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Inferring the chromospheric magnetic fields with the spectropolarimetric observations of Mg II h and k lines

Hao Li[1], Tanausú del Pino Alemán[2,3], Javier Trujillo Bueno[2,3], and CLASP2 team
[1]Key Laboratory of Solar Activity and Space Weather, National Space Science Center, Chinese Academy of Sciences
[2]Instituto de Astrofísica de Canarias
[3]Departamento de Astrofísica, Universidad de La Laguna
e-mail (speaker): lihao01@nssc.ac.cn

In the chromosphere the magnetic pressure starts to overcome the gas pressure and the plasma dynamics and structures are increasingly dominated by the magnetic field. The determination of the magnetic field vector in the solar chromosphere is thus key to understanding the physics of this interface region between the underlying photosphere and the overlying corona. Among the spectral lines forming in the upper solar chromosphere, strong ultraviolet lines such as the Mg II h and k lines, sensitive to the magnetic field via the Hanle, Zeeman and magneto-optical effects, hold significant diagnostic potential for studying the magnetic field vector. The Chromospheric LAyer SpectroPolarimeter (CLASP2) sounding rocket experiment successfully measured the full Stokes parameters of the Mg II h and k. In order to decipher the magnetic field information encoded in these unprecedented data sets, we recently developed a Stokes inversion code, namely the HanleRT Tenerife Inversion code (HanleRT-TIC) [1][2], which takes into account scattering polarization, partial frequency redistribution effects, and quantum level interference in the presence of arbitrary magnetic fields (from zero field to the complete Paschen–Back regime).

In this talk we briefly introduce the necessary physical ingredients to model the polarization of the Mg II h and k lines, including the scattering polarization, and the Hanle and Zeeman effects. Besides, we present a spectropolarimetric observation of an active region plage [3] and a quiet Sun region near the solar limb [4] obtained by CLASP2. The data corresponding to the plage region show significant circular polarization in the plage region. By applying the HanleRT-TIC, we obtained a stratified model atmosphere and the longitudinal components of the magnetic fields from the intensity and the circular polarization profiles [5]. In the quiet region, the significant linear polarization allows us to estimate the magnetic field vector via the Hanle and magneto-optical effects.

References

[1] del Pino Alemán, T., Casini, R., & Manso Sainz, R. 2016, ApJL, 830, L24
[2] Li, H., del Pino Alemán, T., Trujillo Bueno, J., & Casini, R. 2022, ApJ, 933, 145
[3] Ishikawa, R., Trujillo Bueno, J., del Pino Alemán, T., et al. 803 2021, Science Advances, 7, eabe8406,
[4] Rachmeler, L. A., Trujillo Bueno, J., McKenzie, D. E., et al. 2022, ApJ, 936, 67
[5] Li, H., del Pino Alemán, T., Trujillo Bueno, J., et al. 2023, ApJ, 945, 144