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Ab initio theory and the structure of heavy nuclei

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Breakthroughs in our treatment of the many-body problem and nuclear forces are rapidly transforming modern nuclear theory into a true first-principles discipline. This allows us to address some of the most exciting questions at the frontiers of nuclear structure and physics beyond the standard model, such as the nature of dark matter and neutrino masses, as well as searches for violations of fundamental symmetries in nature.

In this talk I will briefly outline our many-body approach, the valence-space in-medium similarity renormalization group, and how recent advances now allows us to calculate converged properties of closed- and open-shell nuclei to the ^{208}Pb region and beyond. In particular correlations of the neutron skin and dipole polarizability in heavy nuclei provide new constraints on symmetry energy parameters for determining neutron star properties. Finally, I will finally highlight new results for converged calculations of neutrinoless double beta decay and WIMP-nucleus scattering in heavy nuclei.

Primary author: HOLT, Jason (TRIUMF)

Presenter: HOLT, Jason (TRIUMF)

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