Onset of collectivity in Neutron-Rich iron isotopes: Toward a new island of inversion?

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The lifetimes of the first excited 2^+ states in ^{62}Fe and ^{64}Fe have been measured for the first time using the recoil-distance Doppler shift technique. A ^{238}U beam of 6.5 AMeV impinged on 64Ni target, and the target like products were slowed down by degrader foil positioned at micrometer distance downstream of the target and identified in the VAMOS spectrometer on an event-by-event basis. The lifetimes were then determined from the intensities of the degraded and fully Doppler shifted components of the $2^+ \rightarrow 0^+$ transition detected in EXOGAM detectors positioned at backward angles.

The resulting lifetimes show a steep increase of the B(E2) values of the first excited 2^+ state from ^{62}Fe to ^{64}Fe. A comparison with shell model calculations shows that the onset of collectivity is related to the occupation of neutron intruder orbitals. The large B(E2) value for ^{64}Fe is only reproduced if the valence space includes both the neutron $g_{9/2}$ and $d_{5/2}$ orbitals. The transition from spherical ^{68}Ni to more proton-deficient N 40 isotones has some similarity with the island of inversion around ^{32}Mg. The developing quadrupole collectivity can in both cases be related to the occupation of neutron intruder orbitals which are at the same time quasi-SU(3) partners: ($f_{7/2}$, $p_{3/2}$) for ^{32}Mg and ($g_{9/2}$, $d_{5/2}$) for the neutron-rich Fe.

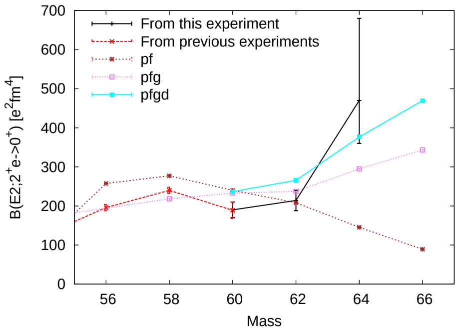

Figure 1: *$B(E2; 2^+_1 \rightarrow 0^+_1)$ values for neutron-rich iron isotopes. Values from this work are shown in black. New shell-model calculations clearly show the importance of the $g_{9/2}$ intruder orbital and its $d_{5/2}$ quadrupole partner.*