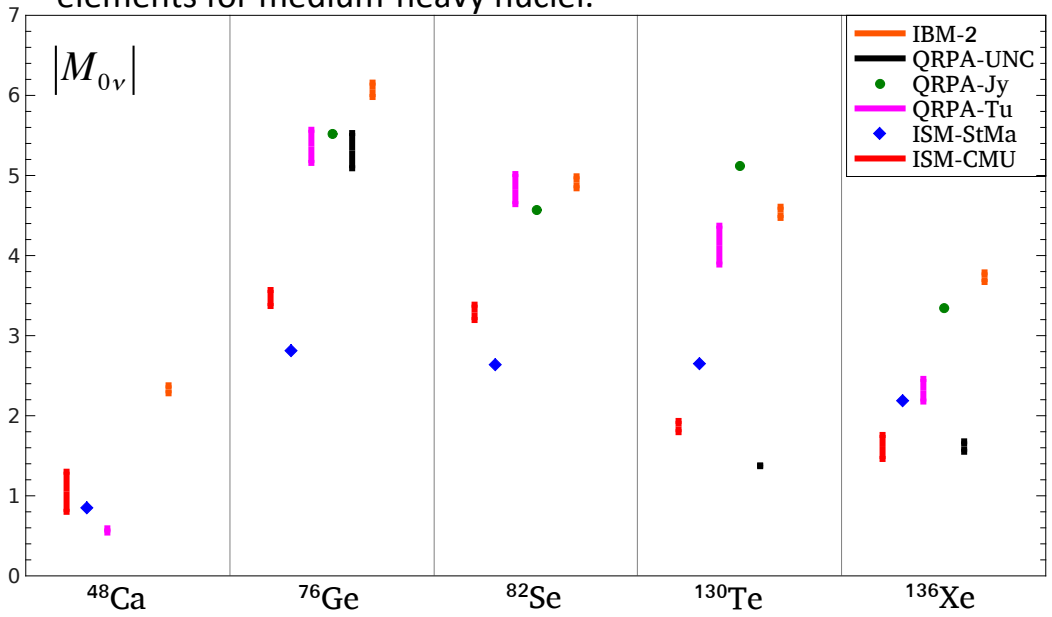
Neutrinoless Double-Beta Decay: Advanced Shell Model Approach

Objectives

- Reduce the uncertainties of the neutrinoless double-beta decay nuclear matrix elements that can be used for reference and analysis of the expensive ongoing experimental efforts.
- To accomplish this goal we use an interactive shell model approach (ISM-CMU) that was proven to describe more accurately the short range correlations around the Fermi surface, and by increasing the single particle model space we attempt to describe more accurately the nuclear matrix elements for medium-heavy nuclei.

Impact

- Nuclear matrix elements provide guidance for the design and the monitoring of the double-beta decay experiments, and could be used to analyze the results and to identify physics beyond the Standard Model.
- The application of sophisticated shared-memory parallel programming techniques were employed to increase the efficiency of the shell model code; for example, close to 1M CPU x hour were necessary to reach convergence in the case of ^{76}Ge.
- Provides benchmark for future *ab-inito* calculations.



Accomplishments

- Novel, large-scale calculation of the nuclear matrix elements for the double beta decay of ^{136}Xe.
- First shell model calculations of nuclear matrix elements for competing mechanisms to the neutrionoless double-beta decay process .
- First realistic shell model calculations of the neutrinoless double-beta decay nuclear matrix elements beyond closure approximation .
- New alternative method of calculating the nuclear matrix elements using pair transitions.
- Papers were published in Physical Review Letters and Physical Review C Rapid Communications.

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Reference: A. Neacsu, M. Horoi, Phys. Rev. C **91**, 024309 (2015)

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