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Multiscale Functional Renormalization Group Approach to the 1D Extended Hubbard Model

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We review our recent development of the Multiscale Functional Renormalization Group (MFRG) as an approach to the study of strongly correlated electronic materials in which both electron-electron (e-e) and electron-phonon (e-ph) interactions play important roles. Our MFRG method includes in a systematic manner the effects of the scattering processes involving electrons away from the Fermi surface and also permits proper inclusion of phonon retardation effects. After introducing the basic concepts, I will discuss in detail the application of this method to the 1D Extended Hubbard model and show that it correctly captures the subtle bond-order wave (BOW) phase in that model.

We will then discuss additional applications of the MFRG method and show that it can be applied to multi-band models in higher dimensions, recovering previously known results and predicting novel behaviors that have been seen in experiment. Finally, we will discuss possible future applications of the MFRG approach.

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