**Isoscalar dipole strength distributions in nuclei and the Schiff moment**

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In a recent paper [1] it was pointed out that the isoscalar dipole (ISD) resonance could have a substantial contribution to the nuclear Schiff moment whose operator is the same as the operator commonly used in the study of the ISD strength distribution. The value of the Schiff moment is central to the measurement of time reversal violation in an atom. The mechanism considered in Ref. [1] finds that the Schiff moment in odd-even nuclei *is proportional to the inverse energy weighted sum (IEWS) of the ISD strength distribution* in the even-even core and therefore the Schiff moment is quite large when the contribution of the ISD is included. The odd nucleon couples to the $0^+$ ground state and to the $1^-$ dipole strength. States with the same angular momentum, J, but opposite parity, mix via an assumed time reversal and parity violating interaction. As a result one finds a non-zero Schiff moment. That Schiff moment induces in the atom parity and time reversal mixing which in turn produces a static electric dipole moment of the atom which is measured in experiment.

The commonly used operator for the ISD is defined as [1]:

$$D = \sum_i (r_i^2 - \frac{5}{3} < r^2 >) \mathrm{r}_i , \qquad (1)$$

while *the isoscalar* part of the Schiff operator is defined as [1]:

$$S = \frac{1}{10} \sum_i (r_i^2 - \frac{5}{3} < r^2 >) \mathrm{r}_i , \qquad (2)$$

Thus the two operators, apart from normalization, are the same. The Schiff moment is the ground state expectation value of the Schiff operator in an odd-even nucleus in the presence of a time reversal violating interaction [1]. The Schiff strength distribution we are discussing in this work is related to the even-even nucleus. The Schiff moment that is relevant to the measurement of the static atomic dipole moment is the one that is present in the odd-even nucleus

We have carried out fully self-consistent HF-RPA calculations, using 18 commonly employed Skyrme type interactions [2], for the strength functions and corresponding inverse energy moments of the isocalar dipole (ISD) for various nuclei using a probing operator which is the same as the Schiff operator up to a normalization.

In Fig. 1 we display the HF-based RPA results for the strength function divided by the energy, S(E)/E, of the ISD, in $^{90}$Zr, $^{104}$Zr, $^{144}$Sm, and $^{208}$Pb calculated [2] using the KDE0v1 Skyrme interaction.

Note the relatively large contribution to moment $m_{-1}$ from the low energy region, in particular in the case of neutron rich nuclei.

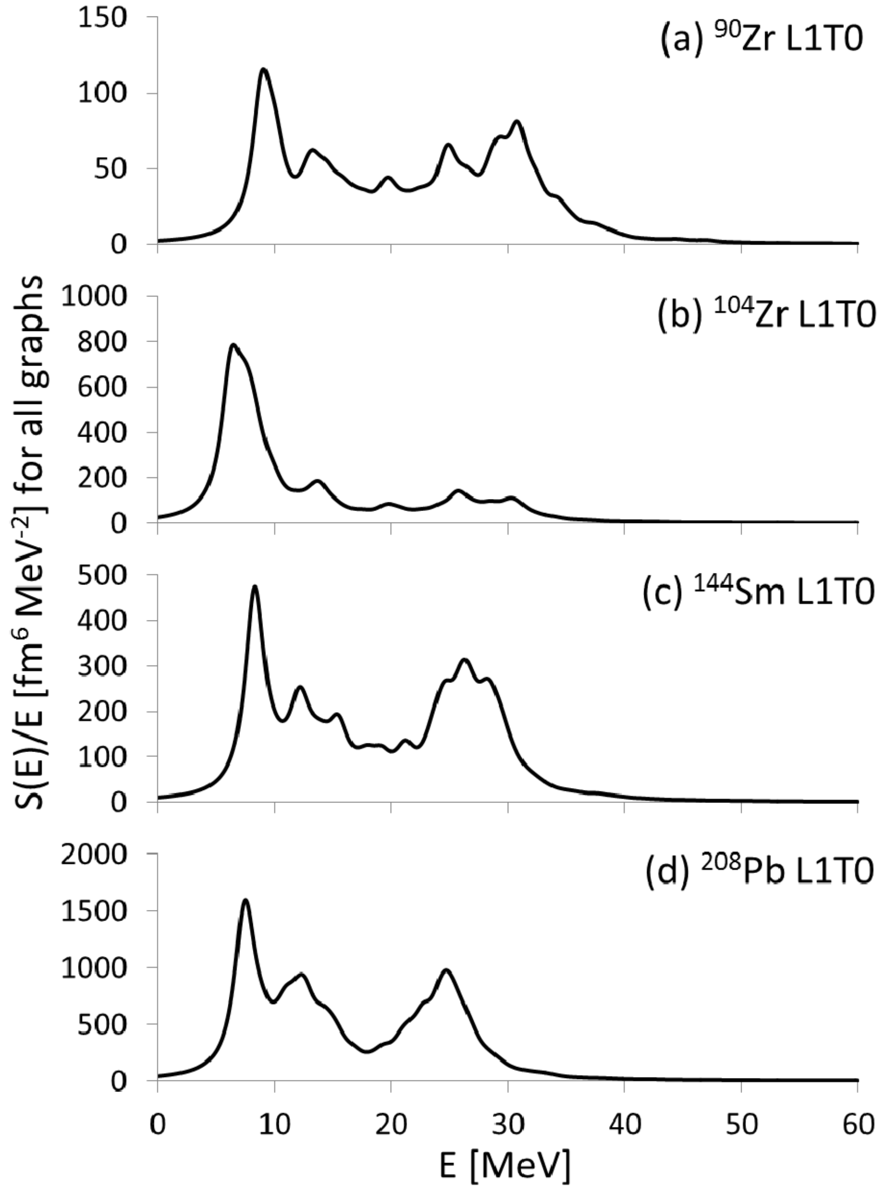


**FIG. 1.** Self-consistent HF-based RPA results for the distribution of the strength function divided by the energy, S(E)/E, of the isoscalar dipole, obtained for the $^{90}$Zr, $^{104}$Zr, $^{144}$Sm, and $^{208}$Pb nuclei, calculated [2] using the KDE0v1 Skyrme interaction. An excitation energy range of 0-60 MeV and Lorenzian smearing of a 2 MeV width were used in the calculation


[1] N. Auerbach and V. Zelevinsky, Phys. Rev. C **86**, 045501 (2012).

[2] N. Auerbach, Ch. Stoyanov, M.R. Anders and S. Shlomo, Phys. Rev. C **89**, 014335 (2014).