On the Solution of the Rate Equations.

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To construct non-LTE model atmospheres it is necessary to solve the radiative transfer equation at hundreds of thousands of frequencies, and to solve thousands of rate equations at each depth while simultaneously satisfying the constraint of radiative equilibrium. Ideally we would like a stable code that converges rapidly to the desired solution with minimal assumptions. Unfortunately stability and speed are often mutually exclusive.

We examine the approach taken in CMFGEN, a non-LTE code used for modeling the spectra of hot stars with stellar winds, and compare the techniques used with those used in other codes. An honest appraisal of CMFGEN's convergence properties are given, and we discuss when difficulties occur.

We examine the solution of the rate equations in detail, and highlight the coupling between the radiative equilibrium equation, and the rate equation. Procedures for ensuring stability and accelerating convergence are discussed. We also examine the tradeoff between local and non-local operators.