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Abstract for an Invited Paper  
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### **Theory for Time-Domain Photon Spectroscopy**

THOMAS DEVEREAUX, SLAC National Accelerator Lab and Stanford University

In this talk I will present some recent work concerning the development of theories for time-domain photon spectroscopies, with a focus on studying non-equilibrium pump-probe dynamics. Studies of several model systems will be presented, including non-equilibrium dynamics across of metal-insulator transition in correlated systems, strong electron-phonon interactions, and spectral properties in a charge density wave state. The similarities and differences between equilibrium dynamics will be highlighted [1].

[1] Phys. Scripta T151, 014062 (2012); arXiv:1210.3088; arXiv:1207.3835; Phys. Rev. Lett. 109, 176402 (2012); Nature Communications 3, 838 (2012); arXiv:1204.1803