Contribution ID: **162** Type: **Oral**

Intertwined quantum phase transitions in the Zr isotopes

Wednesday, 15 May 2019 12:00 (20 minutes)

Most of the attention in the study of quantum phase transitions (QPT) in nuclei, has been devoted to shape phase transitions in a single configuration (denoted Type I), described by a single Hamiltonian, $\hat{H}(\xi) = (1-\xi)\,\hat{H}_1 + \xi\hat{H}_2$, where ξ is the control parameter. A different type of phase transitions (denoted Type II) occurs when two (or more) configurations coexist. In this case, the quantum Hamiltonian has a matrix form, with entries: $\hat{H}_A(\xi^A)$, $\hat{H}_B(\xi^B)$, $\hat{W}(\omega)$, where the index A, B denotes the two configurations and $\hat{W}$ denotes their coupling. As the control parameters are varied, the separate Hamiltonians $\hat{H}_A$ and $\hat{H}_B$ can undergo shape-phase transitions of Type I, which in turn can result in a crossing of configurations A and B. In the present contribution, we focus on the $_{40}$Zr isotopes and find a variety of multiple intertwined phase transitions both of Type I and Type II [1]. These isotopes have been recently the subject of several experimental investigations [2] and theoretical calculations [3]. By employing the interacting boson model with configuration mixing, we have calculated the spectra and other observables of the entire chain of Zr isotopes, from neutron number 52 to 70. The latter exhibit a complex phase structure with coexisting Type I and Type II QPTs, and ground state shapes changing from spherical ($^{92-98}$Zr), to X(5)-like (^{100}Zr), to axially deformed ($^{102-104}$Zr), and finally to γ-unstable ($^{106-110}$Zr). This interpretation is corroborated by the evolution along the Zr chain of order parameters and key observables, including B(E2) values, isotope shift and two-neutron separation energies.

[1] N. Gavrielov, A. Leviatan and F. Iachello, submitted (2019).

[2] P. Singh et al., Phys. Rev. Lett. 121, 192501 (2018) and references therein.

[3] See e.g., T. Togashi et al., Phys. Rev. Lett. 117, 172502 (2016).

Primary authors: Prof. LEVIATAN, Amiram (The Hebrew University); Mr GAVRIELOV, Noam (The Hebrew University); Prof. IACHELLO, Francesco (Yale University)

Presenter: Prof. LEVIATAN, Amiram (The Hebrew University)

Session Classification: Session XIV