

# Formulation of $n$ -electron systems in terms of the cumulants $\lambda_k$ of the reduced density matrices $\gamma_k$

Werner Kutzelnigg

*Lehrstuhl für Theoretische Chemie*

*Ruhr-Universität Bochum,*

*D-44780 Bochum, Germany*

## Abstract

An important paradigm of many-electron theory is that one should formulate it in terms of quantities that are additive separable (extensive) and describable in terms of connected diagrams. The reduced density matrices  $\gamma_k$ , which contain all relevant information about a quantum mechanical state, are, at variance with the *cumulants*  $\lambda_k$  of the reduced density matrices, *not extensive*. This makes a theory in terms of cumulants preferable. The properties of these density cumulants are studied, especially trace relations and partial trace relations, as well as particle-hole symmetries. A *generalized normal ordering* and a *generalized Wick theorem* are intimately related to the concept of cumulants. The irreducible contracted Schrödinger equations ICSE $_k$ , as well as the irreducible Brillouin conditions IBC $_k$  are conditions for stationarity of the energy with respect to variations of the wave function, and are expressible in terms of the cumulants. Strategies for the construction of many-electron wave functions based on these conditions are discussed.

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