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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 multiband 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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