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# Break up reactions with exotic nuclei and the impact of core excitations: from $^{19}$C to $^{31}$Ne

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A successful and widely used tool for the understanding of halo nuclei has been the analysis of nuclear reactions within few-body reaction formalisms. In these analyses, one-neutron halo nuclei are treated as a valence-core two-body system assuming an inert core. This assumption is satisfied for the traditional one- and two-neutron halo nuclei like $^{11}$Be, although some evidences of core excitations can be found in its scattering.

Present developments in radioactive beam facilities allows us to find new halo nuclei farther and farther from the stability line. These new cases will present more complex cores whose excitations will have an impact on the final cross sections. Recently, a great effort has been made in order to introduce the effect of a non-inert core in few-body reaction formalisms giving rise to the extensions of the DWBA (NR-XDWBA), the Faddeev/AGS equations and the CDCC (XCDCC).

However, rather than a problem, it can turn into a great opportunity to deepen our knowledge of these new features. In this contribution we show how the inclusion of core excitations in the analysis of resonant break up opens the possibility of extracting spectroscopic information of the resonances of exotic nuclei [PRL109, 232502]. Experimental data for the break up of $^{19}$C and $^{23}$O on protons at intermediate energies [PLB660, 320 (2008); FBS54, 287 (2013)] will be analysed within XCDCC and NR-XDWBA. It will allow us to infer the structure of the resonances measured in $^{19}$C and $^{23}$O.

Finally, the electromagnetic excitations of the core may compete with the dipole polarization of the halo nuclei. We will show how this affects to the study of halo nuclei through Coulomb dissociation and the extraction of the dipole electromagnetic transition probability B(E1) of $^{19}$C and $^{31}$Ne.

We apply the recent extensions of the DWBA and CDCC including core excitations to analyze the resonant break up of $^{19}$C and $^{23}$O measured in [PLB660, 320 (2008); FBS54, 287 (2013)]. It allows us to infer structure information on the corresponding resonances of $^{19}$C and $^{23}$O. Strong evidences of core excitations in the present data are found. We also consider the effect of these core excitations in the Coulomb dissociation of halo nuclei. We conclude that it is compulsory to consider possible excitations of the core for the proper extraction of the B(E1) in halo nuclei like $^{19}$C and $^{31}$Ne.



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