

# Calculations of Ionization Timescales in a Laser-irradiated Plasma

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Calculations of plasma emission and ionization may be simplified by assuming Local Thermodynamic Equilibrium (LTE), where populations are given by the Saha-Boltzmann equation. LTE can be achieved at high densities when collisional processes are much more significant than radiative processes, but may not be valid if plasma conditions change rapidly. A collisional-radiative model has been used to calculate the times taken by carbon and iron plasmas to reach LTE at varying densities and heating rates. This work shows regimes in rapidly changing plasmas, such as those created by optical lasers and FELs, where the use of LTE is justified, because timescales for plasma changes are significantly longer than the times needed to achieve an LTE ionization balance.

## References

- [1] V. Aslanyan and G. J. Tallents, *Phys. Plasmas* **21**, 062702 (2014).
- [2] D. Salzmann, “*Atomic Physics in Hot Plasmas*” OUP (1998).