Exotic medium-mass nuclei

Understanding structure and reactions of medium mass and neutron rich isotopes is of fundamental importance in the physics of nuclei and astrophysics

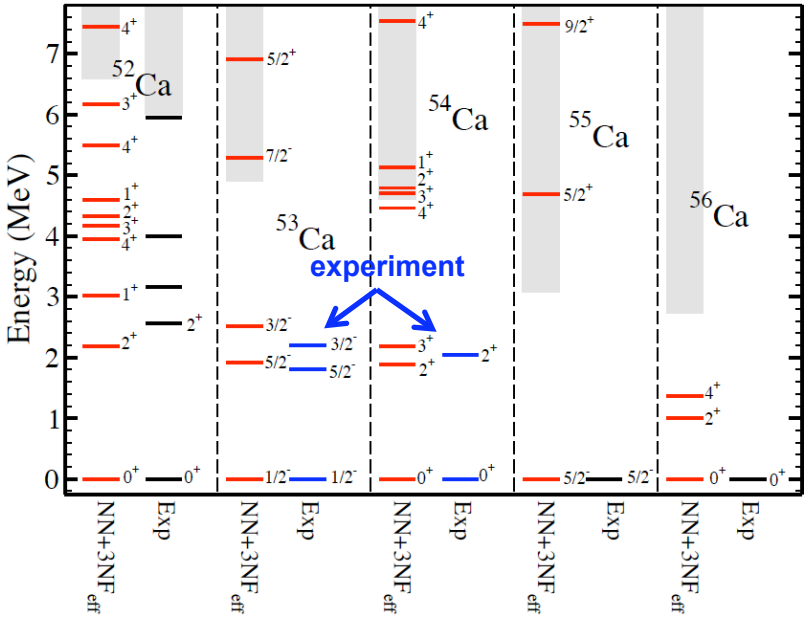
- Evolution of shell structure
  Determines behavior of entire regions of the nuclear chart
  Relevant for pathway of rapid neutron capture in astrophysics

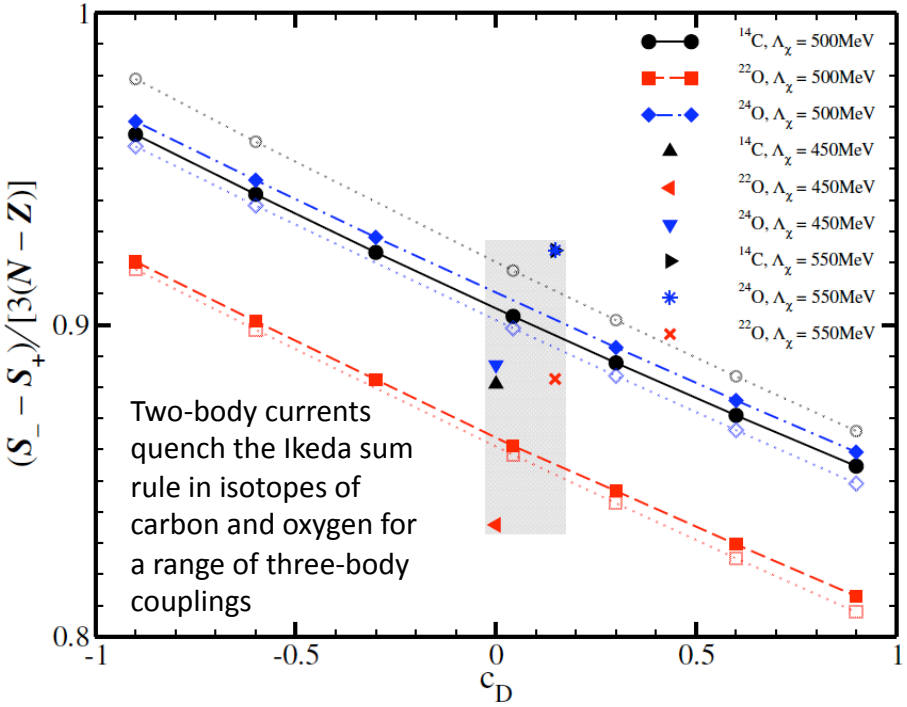
- Limits of nuclear stability
  Enhances smaller and less well known aspects of the nuclear force
  Weak binding causes exotic clustering and halo phenomena

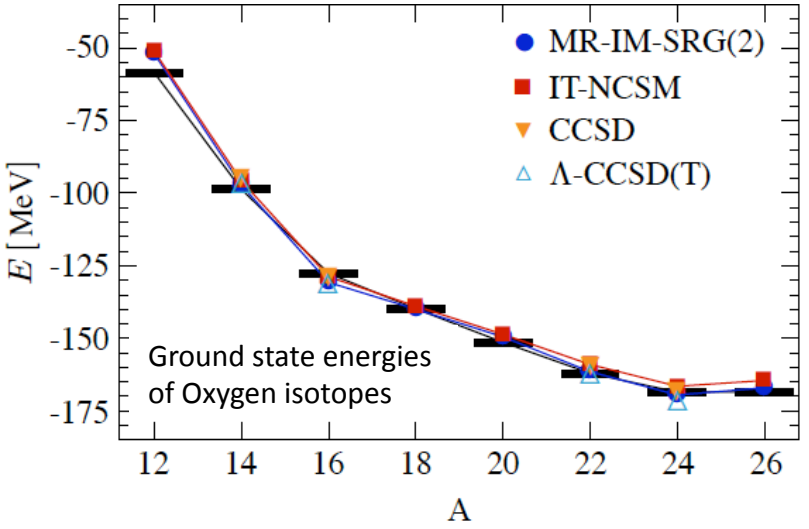
- Fundamental symmetries and weak decays
  Nuclear matrix element for neutrinoless double beta decay links lifetime to hierarchy and scale of neutrino masses for Majorana neutrinos

Present status

- Ab-initio computations with chiral two- and three-nucleon forces have advanced to mid mass nuclei
- Theory has provided predictions in exotic nuclei, some of which have been confirmed experimentally
- Optimization of interactions from chiral effective field theory with consistent currents
- First steps towards including two-body currents in weak decays







Future challenges

- Explore role of three-nucleon forces on saturation in mid-mass nuclei
- Explore the role of three-nucleon forces and two-body currents on weak decays in experimentally relevant nuclei
- Provide guidance to experiment based on reliable theoretical predictions with error bars
- Develop a unified description of structure and reactions
- Exploit opportunities from high performance computing

Requirements: Faculty and staff + several students and post-docs; collaboration between nuclear physicists and applied mathematicians/computer scientists; large scale computing