Propagators, the Random Phase Approximation and Consistency Requirements.

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Privileged by emeritus status, I will review some efforts to reconcile propagator methods, in particular the polarization variety, with variational methods and state vector descriptions. The decoupling of equations of motion and associated factorizations of expectation values are generally not N-representable, as pointed out graciously by Per-Olov Löwdin.

A quest for an appropriate ground state that would be a "vacuum" for particle-hole excitations, led Yngve Öhrn and myself through a wilderness of generator coordinate representations and Hurwitz integrals in the Unitary Group parameter space to a realization in the form of the Antisymmetrized Geminal Power state. This form, which had been shown by Sasaki and Coleman to be the wave function form which corresponds to the extreme points in the set of two-particle density matrices, and which was known as the projected Bardeen-Cooper-Schrieffer superconducting ground state, appeared as the necessary form for a consistent RPA state.

The Antisymmetrized Geminal Power does offer an improvement from the Hartree-Fock state, but will typically yield only some 50% of the correlation energy. Calculations at the Quantum Theory Project at Florida demonstrated satisfactory improvements for excitation spectra while presenting awkward problems for optimization of the reference state.