Session 3

Modeling scattering polarization accounting for angle-dependent PRD effects

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The correct modeling of the scattering polarization signals observed in many strong resonance lines of the solar spectrum requires accounting for coherent scattering processes with partial frequency redistribution (PRD). Modeling PRD effects is notoriously difficult from a computational standpoint, and simplifying approximations, such as angle-averaging the redistribution matrices, are frequently applied to lower the computational cost, but at the price of introducing hardly predictable artifacts and inaccuracies.

Starting from a suitable algebraic formulation of the problem, we devised a new parallel solution strategy for the non-LTE radiative transfer problem for polarized radiation. The approach is tailored for modeling PRD effects by applying the exact angle-dependent expression of the redistribution matrix. A code capable of solving the problem in both 1D and 3D models of the solar atmosphere, for the case of a two-level atom in the presence of arbitrary magnetic and bulk velocity fields, is operational. In the 1D geometry, it can be routinely applied to get scientific worthy results in a few minutes, using a couple of computing nodes.

Following a brief account of the physical and numerical approach to the problem, we explore a number of 1D applications of scientific interest, contrasting the results of angle-dependent and angle-averaged calculations, and we present first preliminary results of 3D calculations.