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Nonequilibrium dynamical mean-field theory[1]

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Dynamical mean-field theory (DMFT) is establishing itself as one of the most powerful approaches to the quantum many-body problem in strongly correlated electron materials. Recently, the formalism has been generalized to study nonequilibrium problems [1,2], such as the evolution of Bloch oscillations in a material that changes from a diffusive metal to a Mott insulator [2,3]. Using a real-time formalism on the Kadanoff-Baym-Keldysh contour, the DMFT algorithm can be generalized to the case of systems that are not time-translation invariant. The computational algorithm has a parallel implementation with essentially a linear scale up when running on thousands of processors. Results on the decay of Bloch oscillations, their change of character within the Mott insulator, and movies on how electrons redistribute themselves due to their response to an external electrical field will be presented. In addition to solid-state applications, this work also applies to the behavior of mixtures of light and heavy cold atoms in optical lattices.

[1] V. M. Turkowski and J. K. Freericks, Spectral moment sum rules for strongly correlated electrons in time-dependent electric fields, Phys. Rev. B 075108 (2006); Erratum, Phys. Rev. B **73**, 209902(E) (2006).
[2] J. K. Freericks, V. M. Turkowski , and V. Zlatić, Nonlinear response of strongly correlated materials to large electric fields, in *Proceedings of the HPCMP Users Group Conference 2006, Denver, CO, June 26–29, 2006* edited by D. E. Post (IEEE Computer Society, Los Alamitos, CA, 2006), to appear.
[3] J. K. Freericks, V. M. Turkowski, and V. Zlatić, Nonequilibrium dynamical mean-field theory, *submitted to Phys. Rev. Lett.* cond-mat//0607053.

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