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Ultrafast phase transitions in advanced materials: review of some experiments and a new theoretical approach ROLAND ALLEN, AYMAN ABDULLAH-SMOOT, MICHELLE GOHLKE, DAVID LUJAN, JAMES SHARP, ROSS TAGARAS, Texas A&M University — This talk will review some experimental studies of advanced materials responding to fast intense laser pulses, including light-induced superconductivity in cuprates [1]. A new method will be introduced for treating ultrafast phase transitions, such as those involving superconductivity, magnetism, charge density waves, and spin density waves. This method is made possible by the fact that the density-functional-based technique emphasized here (and also standard density-functional approaches and other first-principles techniques, as long as they include nuclear motion) can yield a true electronic temperature [2]. Illustrative results will be presented for a simple model, with the electronic temperature immediately after the laser pulse calculated as a function of the fluence.
1. D. Fausti, R. I. Tobey, N. Dean, S. Kaiser, A. Dienst, M. C. Hoffmann, S. Pyon, T. Takayama, H. Takagi, and A. Cavalleri, Light-Induced Superconductivity in a Stripe-Ordered Cuprate, Science 331, 189 (2011).
2. Zhibin Lin and Roland E. Allen, Ultrafast equilibration of excited electrons in dynamical simulations,J. Phys. Condens. Matter 21, 485503 (2009).

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