Comment on "Heavy Cluster Knockout Reaction $^{16}O(^{12}C, 2^{12}C)^4He$ and the Nature of the ^{12}C-^{12}C Interaction Potential"

In a recent Letter and subsequent Erratum [1] it was claimed that the heavy cluster knockout reaction was observed in the $^{16}O(^{12}C, 2^{12}C)^4He$ measurement at a beam energy of 118.8 MeV. From the comparison of the experimental data (only one spectrum) with the predictions of three impulse approximation approaches, far reaching conclusions were made on the nature of the ^{12}C-^{12}C interaction potential. The aim of this Comment is to show that the claim and conclusions could not be made from the presented data.

The main problem of the Letter is the claim that most of the events in the energy spectrum on Fig. 4 of the Letter (and Fig. 1 here) are the result of the heavy cluster (^{12}C) knockout reaction from the ^{16}O target nuclei. It is forgotten that in this three-body reaction there are other processes leading to the same final state, like sequential ones going through the intermediate states of ^{16}O and ^{24}Mg nuclei. Even if one may neglect the processes through ^{24}Mg excited states at high excitations populated in the measurement, the same must not be done with the processes involving unbound states of ^{16}O. Energies in the α-^{12}C pairs cover excitations in the compound ^{16}O system from 11.5 to 29 MeV in one pair and from 34.6 to 14.5 MeV in the other. In this energy range *more than hundred* ^{16}O states have been established, many of them decaying into the α-^{12}C channel [2]. Energies where contributions are expected from the states with the largest alpha-spectroscopic factors are marked in Fig. 1.

Very strong contributions of the sequential processes through the ^{16}O states at excitations around 11, 15, and 21 MeV observed in the $^{12}C(^{16}O, 2^{12}C)^4He$ reaction measured at similar energies (e.g. [3–5]) point to the importance of the processes in the present case, too. An unsuccessful attempt to correct the Letter by estimating their contributions is presented in the Erratum. First of all there is *no successful theoretical description* of heavy ion three-body reactions involving intermediate nuclei at higher excitations with many, very often overlapping states like in this case. In the Erratum a very simplified approach for the estimate is used by considering scattering to only some ^{16}O states as if they were bound. However, the direct inelastic formalism [6] used there does not take into account the α-particle transfer between ^{12}C and ^{16}O nuclei, contributions of which become important for the experiment's geometry (c.m. angles around 100°) and especially for the states with prominent α-^{12}C structure. Also, a large number and variety of the states are ignored as well as the angular correlation of the decay products. Because of all this one cannot take seriously the estimate from the Erratum and one has no reason to downplay the role of the sequential process through the ^{16}O states which contributions were found to be predominant in the energy spectra from many experiments.

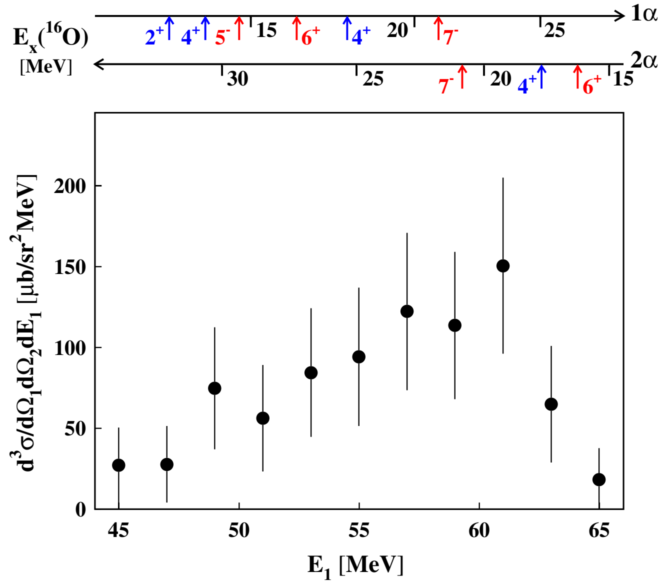

FIG. 1 (color online). The spectrum from the Letter [1], with additional axes giving the ^{16}O excitation energies in two α-^{12}C pairs. The arrows show the positions of the ^{16}O known members [2] of rotational bands with the $^{12}C + \alpha$ structure (red), and of the other states having large alpha-spectroscopic factor (blue).

To conclude, the task to extract the cluster knock-out process contribution from the presented data is unfeasible and any conclusion about the nature of the ^{12}C-^{12}C interaction potential based on the published spectrum should be considered arbitrary. In any future search for the heavy cluster knockout process, systematic measurements with good energy resolution and high statistics are essential. In particular, measurement of the momentum distribution of spectator particles can be an important test of the dominance of the knockout process.

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