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Séminaire

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Isospin Symmetry and E1 Transition Strengths in Mirror Nuclei

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The investigation of mirror nuclei along the N = Z line is of considerable interest since it directly addresses the validity of the charge symmetry of the nuclear forces and the role of the Coulomb effects on the nuclear structure. It also allows probing calculated isospin mixing corrections, which are indeed essentials for the precise determination of the ud quark mixing matrix element and in general for the unitarity of the CKM matrix. In the limit of long wavelengths, where the Siegert theorem holds, the E1 transition operator is purely isovector. If the charge symmetry of the nuclear force is exact, E1 transitions between states of equal isospin are forbidden in N=Z nuclei and have equal strength in mirror nuclei. Experimental deviations from the two rules above can, therefore, be used to investigate isospin symmetry breaking. We have recently investigated isospin conservation in the A=31 mass region through the comparison of the E1 strengths of the transitions depopulating the 7/2- analog states in the mirror nuclei 31S and 31P. Mirror E1 transitions $7/2^-_1 \rightarrow 5/2^+_{1,2}$ clearly show different strengths. To verify if the observed different intensities of those transitions in both nuclei correspond to different B(E1) values, the knowledge of the branching ratios of the transitions deexciting the states of interest, their M2/E1 mixing ratios and the lifetimes of the two analog states are required. To achieve this goal angular correlation of coincident γ-rays and Doppler-shift attenuation lifetime measurements have been performed for this two nuclei at the Legnaro National Laboratories. The comparison of the B(E1) strengths in the two mirror transitions indicates a violation of the isospin symmetry, manifested by the presence of a large induced isoscalar component. Self-consistent calculations using the $NNLO_{sat}$ and using the Equation of Motion Phonon Method reproduce well the experimental findings, confirming the breaking of the isospin symmetry originating from the violation of the charge symmetry of the two- and three- body parts of the potential. The result provides evidence for a coherent contribution to isospin mixing, probably involving the isovector giant monopole resonance. A microscopic description of the mixing of isospin within the EMPM approach using the isospin formalism for expressing the hole- phonon basis is ongoing.