

Abstract Submitted
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**The
Nonequilibrium Thermodynamics of Plasma Under Collisional-Radiative
Equilibrium**¹ R. EPSTEIN, A. SHVYDKY, LLE, University of Rochester, I. E.
GOLOVKIN, Prism Computational Sciences, W.-F. FONG, Dept. of Physics and
Astronomy, Northwestern U. — We present a thermodynamically consistent de-
scription of plasma under collisional radiative equilibrium (CRE). Many plasmas
composed of mid- to high- Z materials are much more accurately described by CRE
than local thermodynamic equilibrium (LTE), particularly when plasma properties,
such as specific heat and sound speed require accurate accounting of the ionization
component of the internal energy. CRE opacity/emissivity tables have been in use
for many years in radiation-hydrodynamic simulations. We seek self-consistency
by implementing equation-of-state tables based on the same CRE atomic models.
CRE extends LTE by accounting for the steady-state atomic-kinetic effects of radi-
ation escaping freely from the point of emission. As under LTE, plasma under CRE
is described completely in terms of local thermodynamic variables. Consequently,
radiative and thermodynamic properties can be tabulated in terms of local thermo-
dynamic variables, and thermodynamically consistent descriptions of both limits are
possible. Conceptual problems arise from CRE not being a true equilibrium, which
requires a description in terms of nonequilibrium thermodynamics.

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