Solutions of polarized line transfer equations

K.N. Nagendra

Indian Institute of Astrophysics, Bangalore 560 034, India.

Recent developments in the NLTE polarized line formation theory in Astrophysics is discussed. Attention is focussed on pure theoretical aspects of the problem.

A conventional method of solving the line transfer equation is described briefly, in order to give a perspective to the modern Polarized Approximate Lambda Iteration (PALI) methods, which are developed only in recent years. Sample results computed using this old finite difference method for the polarized line transfer in planar and spherical media are presented. These examples include polarized resonance scattering in spherical media, polarized line formation in expanding atmospheres, and the role of collisional frequency redistribution in polarized line scattering.

Further, the basic characteristics of a PALI method are described using a prototype resonance polarization problem, keeping the assumption of CRD. Directions are given about the manner in which the presence of an external weak magnetic field can be incorporated in a PALI method. This is basically, the well known problem of Hanle effect in weak magnetic fields. The PALI method for Hanle effect is then described, first with CRD, and then with PRD scattering mechanism. Finally the generalization of PALI to the most difficult problem we have attempted until now, namely the study of partial frequency redistribution in the presence of collisions and an external weak magnetic field, is presented. Once again, sample results are shown to illustrate the essentials of PALI method, and the nature of solutions computed using this method. A comparison of the conventional and the PALI approaches is made, in some cases.