Reply to the Comment on 'Pygmy dipole response of proton-rich argon nuclei in random-phase approximation and no-core shell model'.

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In Ref. [1], we have considered the distribution of low-lying dipole strength in proton rich nuclei, in order to investigate possible differences between the standard random phase approximation (RPA) and the shell model description of the response. The ^{32}Ar and ^{34}Ar isotopes were studied, in view of upcoming experimental data. Our approach was recently questioned by Paar in [2]. In particular, this Comment is based on general critics against the V_{UCOM} interaction and its use in nuclear structure calculations. Understanding the limits and merits of V_{UCOM} (and other low-energy interactions) is certainly important to nuclear structure. A full discussion of these issues would also benefit from the involvement of those colleagues directly engaged in their development. At the same time, we retain that the V_{UCOM} interaction was sufficiently accurate for our purposes. In the following, we respond to the comments raised in Ref. [2].

Before discussing the choice of the interaction, the following comments are in order. The term "Pygmy" has been used in the literature to simply indicate the simple presence at low-energy of dipole strength. The information that can be accessible from the experiment are: (i) the location of dipole strength at low energies and (ii) the transition densities.Ref. [1] then focused solely on these two quantities. The Comment [2], suggests that the term "Pygmy resonance" should be reserved only to the cases in which the collective nature of the excitation is demonstrated. One may note, however, that arguments as those based on the number of particle-hole configurations needed to construct a given excited state may depend on the choice of the single particle basis.In the unfortunate event where two models describe the same data but with different internal structures, there would be no clear way to discern among them. A similar situation has been reported for the ^{208}Pb and ^{120,132}Sn isotopes [3].

The V_{UCOM} interaction with the HF+RPA approximations has been found in disagreement with data on *stable* nuclei. In particular, the gaps at the Fermi surface are obtained too large [4, 5], which translates in overestimating the energy of giant dipole resonances (GDR) [6]. Our calculations confirm these results. However, we found a different situation close to the dripline, where the relevant degrees of freedom become dominated by the proximity to the continuum. The GDR results from collective excitations of occupied orbits into unoccupied states of the next shell of different parity. Near the driplines, the valence nucleons have a few MeV separation energy at most (2.13 MeV in our HF calculation for ^{32}Ar, compared to the experimental value of 2.40 MeV). The next shell is found in the continuum and is dominated by the kinetic energy. This allows generating a pygmy-like peak at low energies and can lower the GDR sensibly. Correspondingly, it was found that applying the V_{UCOM} force to proton rich Ar isotopes leads to an RPA description of the dipole response which is: (i) in qualitative agreement with the systematic of dripline nuclei (a low-energy pygmy peak and a giant resonance), and (ii) in good quantitative agreement with other theoretical predictions for the same nuclei [7] (no experimental data is yet available). The same interaction was then applied in shell model calculations and a reduction of the low-energy dipole strength with respect to RPA was found. This is our main result.

As noted in the conclusions of Ref. [1], second RPA (SRPA) calculations with V_{UCOM} sensibly lower the GDR. Hence, they tend to cure the discrepancy with data [8]. This is of course the experience with stable nuclei. The behavior of SRPA at the driplines is still an open question and the vicinity to the continuum is likely to affect this case as well. For the case of the shell model, including up to 2p2h configurations, no change in the energy of the pygmy peak and GDR was found.

In conclusion, the aim of Ref. [1] is the question is whether there is a change in the low-energy dipole distribution when one includes more correlations than in RPA. For the particular cases of the isotopes under study, V_{UCOM} was found to give a sufficiently realistic RPA response. Furthermore, this interaction is readily accessible for calculation with both the RPA and the shell model. It was then used to carry out first shell model calculations of low-energy dipole response at the proton dripline.

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