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Exact Solutions for Pairing Correlations Among Protons and Neutrons[1] MADELEINE MIORA, Rollins College, KRISTINA LAUNEY, DAVID KEKEJIAN, Louisiana State University, FENG PAN, Louisiana State University, Liaoning Normal University, JERRY DRAAYER, Louisiana State 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.

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Madeleine Miora
Rollins College

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