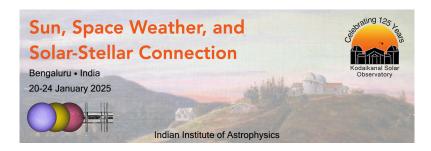
## Sun, Space Weather, and Solar-Stellar Connection



Contribution ID: 34 Type: Contributed talk

## Unravelling the Stratification of the Chromospheric Magnetic Field Using the Hα Line

Tuesday, January 21, 2025 9:10 AM (15 minutes)

The H $\alpha$  line is widely utilized for studying the solar chromosphere, but there is a scarcity of polarimetric studies aimed at inferring magnetic fields. One of the many reasons could be that there are no polarimetric studies of the Hα line utilizing 3-D radiative transfer, and earlier 1-D radiative transfer studies suggested a significant contribution of the photospheric fields in the Stokes V profiles. In our recently published work, Mathur et al. 2023, using spectropolarimetric data of a pore simultaneously recorded in the Hα and Ca II 8542 Å lines we investigated the potential of H $\alpha$  Stokes V profiles in determining chromospheric magnetic fields. Our findings suggested that the line core of the  $H\alpha$  line probes the chromospheric magnetic field. However, the previous study was limited to a small pore. In this study, using spectropolarimetric observations of an active region recorded simultaneously in the H $\alpha$  and Ca II 8662 Å lines, we inferred the stratification of the chromospheric magnetic field. The sunspot exhibits multiple structures, viz., 4 umbras and a lightbridge and a region where Ca II 8662 Å line core is in emission. The Hα line core image also displays brightening in the emission region, a signature of localized heating, with the spectral profiles showing elevated line cores. Consistent with the Mathur et al. 2023, we found that the magnetic field inferred from the H $\alpha$  line core is consistently smaller than that inferred from inversions of the Ca II 8662 Å line at  $\log \tau 500 = -4.5$ , however, in contrast with Mathur et al. 2023, uncorrelated. The field strength and morphology inferred in the heating region from the inversions at  $\log \tau 500 = -4.5$  is comparable to that of at  $\log \tau 500 = -1$ . There is also a good agreement with the field strengths at  $\log \tau 500 = -1$  with that inferred from WFA over H $\alpha$  full spectral range, except in the heating region. In addition, the fields inferred in the heating region from the WFA over H $\alpha$  line core and full spectral range are similar in strengths and morphology. In addition, we have also performed a theoretical study of synthesizing the polarization profiles of the Hα line in 3D. We show that the line of sight magnetic field retrived is sensitive to log  $\tau$ 500 = -5.7, which is at higher heights compared to the Ca II IR line. Thus, we suggest that the line core of the H $\alpha$  line always probes the chromospheric magnetic field at higher heights than that probes by the Ca II IR triplet. In case of heating events, the full  $H\alpha$  line becomes sensitive to the chromospheric magnetic field instead of just the line core. Consequently, the Hα line spectropolarimetry is a valuable diagnostic for studying the chromosphere, especially in regions with localized heating, where the Ca II IR triplet lines probe deeper layers of the solar atmosphere.

## **Contribution Type**

## Theme

Solar Magnetism in High-Resolution

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