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Failure of Steady State Thermodynamics[1] RONALD DICKMAN, Universidade Federal de Minas Gerais — To be useful, steady state thermodynamics (SST) must be self-consistent and have predictive value. Consistency of SST was recently verified for driven lattice gases under global weak exchange. Here, I verify consistency of SST under local (pointwise) exchange, but only in the limit of a vanishing exchange rate; for a finite exchange rate the coexisting systems have different chemical potentials. I consider the lattice gas with nearest-neighbor exclusion on the square lattice, with nearest-neighbor hopping (NNE dynamics), and with hopping to both nearest and next-nearest neighbors (NNE2 dynamics). I show that SST does not predict the coexisting densities under a nonuniform drive, or in the presence of a nonuniform density provoked by a hard wall or nonuniform transition rates. The steady state chemical potential profile is, moreover, nonuniform at coexistence, contrary to the basic principles of thermodynamics. Finally, I discuss examples of a pair of systems possessing *identical steady states*, but which *do not coexist* when placed in contact. These results cast serious doubt on the consistency and predictive value of SST.

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