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# Non-adiabatic effects and exciton-like states during insulator-to-metal transition in warm dense hydrogen

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Transition of molecular hydrogen to atomic ionized state with increase of temperature and pressure poses still unresolved problems for experimental methods and theory. Here we analyze the dynamics of this transition and show its nonequilibrium non-adiabatic character overlooked in both interpreting experimental data and in theoretical models. The non-adiabatic mechanism explains the strong isotopic effect [Zaghoo, Husband, and Silvera, Phys. Rev. B 98, 104102 (2018)] and the large latent heat [Houtput, Tempere, and Silvera, Phys. Rev. B 100, 134106 (2019)] reported recently. We demonstrate the possibility of formation of intermediate exciton-like molecular states at heating of molecular hydrogen that can explain puzzling experimental data on reflectivity and conductivity during the insulator-to-metal transition.

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