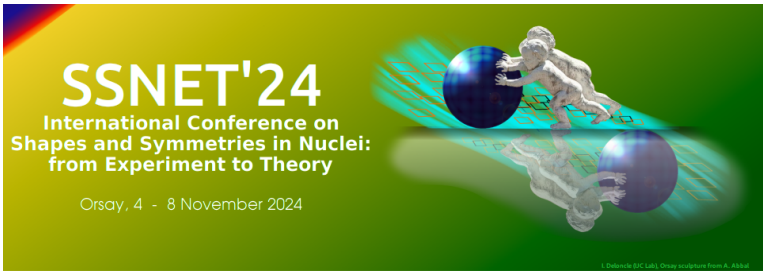

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Vibrations or Coexistence? The Nature of 0+ States

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Transfer reactions at the high-precision Q3D spectrometer at the University of Munich have shown that there are many low-lying excited K=0+ states in well-deformed nuclei. Historically, 0+ states were difficult to measure and hindered testing and verification of numerous nuclear models due to the absence of the predicted and essential 0+ states. This entire process changed, since starting in 2002, one of the first Q3D measurements showed the existence of 13 0+ states [1] in one nucleus below 3.1 MeV. This work was followed by many others to reveal that in some cases, tens of 0+ states exist in the low-lying structure of numerous deformed nuclei. The discovery of these states and their characterization continues to be a lively contributor to the discussions and debates between coexistence and vibrational collectivity.
In the many instances where several 0^+ states were identified, we have followed investigations with lifetime measurements where possible using a variety of techniques and developed criteria for assigning the nature of these states using both transition probabilities, moments of inertia if the members of the bands built on these 0+ states could be identified, and reaction cross sections [(p,t) and (t,p)]. We have focused on the Z=50-82 region of the chart of nuclides and correlate these with the shape evolution of nuclei from spherical shapes near the closed shells, to deformed in the middle of the shells. We compare the experimental results with the universal CHFB+5DCH theoretical calculations [2] for the entire chart of nuclides and show some specific examples within the IBA [3].
References:
[1] S.R. Lesher et al., Phys. Rev. C 66, 051305 (R) (2002)
[2] J.P. Delaroche et al., Phys. Rev. C 81, 014303 (2010)
[3] R. Bijker and J. Mas Ruiz, Conference Proceedings of Simposia Fisica Nuclear, in press (2024)

Auteur principal: APRAHAMIAN, Ani (University of Notre Dame, USA)

Co-auteurs: Dr LEE, Kevin (University of Notre Dame); Prof. BIJKER, Roelof (Universidad National Autonoma de Mexico); Prof. LESHER, Shelly (University of Wisconsin La Crosse)

Orateur: APRAHAMIAN, Ani (University of Notre Dame, USA)

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