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Ab Initio Determination of Thermal Conductivities for Dense Hydrogen and CH Plasmas at ICF conditions

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Among the numerous parameters that condition the success of future inertial confinement fusion (ICF) experiments, electronic thermal conductivity plays a central role. It is however poorly known in the hot and dense regime. Most of the models interpolate between weakly coupled regime and strongly degenerated plasmas. They disagree at high densities so that an independent determination is needed. Quantum molecular dynamics has been proved to be a powerful tool to finely study matter in warm dense regime. We will present ab initio calculations of thermal and electrical conductivities for hydrogen at densities between 10 g/cc and 160 g/cc and temperatures up to 800 eV, i.e. thermodynamical conditions relevant to ICF. The ionic structure is obtained using molecular dynamics simulations based on an orbital-free treatment for the electrons. The transport properties were computed using ab initio simulation in the DFT/LDA approximation. The thermal and electrical conductivities are evaluated using Kubo-Greenwood formulation. These calculations are then used to check various analytical models (Hubbard, Lee-More, Ichimaru) widely used in hydrodynamics simulations of ICF capsule implosions. The Lorentz number, which is the ratio between thermal and electrical conductivities, is also computed and compared to the well-known Wiedemann-Franz law in different regimes ranging from the highly degenerated to the kinetic one. Evaluations of electronic transport properties for CH are also presented.