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

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The two-fluid nature of nuclear matter leads to the existence of special excited states which are symmetric or partially anti-symmetric with respect to the relative contributions of the two components of the system, protons and neutrons. These latter states are called proton-neutron mixed-symmetry states (MSSs) [1,2]. The fundamental MSS of weakly collective vibrational nuclei is the one-quadrupole phonon $2^+_{1,ms}$ state [1]. It is intended to identify these states in three related nuclei near the $N = 82$ shell closure. Due to their isovector character, MSSs decay rapidly by magnetic dipole transitions and are comparatively short lived. Investigating FSS and MSS of weakly collective nuclei provides insight in the effective proton-neutron interaction in the nuclear valence-shell.

It is proposed to perform Coulomb excitation experiments on beams of radioactive ions delivered by HIE-ISOLDE that differ by two neutrons from the $N = 82$ magic number: $^{136}$Te, $^{140}$Nd, $^{142}$Sm. Scattered particles will be detected by a DSSSD detector and $\gamma$ rays will be detected by the MINIBALL array. In $^{136}$Te the proposed Configurational Isospin Polarization (CIP) [3] effect will be determined by measuring the E2 excitation yield distribution to the two lowest $2^+$ states. The expected proton-dominated one-phonon character of the second excited $2^+$ state of $^{136}$Te will be tested on the basis of absolute electromagnetic matrix elements from the observed Coulomb excitation cross sections. Complementary lifetime information on this predominant $2^+_{1;ms}$ state will be extracted using the differential DSAM technique. The experiment will clarify to what extent CIP is responsible for the $2^+$ anomaly in $^{136}$Te [4].

We will further investigate the microscopic mechanism which leads to a concentration or a fragmentation of the quadrupole-collective isovector valence-shell excitations, an effect called \textit{shell stabilization} of MSSs [4]. This aim will be achieved by identification of MSSs of the unstable nuclei $^{140}$Nd and $^{142}$Sm. The first steps of this program have been undertaken in two runs of the experiment IS496 in which we have measured the $B(E2; 2^+_1 \to 0^+_1)$ transition strengths in these radioactive nuclei [6,7]. The program will be completed by finally identifying the MSSs of these nuclei from E2 and M1 strengths measured relative to the population of the first $2^+$ states in Coulomb excitation (CE) reactions.

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