Radiative transfer in molecular lines

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Since Berner (1979), most of the RT codes for molecular lines have used numerical strategies based on a combination of Montecarlo techniques and the Λ-iteration method to obtain non-LTE level populations. More recently, some efforts have been dedicated to improve the poor convergence rate of this type of schemes. Thus, Accelerated Lambda Iteration (ALI) methods have recently started to be applied to molecular radiative transfer.
Very recently, extra efforts in the fields of Stellar Atmospheres and of Solar and Stellar Physics have led to the development of novel RT tools. These new developments have made it possible the numerical solution of complex RT multilevel problems (in 1D, 2D and 3D) for both unpolarized and polarized radiation. As shown by us in a previous contribution at this conference these novel RT methods are based on iterative schemes that allow the solution of a given RT problem with an order of magnitude of improvement in the total computational work with respect to the standard ALI method (see also Trujillo Bueno and Fabiani Bendicho, ApJ, 1995).
In this contribution we present the generalization of such efficient RT tools to the case of RT in molecular lines in stellar spherical envelopes with macroscopic velocity fields. Our motivation is to develop a number of powerful RT tools and to apply them with the aim of planning and interpreting future observations with FIRST. As a first application we show some preliminary results of non-LTE RT simulations in the CO molecule that are helping us to interpret observations of the fundamental tone at 4.6 μm of the oxygen-rich star VYCMa.