cm^{-1} line, whose absolute value is 34×10^{-8} cm^4/g [2]. If we use as standard the 802 cm^{-1} line of C_6H_{12}, the measure of the absolute intensity in the scale $S = \frac{(5b'^2 + 7g'^2)_{\Delta\nu}}{(5b'^2 + 7g'^2)_{802}}$ is $(5b'^2 + 7g'^2)_{802} = 24 \cdot 10^{-8}$ cm^4/g [3].

But uniform illumination of the vessel in a plane perpendicular to the axis (as in the standard elliptical illuminator) makes it preferable to use the scale $R = \frac{(5b'^2 + 13g'^2)_{\Delta\nu}}{(5b'^2 + 13g'^2)_{802}}$, because this ratio can be evaluated by experiment with-

out measuring the degree of depolarization ρ, which has to be measured in order to obtain S [1].

Naberukhin [4] (see also [5]) has shown that $f(\rho)$, the relation of the measured integral intensity to ρ and to the geometry of the illumination in an elliptical system, varies by not more than 4% for ρ from 0 to 6/7.

Placzek's theorem gives [1, 3] that

$$R=\frac{(5b'^2+13g'^2)_{\Delta\nu}}{(5b'^2+13g'^2)_{802}}=\frac{Q}{Q_{802}}\frac{n^2}{n^2_{C_6H_{12}}}\frac{\sigma}{\sigma_{802}}\frac{M}{d}\left(\frac{d}{M}\right)_{C_6H_{12}}\frac{\Delta\nu}{802}\left(\frac{\nu-802}{\nu-\Delta\nu}\right)^4\frac{f(\rho)}{f(\rho_{802})}. \quad (1)$$

Here Q is the area under the line, n is the refractive index of the liquid, σ is the spectral sensitivity of the photomultiplier, M is molecular weight, d is density, and $\Delta\nu$ is line frequency. It is simple to show that $f(\rho)/f(\rho_{802})$ and $f(\rho)/f(\rho_{459})$ may vary from 1 to 1.03 for the elliptical system for ρ between 0 and 6/7, so we may put $f(\rho)/f(\rho_{802})=1$, and R is virtually independent of ρ. This produces an error less than that from substituting in $f(\rho)/f(\rho_{802})$ for the measured ρ, because the latter have 5-10% error. All the other quantities on the right in (1) can be found by experiment.

To find S requires measurement of ρ, whereas to find R does not, so $(5b'^2+13g'^2)_{\Delta\nu}$ can be found without direct measurement of ρ (which is a difficult task). Also, the $(5b'^2+7g'^2)_{\Delta\nu}$ arising in the determination of S differs from $(5b'^2+13g'^2)_{\Delta\nu}$ in that the latter directly characterizes the absolute intensity, because Placzek's theory gives $I_{\Delta\nu}$ as proportional to $(5b'^2+13g'^2)_{\Delta\nu}$, not to $(5b'^2+7g'^2)_{\Delta\nu}$. Then $(5b'^2+13g'^2)_{802}=(5b'^2+7g'^2)_{802}(1+\rho_{802})=26\cdot10^{-8}$ cm^4/g, because $\rho_{802}=0.07$. Measurement of R gives us the absolute line intensities as

$$(5b'^2+13g'^2)_{\Delta\nu}=R\cdot26\cdot10^{-8}\ \text{cm}^4/\text{g}.$$

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BASIS FOR NEGLECTING OVERLAP INTEGRALS IN CALCULATIONS ON MOLECULAR SYSTEMS

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The most usual method in calculations on molecules, MO-LCAO, employs parameters calculated by Mulliken's method [1], which has the disadvantage of neglecting overlap integrals without giving a convincing reason for this. The basic equation in MO-LCAO may be put as

$$Fc_{j\kappa}=\varepsilon_j Sc_{j\kappa}, \quad (1)$$

in which F is the matrix for the Fok hamiltonian, S is the matrix for the overlap integrals, the $c_{j\kappa}$ are the coefficients in the expansion for the molecular orbital, and the ε_i are the energy levels.

The nondiagonal elements of (1) take the following form in the semi-empirical MO-LCAO method:

$$\beta_{i\kappa}-S_{i\kappa}\varepsilon_j, \quad (2)$$

in which

$$\beta_{i\kappa}=\frac{1}{2}S_{i\kappa}(\alpha_{ii}+\alpha_{\kappa\kappa}), \quad (3)$$

the α being the diagonal elements.

We see from (2) and (3) that both terms in (2) are of the same order in S, so it would seem impossible to neglect