Exploring Chromospheric Magnetism: Polarization Diagnostics from Mg II and Fe II Spectral Lines

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The polarization of ultraviolet spectral lines is a powerful diagnostic tool for probing the magnetic field in the upper solar chromosphere. Observations from the Chromospheric LAyer Spectropolarimeter missions (CLASP2 and CLASP2.1) have demonstrated the diagnostic potential of the MgII h k resonant doublet for constraining the chromospheric magnetic field. Recent studies have advocated for the inclusion of the Fe II lines within the 250-270 nm spectral range as an optimal complement to the Mg II h and k spectral window lines to obtain a more detailed mapping of the magnetic field stratification through the solar chromosphere. In this context, the Chromospheric Magnetism Explorer (CMEx) mission is being developed to exploit the full diagnostic capabilities of this ultraviolet spectral region. We conducted radiative transfer modeling of MgII and FeII polarization signals using magneto-hydrodynamic simulations of different solar active regions. These synthetic observations allow us to test inversion techniques for recovering the magnetic field's stratification throughout the whole solar chromosphere. Our results demonstrate that a CMEx-like mission could distinguish between magnetic structures such as magnetic flux ropes (MFR) and sheared magnetic arcades (SMA), confirming the validity of existing models of solar eruption formation.