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Single-boson exchange formulation of the Schwinger-Dyson equation and its application to the fRG

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We extend the recently introduced single-boson exchange (SBE) formulation to the computation of the self-energy from the Schwinger-Dyson equation. In particular, we derive its general expression both in diagrammatic and in physical channels and show that the SBE formulation of the Schwinger-Dyson equation can be naturally applied also to non-local interactions. We furthermore discuss its implications in a truncated unity solver. As an application, we provide fRG results for the two-dimensional Hubbard model at weak coupling, where the use of the Schwinger-Dyson equation for the self-energy flow allows to capture the pseudogap opening. We illustrate that the SBE formulation proves particularly advantageous in identifying the relevant physical channels that drive the physical behavior. The expressions obtained for the self-energy rely on a single-channel parametrization, allowing further investigations within a fluctuation diagnostic of the different self-energy contributions, and this would enable to establish a comprehensive framework applicable to models with a non-local interaction or an $SU(2)$ symmetry broken phase. We discuss the extension to the strong coupling regime by combining the fRG with dynamical mean-field theory (DMFT) in the so-called DMF2RG.

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