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Isospin Symmetric Island of inversion at the N=Z line

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The development of collectivity along the N = Z is one of the subjects that has recently attracted great experimental efforts. In particular, heavy N=Z nuclei in the mass region A=80 are expected to be some of the most deformed ground states which have been found [1] in mid-mass nuclei, typically 8p–8h, 12p–12h for e.g. the cases of 76Sr, 80Zr. This strong enhancement of collectivity with respect to lighter N=Z nuclei has its origin in cross shell excitations across the N=40 shell gap to g9/2, d5/2 and s1/2 which are intruder quadrupole partners generating deformations. These structures can be interpreted in terms of algebraic Nilsson-SU3 self-consistent model to describe the intruder relative evolution in the vicinity of 80Zr [2]. In this presentation, we will expose some of the latest developments in microscopic nuclear structure calculations for exotic nuclei far from stabilitity at the N=Z [3]. The new theoretical calculations for the very region of 80Zr will be presented for the first time within the interacting shell model framework using an enlarged model space outside a 56 Ni core comprising the pseudo-SU3 p3/2f5/2p1/2 and quasi-SU3g9/2d5/2s1/2 orbitals for both protons and neutrons. We will present and compare results from both exact Shell Model diagonalization [4] and our newly developed DNO Shell Model approach employing beyond mean field techniques [5]. These theoretical calculations allow a very good description of the rapid transition (A=60–100) from spherical to deformed structures which can be intepreted in terms of "simple" many particles - many holes configurations. The whole Island of Collectivity in the region and sudden shape change recently observed between 84Mo and 86Mo is interpreted as an effect on the N = 50 gap induced by the addition of the two neutrons, a fingerprint of three-body forces.

[1] R. D. O. Llewellyn et al., Phys. Rev. Lett. 124, 152501 (2020).
[2] A. P. Zuker et al., Phys. Rev. C 92, 024320 (2015)
[3] D. D. Dao, F. Nowacki, A. Poves in preparation
[4] E. Caurier, G. Martínez-Pinedo, F. Nowacki, A. Poves, and A. P. Zuker, Rev. Mod. Phys. 77, 427 (2005).
[5] D. D. Dao and F. Nowacki, Phys. Rev. C 105, 054314 (2022).

Collaboration

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