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# ON THE ZERO-POINT GOLDHABER-TELLER (GT) MOTION

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In ref.[1] a beautiful model-independent interpretation of the bremsstrahlung weighted photoabsorption cross-section $\sigma_{-1}$ has been given : $\sigma_{-1} \equiv \int (\sigma(\omega)/\omega)d\omega = (4/3)\pi^2(e^2/\hbar c)(NZ/A)^2 \langle 0|r_{ZN}^2|0\rangle$ where $\vec{r}_{ZN}$ is the relative coordinate of the center of mass of protons with respect to the center of mass of neutrons. The above equation tells that $\sigma_{-1}$ is a direct measure of the GT zero-point motion. We analyse the experimental data to extract the amplitude of this motion (see table). From the experimental knowledge of $\sigma_{-1}$ [2] (first column) is extracted the value of $\langle r_{ZN}^2\rangle^{1/2}$ (second column). The ratio R of $\langle r_{ZN}^2\rangle^{1/2}$ to the experimental charge root mean square radius $r_c$ (third column) is given in the fourth column. The fifth column gives the following estimation of R : take $H_{ZN} = (p^2/2\mu) + (1/2)\mu\Omega^2 r_{ZN}^2$ to describe the relative proton-neutron motion, with $\mu = (NZ/A)m \simeq (A/4)m$ and $\hbar\Omega \simeq 79\ A^{-1/3}$ MeV in agreement with the systematics on the GDR. One obtains $\bar{R} = 1.87\ A^{-2/3}$, shown on the fifth column, in good agreement with the value of R extracted from experiment. The last column ($R_{GDR} = \sqrt{5/3}\ R$) corresponds to the ratio of the root mean square radius of proton-neutron motion of the GDR to $r_c$. For light nuclei, R and $R_{GDR}$ are large and therefore there are good chances that during the dipole oscillation proton and neutron distributions have a relatively small overlap. One can then imagine that the study of the deexcitation of the GDR of light nuclei may provide information on, for instance, neutron-neutron correlations. In particular, the possibility to observe multineutron bound states in this way should be explored (in $^7$Li, for which $R_{GDR}$ is 0.68, the 2n threshold is at 10.9 MeV and the 3n is at 31.5 MeV, not too far from the GDR).

| | $\sigma_{-1}$ (mb) | $\langle 0\|r_{ZN}^2\|0\rangle^{1/2}$ (fm) | $r_c$ (fm) | R | $\bar{R}$ | $R_{GDR}$ |
|---|---|---|---|---|---|---|
| $^7$Li | 4.64 | 1.28 | 2.41 | 0.53 | 0.51 | 0.68 |
| $^9$Be | 5.19 | 1.05 | 2.51 | 0.42 | 0.43 | 0.54 |
| $^{12}$C | 8.81 | 1.01 | 2.45 | 0.41 | 0.36 | 0.53 |
| $^{16}$O | 14.50 | 0.97 | 2.72 | 0.36 | 0.29 | 0.46 |
| $^{40}$Ca | 45.5 | 0.69 | 3.48 | 0.20 | 0.16 | 0.26 |
| $^{90}$Zr | 70.6 | 0.39 | 4.28 | 0.09 | 0.09 | 0.12 |
| $^{208}$Pb | 229.2 | 0.31 | 5.50 | 0.06 | 0.05 | 0.07 |

[1] A. Dellafiore and D.M. Brink, Nucl. Phys. A286 (1977) 474.
[2] J. Ahrens et al., Nucl. Phys. A251 (1975) 479 ; R. Bergère in "Lecture Notes in Physics", Vol. 61, Springer-Verlag.

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