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Finessing the Exponential Scaling with N Problem for Manybody Systems[1] DEBORAH WATSON, MARTIN DUNN, University of Oklahoma — The resources required for an exact solution of the general quantum mechanical N-body problem are widely believed to scale exponentially with N, typically doubling for every particle added. With current numerical resources, this problem "hits a wall" around $N = 10$ (within a factor of 2). We have formulated a perturbation method for the general N-boson problem that uses symmetry to *rearrange* this exponential wall so the problem scales as N^0. This is achieved by using a perturbation expansion that is invariant under the $N!$ operations of the symmetric group S_N, allowing group theory and graphical techniques to be used to solve the problem exactly and analytically at each order for arbitrary interactions and for arbitrary N, i.e. the problem scales as N^0 at each order. This approach also shifts the work from numerical effort for a single N to analytic work valid for all N. The exponential complexity reappears in an exponential wall that scales with the order of the series. We have investigated the growth of complexity as a function of order by enumerating the graphs that correspond to the basis tensors at each order. This formulation opens up the possibility of exact analytical calculations for very large N systems through low order.

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