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Unbound states in ^{16,18,20}C with the R^{3}B/LAND setup: the search for the mixed-symmetry 2^+ state

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The evolution of the traditional nuclear magic numbers away from the valley of stability has gathered attention in recent years. Experimental efforts focus on obtaining key spectroscopic information that will provide great insight into the structure of exotic nuclei in order to understand the driving mechanism behind the shell evolution.

Recently, ^{A}N(p,2p)$^{A-1}$C quasi-free scattering reactions, employed at the R3B/LAND setup at GSI, extracted the proton component of the 2^+_1 state of ^{16,18,20}C in order to probe the proton $1p_{1/2}-1p_{3/2}$ spin-orbit splitting towards the neutron dripline. These results reported a moderate quenching of the Z=6 sub shell closure [1].

We work upon the model of a two-state mixing of pure proton and pure neutron excitations to describe excited 2^+ states in neutron-rich carbon isotopes [2,3]. The coupling of the unperturbed proton and neutron 2^+ states should give rise to a second 2^+ state of mixed symmetry character, expected to be unbound and strongly populated via (p,2p) reactions. This work focuses on identifying these strongly populated unbound mixed-symmetry 2^+ states in ^{16}C, ^{18}C and ^{20}C. The preliminary results of this work will be presented, and its implications for the Z=6 shell gap will be discussed.

[1] I. Syndikus et al., Probing the Z = 6 spin-orbit shell gap with (p,2p) quasi-free scattering reactions, Physics Letters B (2020).
[2] M. Petri et al., Phys. Rev. C. 86, 044329 (2012).
[3] A. O. Macchiavelli et al. Phys. Rev. C 90 067305 (2014).

Topic

Experiment

Authors: PETRI, Marina; MURILLO MORALES, Silvia (University of York)

Presenter: MURILLO MORALES, Silvia (University of York)

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