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Band Occupation and Optical properties of Warm Dense Gold

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Intense and short laser pulses can be used to create dense plasma or warm dense matter. States under these extreme conditions are very complex and new experimetal methods as well theoretical approches are required. After excitation with a laser pulse, electrons are driven out of thermodynamic equilibrium. They then relax on a few femtoseconds. However, there exits different types of nonequilibria which can relax on a different timescale. For gold excited with optical photons, two main bands are generally involved, namely the $5d$-valence band and the $6sp$-conduction band.
In this contribution, we focus on the case where a temperature has already been established within the electrons. Moreover, due to fast energy exchange between the bands, the electrons of both bands quickly reach a joint temperature. However, since particle exchange require much longer time, the occupation of the bands stays much longer in nonequilibrium. We model electrons dynamics in gold using a set of rate equations which trace the occupation numbers of the bands as well as the energy balance. These predictions are then used to calculate the optical properties, like the reflectivity and compared with time-resolved measurements.

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