Spectroscopic Modeling of Massive Stars and Supernovae

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We have developed a radiative transfer code, CMFGEN, which allows us to model the spectra of massive stars and supernovae. Using CMFGEN we can derive fundamental parameters such as effective temperatures and surface gravities, derive abundances, and place constraints on stellar wind properties. The later is important since all massive stars are losing mass by a stellar wind that is driven from the start via radiation pressure, and this mass loss can substantially influence the spectral appearance and evolution of the star. Recently we have extended CMFGEN to allow us to undertake time-dependent radiative transfer calculations of supernovae. Such calculations will be used to place constraints on the supernova progenitor, to place constraints on the supernova explosion and nucleosynthesis, and to derive distances using a physical approach called the ``Expanding Photosphere Method". We describe the assumptions underlying the code and the atomic processes included. A crucial ingredient in the code is the atomic data. For the modeling we require accurate transition wavelengths, oscillator strengths, photoionization cross-sections, collision strengths, autoionization rates, and charge exchange rates for virtually all species up to, and including, cobalt. Presently, the available atomic data varies substantially in both quantity and quality.