Comment on "Spreading widths of giant resonances in spherical nuclei: Damped transient response"

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We argue whether the physics of the general approach of Severyukhin *et al.* [Phys. Rev. C **95**, 061305(R) (2017)] is appropriate.

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A so-called general approach (GA) to describe the spreading widths of giant resonances (GRs) in atomic nuclei has been proposed recently in Ref. [1]. We discuss below its physical content.

One reads in the summary that the authors "suggest a way to describe spreading widths of GRs by including the coupling between one- and two-phonon states" [1]. This idea already belongs to well-established knowledge; it has been employed by many nuclear models for almost half a century.

Severyukhin *et al.* suggest generating the coupling matrix elements V^{1ph}_{2ph} between one-phonon (1ph) and two-phonon (2ph) states by means of the random distribution in the Gaussian form [1].

Distribution of the matrix elements V^{1ph}_{2ph} and their role in fragmentation of the giant quadrupole resonance strength have been analyzed in Refs. [2,3]: They have been divided into two subspaces:

(i) a large subspace with V^{1ph}_{2ph} following the Gaussian distribution (plus very small matrix elements which play a marginal role in the fragmentation process) and
(ii) a small subspace with large V^{1ph}_{2ph} values above the Gaussian tails (see Fig. 4 in Ref. [2] or Fig. 20 in Ref. [3]).

It has been demonstrated that, although a large part of the matrix elements V^{1ph}_{2ph} does follow the Gaussian distribution, the fragmentation of the doorway GR states "is dominated by the collective mechanism" [2], i.e., determined by the matrix elements from group (ii) (see, e.g., Fig. 3 in Ref. [2]).

The GA suggests neglecting the most important matrix elements from group (ii) in favor of the less important ones from group (i). As a result, the GA calculations in Ref. [1] confirm [4] the observation in Refs. [2,3]. At the same time, they are at variance with the conclusion in Ref. [1] that the GA enables "to describe a gross structure of the spreading widths of the giant resonances."

To conclude: Any interaction between doorway and background states yields a fragmentation pattern; any distribution has its width. But this alone is not sufficient to claim that the GA is capable of describing the width of the giant resonances. The general approach by Severyukhin *et al.* [1] appears to miss the main physical contribution to the width formation.

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[4] The widths in "Random" are substantially smaller as compared to the ones of phonon-phonon coupling (PPC) for the isoscalar giant monopole resonance (ISGMR) and isoscalar giant quadrupole resonance (ISGQR) (see Table I in Ref. [1]), see also [5].
[5] The isovector giant dipole resonance (IVGDR) width is determined by the Landau damping [compare to the random-phase approximation (RPA) in the same Table I].

