Session 3

(Invited) Modeling the polarization of the Na I and K I D lines

E. Alsina Ballester[1], L. Belluzzi[2], J. Trujillo Bueno[1]
[1] IAC, [2] IRSOL

The cores of the solar Na I and K I D lines provide information on the thermodynamic and magnetic properties of the middle chromosphere and of the region comprising the upper photosphere and lower chromosphere, respectively. Unlike the D1 lines, the D2 lines are intrinsically polarizable and are expected to present scattering polarization signals (i.e., the linear polarization signals produced by the scattering of anisotropic radiation) of sizable amplitude. These signals can be suitably modeled by considering two-term atomic systems with hyperfine structure (HFS). In this talk, we present a series of numerical investigations enabled by our recently developed non-LTE radiative transfer code, which can synthesize the intensity and polarization line profiles considering the aforementioned atomic systems, accounting for frequency correlations between incident and scattered radiation (partial frequency redistribution; PRD) as well as J- and F-state interference. The code can also account for the impact of magnetic fields in the incomplete Paschen-Back effect regime. The investigations presented here are split into two blocks. In the first block, we discuss the resolution of a long-standing paradox, in which the observed sodium D1 linear polarization signals could only be reproduced assuming that the solar chromosphere is practically unmagnetized. By accounting for HFS and PRD, we show that an appreciable D1 scattering polarization signal persists even in the presence of magnetic fields of strengths of tens of gauss. In the second block, we investigate the relevant physical mechanisms in shaping the intensity and polarization patterns of the potassium D lines as well as their magnetic sensitivity, paying particular attention to the D2 line. Our findings enhance the value of the scattering polarization of these lines for diagnostics of the magnetism of the solar chromosphere and upper photosphere, complementary to the information that is available via the circular polarization signals of the same lines.