Many-Body Density Matrix Perturbation Theory[1] C.J. TYM-
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Laboratory — One fundamental limitation of quantum chemical methods is the
accuracy of the approximate many-body theoretical framework that is utilized. Ac-
curate many-body formalisms for quantum chemical methods do exist, but these
methods are computationally very expensive. Methods also exist that are much less
computationally expensive such as Hatree-Fock, Density Functional and the Hybrid
Functional theories, but at a reduced representation of the exact many-body ground
state. This severely limits either the system size that can be addressed accurately, or
the accuracy of the representation of the many-body ground state. What is essential
is a method which represents the many-body ground state accurately, but with a
low computational cost. Recently, a method for determining the response, to any
order of the perturbation, within the density matrix formalism has been discovered.
This method is very simple and computationally efficient, and it immediately opens
up the possibility of computing the variational many-body ground state to unprece-
dented accuracy within a simplified computational approach. Within this article,
we report on the theoretical development of this methodology, which we refer to as
Many Body Density Matrix Perturbation Theory.

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