Contribution ID: **192** Type: **Parallel-Few-Body Physics**

Two-nucleons with various methods

Lattice QCD calculations of two-nucleon systems have suffered from a significant systematic uncertainty for more than a decade. Two different methods of computing the interaction energy have yielded qualitatively different solutions: the use of local creation operators yields deeply bound di-nucleon systems, while calculations that use momentum space creation operators or the HAL QCD potential observe both di-nucleon systems to be unbound. These observations have been made with heavy pions masses where the stochastic signal-to-noise is exponentially larger than at light pion masses. This is not an academic exercise, but a challenge that must be overcome in order for the lattice QCD and broader physics communities to have confidence in lattice QCD calculations of two-nucleon (two-baryon) interactions and two-nucleon electroweak matrix elements. I will present progress that is being made in computing the two-nucleon system with all methods in use, the local creation operators, momentum space creation operators and the HAL QCD potential, for the first time on the same set of gauge configurations. This will enable us to isolate the discrepancy in the spectrum to the method used, and hopefully, resolve this long-standing discrepancy.

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