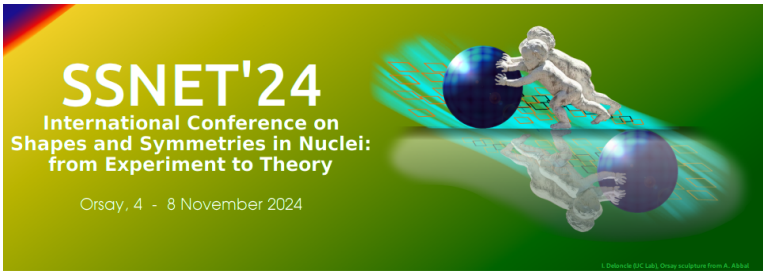

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Nuclear Shape-Phase Transitions: Analytical Insights with a Sextic Oscillator Potential

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This study examines the use of a sextic oscillator in the degree of freedom of the Bohr Hamiltonian to understand critical point solutions in nuclear transitions from spherical to deformed forms. We begin by examining critical point solutions such as E(5), which model the degree of freedom using an infinite square-well (ISW) potential. This model is essential for examining phase transitions in nuclear forms, and differs mainly in its treatment of the degree of freedom. By replacing the ISW potential with a quasi-exactly soluble sextic potential, we obtain exact solutions for the low-energy spectrum and analyze these results in detail. In addition, various forms of the sextic potential, although not exactly solvable, can be treated numerically, providing benchmarks for criticality in shape transitions. We also review two decades of related research, including a map of nuclide regions where these models apply, summarizing their implications in nuclear structure studies.

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