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Investigation of isovector valence-shell excitations in nuclei around the N=82 shell closure

A particular interest in contemporary nuclear structure research is the impact of the local shell structure on the proton-neutron mixing in low-energy quadrupole states at the onset of collectivity near neutron shell closures. In near-spherical nuclei, the two simplest quadrupole-collective excitations can be understood as a mixture of the collective 2^+ proton and 2^+ neutron excitations. The symmetric (isoscalar) coupling appears as the 2^+_1 state while the antisymmetric (isovector) one forms the so-called $2^+_{1,ms}$ state with mixed proton-neutron symmetry. Based on the evolution of these states in the $N = 80$ isotonic chain it has been suggested that the properties of the mixed-symmetry states are sensitive to the underlying subshell structure. In particular, the observed fragmentation of the $2^+_{1,ms}$ of ^{138}Ce has been explained as due to the absence of a mechanism dubbed shell stabilization [1]. This then requires contributions from active proton configuration in both, the $1g_{7/2}$ and $2d_{5/2}$ proton orbitals, and thus leads to fragmentation of low-lying quadrupole phonon excitations at $Z = 58$.

In order to examine further the effect of shell stbailization of the MSSs it is necessary to quantitaively identify and study the properties of these states in the next heavy $N = 80$ isotones beyond $Z = 58$ - ^{140}Nd and ^{142}Sm. This was the main goal of the IS546 experiment run in October 2017. Preliminary results from the experiment for both isotones will be shown and discussed.

Authors: KERN, Ralph Otto (Technische Universitaet Darmstadt (DE)); STEGMANN, Robert (Technische Universitaet Darmstadt (DE)); RAINOVSKI, Georgi Ivanov (University of Sofia (BG)); PIETRALLA, Norbert (IKP, Technische Universität Darmstadt)

Co-authors: CUBISS, James Gerald (University of York (GB)); GAFFNEY, Liam (CERN); GLADNISHKI, Kalin (University of Sofia (BG)); KARAYONCHEV, Vasil (Universitaet zu Koeln (DE)); SODERSTROM, Par-Anders (Technische Universitaet Darmstadt (DE)); SPAGNOLETTI, Pietro Nicola (UWS - Univ. of West of Scotland (GB)); VOGT, Andreas (Universitaet zu Koeln (DE)); WARR, Nigel Victor (Universitaet zu Koeln (DE)); WELKER, Andree (Technische Universitaet Dresden (DE)); WERNER, Volker Ralph (Technische Universitaet Darmstadt (DE)); WIEDERHOLD, Johannes Christoph (Technische Universitaet Darmstadt (DE)); ZIDAROVA, Radostina

Presenter: KERN, Ralph Otto (Technische Universitaet Darmstadt (DE))

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