Abstract

The mechanism governing the mass outflow from evolved late type stars are not well elucidated. It is conspicious that the empirical measurements of wind parameters for individual cool stars are often controversial and do not lead to unique outflow models. Especially, the question whether the contradictious results of wind studies of single stars and binaries are due to intrinsic differences or an artefact of the analyses is not answered. Furthermore, characteristic irregularities in the line profiles observed in high resolution spectra cannot be explained.

The observed supersonic turbulence seems to be crucial for the understanding of the dynamical processes. These large non-thermal velocities are currently treated as mirco-turbulence, which might be a poor approximation for the stochastic velocity component. Traving (1975) developed a theory allowing to take into account correlated turbulent motions in the transfer of line radiation. In this formalism, the hydrodynamic velocity is described statistically by a Gaussian distribution and a characteristic correlation length. Thus, the intensity has also to be considered as a random variable, and the ordinary radiative transfer equation has to be replaced by a Fokker-Planck equation.

Based on this theory, a NLTE radiative transfer model was developed to study the effects of stochastic velocity fields on the interpretation of wind lines in evolved late–type stars. In a first step, the general effects of a correlated velocity field on the line formation was investigated assuming a constant correlation length and width of the turbulent distribution function. In a subsequent study, these variables are considered to vary with direction and height in the atmosphere. It turns out that even a weak velocity correlation may significantly affect the line formation, especially at the base of the wind. For moderate values of the correlation length the differences between an isotropic and an anisotropic model can be neglected. If the velocity correlation in the inner shell is much stronger than in the outer layers the line formation in single stars and binary systems will be affected in different ways. This might provide an explanation for the observed differences. Because of the large number of model parameters it can be expected that the solutions are not unique. Therefore, the occurrence of multiple solutions in parameter space was statistically investigated. While in some regions of the parameter space a wide variety of model solutions is found, other regions allow a more unambiguous parameter determination.