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The three shapes of ^{32}Mg

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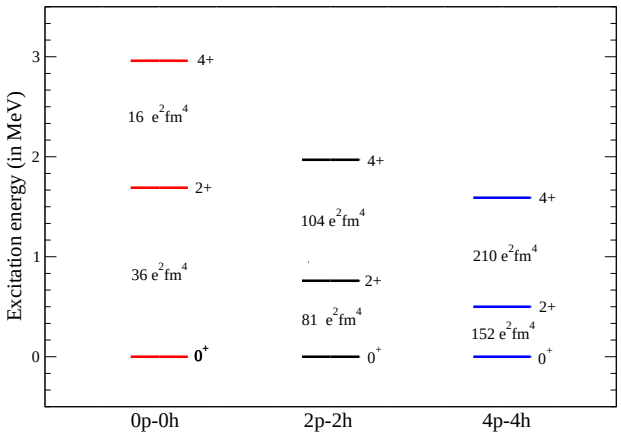
What is the driving force behind the abrupt changes leading to the appearance of the "islands of inversion"? What makes these intruder states so special? That they need to be highly correlated in order to compensate for the energy loss associated to the breaking of the normal filling of the spherical mean field. Obviously, small gaps are easier to overcome, thus a reduction of the neutron magic gaps at the very neutron rich edge is good news for the intruders. Let us concentrate in the N=20 case. Compared to the configurations with closed N=20, the intruders (np-nh) have neutrons in open sd and pf-shell orbits and in some cases protons in open sd- shell orbits. This activates the neutron-proton quadrupole interaction, which can build up correlations very efficiently if the open orbits are the appropriate ones. And whose are those is dictated by the different SU(3) variants. To get large coherence the neutrons and the protons must be in one or another of these schemes. In the N=20 intruders, the neutrons in the orbits $0f_{7/2}$ and $1p_{3/2}$, and the protons in $0d_{5/2}$ and $1s_{1/2}$ are in the Quasi-SU(3) regime and the neutrons in $0d_{3/2}$ and $1s_{1/2}$ in Pseudo-SU3.



These statements can be made quantitative, for instance in the case of ^{32}Mg. We first do calculations at fixed N$\hbar\omega$. The results are presented in the figure. We found the semimagic 0p-0h result, with a high excited 2^+ and a low B(E2); the rotational-like 2p-2h whose B(E2) corresponds to β=0.3 and finally the perfect rigid rotor 4p-4h with E(4^+)/ E(2^+)=3.2 and a huge B(E2) that corresponds to a super-deformed structure. A crucial issue is that the gains in energy due to the correlations are very different in the 0p-0h, 2p-2h and 4p-4h spaces; 1.5 MeV, 12.5 MeV and 21 MeV respectively. These huge correlation energies may eventually overcome the spherical mean field gaps. In fact this is the case in ^{32}Mg. With the effective interaction sdpf-u-mix, the lowest 2p-2h 0^+ state is degenerate with the lowest 0^+ of the 4p-4h space and both are 1 MeV below the 0^+ of the 0p-0h configuration. We will show that in the fully mixed calculation the three states are necessary to understand the ground state band and the extremely low excited 0^+ state recently found at Isolde.