Contribution ID: **81** Type: **Oral**

Nuclear studies with FSU Hamiltonian

Thursday, 20 July 2023 17:15 (15 minutes)

The empirical or semi-phenomenological nucleon-nucleon interactions that have been used in the traditional shell model studies for over half a century still play a key role in microscopic studies of nuclei. Progress has been made in connecting the empirical matrix elements of the Hamiltonian with the fundamental interactions coming from QCD, however full understanding is still missing. The research direction going from experiment to fundamental theory is of major importance.

In this presentation I will discussed the FSU shell model Hamiltonian developed in a collaborative theory-experiment effort at Florida State University [1]. The interaction covers a very broad mass region from light nuclei in the p-shell to those in the fp-shell. I will discuss some technical details and motivations related to the model hamiltonian, fit procedure, and experimental data used for the fit. I will highlight some important applications discussing binding energies, spectroscopy and complex many-body effects such as clustering. Some theoretical questions such as evolution of the mean field, inversion of the traditional shell structures, density of states and particle-hole configuration mixing will be briefly discussed.

[1] R. S. Lubna, et al. Phys. Rev. Research 2, 043342 (2020); Phys. Rev. C 100, 034308 (2019); Phys. Rev. C 97, 044312 (2018).

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This material is based upon work supported by the U.S. Department of Energy Office of Science, Office of Nuclear Physics under Award Number DE-SC0009883.

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Session Classification: Session 13B

Track Classification: Experimental Nuclear Structure