Exact Solutions for Pairing Correlations Among Protons and Neutrons[1] MADELEINE MIORA, Rollins College, KRISTINA LAUNEY, DAVID KEKEJIAN, JERRY DRAAYER, Louisiana State University, FENG PAN, Liaoning Normal University — Using the nuclear shell model we are able to achieve, for the first time, exact solutions for pairing correlations for light to medium-mass nuclei, including the challenging proton-neutron pairs, while also identifying the primary physics involved. We utilize a new Hamiltonian with only two adjustable parameters. In addition to a single-particle energy term and the Coulomb potential, the shell-model Hamiltonian consists of isovector $T=1$ pairing interaction and average proton-neutron isoscalar $T=0$ interaction. The $T=0$ term describes the average interaction between non-paired protons and neutrons. This Hamiltonian is exactly solvable, but calculations represent a challenge, as they require highly non-linear equations to be computed. With this model, including from 3 to 7 single-particle energy levels, we can reproduce experimental data for 0^+ state energies for isotopes with mass $A=10$ through $A=62$ exceptionally well including isotopes from He to Ge. These results provide a further understanding for the key role of proton-neutron pairing correlations in nuclei, which is especially important for waiting-point nuclei on the rp-path of nucleosynthesis.

1

Madeleine Miora
Rollins College

Date submitted: 30 Sep 2016   Electronic form version 1.4