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ROLE OF THE COLLISIONS IN THE RADIATION REDISTRIBUTION: POLARIZATION FAR WINGS OF LINES FORMED BY SCATTERING

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This work is intended to the interpretation of the so-called "Second Solar Spectrum" (Stenflo, 1996), which is the spectrum of the linear polarization formed by scattering and observed close to the solar limb, but on the disk. The lines are also optically thick, and the problem is to solve in a coherent manner, the statistical equilibrium of the atomic density matrix and the radiative transfer in the atmosphere. Following Belluzzi & Landi Degl'Innocenti (2009), 30 % of the solar visible line linear polarization profiles display the M-type shape typical of coherent scattering effect in the far wings. A new theory including both coherent and resonant scatterings was developed by Bommier (1997a,b). In this theory, which is straightly derived from the Schrödinger equation for the atomic density matrix, the radiative line broadening appears as a non-Markovian process of atom-photon interaction. The collisional broadening is included. The published formalism was limited to the two-level atom without lower level alignment. But most of the solar lines are more complex. We will present how the theory has to be complemented to be enabled for multi-level atom modeling, including lower level alignment. The role of the collisions as balancing coherent and resonant scatterings is fully taken into account. Progress report will be given about the development of a new code for the numerical iterative solution of the statistical equilibrium and radiative transfer equations, for multi-level atoms.