Symmetry Adapted Model

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We present a novel combined algebraic and computational approach for addressing the main barriers that stand in the way of full utilization of the Supermultiplet Theory proposed by E. Wigner in 1937, and for which he was awarded the Nobel Prize in 1963. The key feature that underpins this concept is the factorization of the model space into its spatial and spin-isospin parts. The new methodology combines the advanced use of group theoretical methods along with state-of-the-art linear algebra solvers. To be more specific, the latter takes advantage of parallel processing algorithms for resolving any and all multiplicity issues associated with the reduction of the U(4N) model space into a direct product of its spatial U(N) and as well as its spin-isospin U(4) subspaces together with the further reduction of these two spaces into their own respective subspaces, $U(N) \supset U(3)$ for the spatial sector and $U(4) \supset SU_S(2) \otimes SU_T(2)$ for the spin and isospin sector.

Recently, this approach has been used and applied to the spatial and spin-isospin parts in a way that elevates the mutual management of these two sectors on par with one another. Toward this end, three important papers have been pub- lished [1], plus a review article [2], which report on theoretical and computational concepts that underpin these developments. Specifically, when these features are used in concert with one another, they yield what we respectfully suggest should be an all-inclusive model, christened simply as SAM (Symmetry Adapted Model). The latter is expected to far exceed the capability of what is now commonly referred to as the Symmetry Adapted No-Core Shell Model, as in contrast with the latter, SAM takes full advantage of all symmetries that should be part of a truly 21st century model for studying atomic nuclei. With these features in play, we believe that SAM has the potential for not only expanding our understanding of the underpinning nuclear forces but also enabling advanced studies that extend the range of applicability of the theory to medium-mass as well as heavier nuclear species.

References

[1] P. Dang et al., *Eur. Phys. J. Plus* **139** (2024) 704 and 933; *Eur. Phys. J. Plus* **139** (2024) article number 933; DOI: doi.org/10.1140/epjp/s13360-024-05581-6.

[2] J.P. Draayer et al., *Phys. Scr.* **99** (2024) 102002; DOI: 10.1088/1402-4896/ad72af.