A high resolution view of solar magnetic fields

Established by the European Commission

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- Spatio-temporal binning (affects all model parameters)
- Filtering of Q,U&V (makes them inconsistent with Stokes I)

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$$
\chi^2 = \frac{1}{N} \sum_{i=1}^N \left(\frac{o_i - s_i(\mathbf{x})}{\sigma_i} \right)^2 + \sum_{p=1}^M \alpha_p \Gamma(\mathbf{x})^2
$$

A diffraction-limited and critically-sampled map cannot look like this:

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Data courtesy of Michiel van Noort (MPS)

y [pixels]

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y [pixels]

y [pixels]

100 120 120 40 60 80 Ω 20 x [pixels]

(from de la Cruz Rodríguez & Leenaarts 2024) where the weights $\frac{1}{2}$ regulate the influence of the influence of the regulate the regularisa-(from de la Cruz Rodríguez & Leenaarts 2024) ear case, the penalty functions are not independently defined for independently defined for independent of the ϵ functions are not defined at the edge software ϵ

Spatio-temporal regularization in Milne-Eddington inversions the small-scale loop-like features much more visible compared to the unconstrained case. The unconstruction and alone alone alone alone alone alone alone decreases the noise, perhaps yielding a slightly sharper model

Reconstruction with physics-informed neural networks

No regularization

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Reconstruction with physics-informed neural networks

Fig. 6: Magnetic field inference from a Ca ii 8542Å observation using the pixel-wise WFA, the NF WFA, and two additional *Diaz Baso et al. (2025)* approaches introducing an extrapolation term: using the information of \mathcal{L}

HMI magnetogram 2016-09-14 09:17:04 /

Magnetic fields in solar plage

www.heljoviewer.org

Magnetic fields in solar plage

www.heljoviewer.org

Magnetic fields in solar plage

www.helioviewer.org (hv)

Plage photospheres

An explanation for the Stokes V asymmetry in solar faculae

J. Sánchez Almeida, M. Collados, and J. C. del Toro Iniesta Instituto de Astrofísica de Canarias, E-38200 La Laguna, Tenerife, Spain

Received May 19, accepted June 2, 1988

Summary: The asymmetry in the Stokes V profile observed in solar faculae can be explained by assuming that the magnetic field increases with height while downflow speed decreases. The MHD compatibility of such a solution is briefly discussed together with an observational test for that possibility.

Key Words: The Sun: faculae - magnetic fields - Stokes profiles - line asymmetries

1. Introduction

It seems well established that the Stokes V profile (circular polarization versus wavelength) of lines observed in solar faculae show several asymmetric features (Stenflo et al., 1984). Figure 1 chaves an aromala / $E_{\alpha}I$ KOKA 0 and $E_{\alpha}I$ KOKA R) tolean from the

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Early observational indications of the canopy effect imprinted in the Stokes V profiles!

e f *Buhler et al. (2015)*

Plage photospheres

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⁴⁵⁰⁰ ⁵⁰⁰⁰ ⁵⁵⁰⁰ ⁶⁰⁰⁰ ⁶⁵⁰⁰ Temperature [K] *Buhler et al. (2015)*

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• The magnetic field is confined to inter granular lanes

Plage photospheres

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• Gas pressure drops with height and the field can expand

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• Flux emergence can occur inside plage (Chitta et al. 2019) gence can occur inside plage (Chitta et al. 2

Fig. 16. Vertical reconstruction of the canopy magnetic field from the *Morosin et al. (2020)*

Morosin et al. (2022)

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Based on Clasp-2 data

Plage chromospheres

Li et al. (2024)

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de la Cruz Rodriguez & van Noort in prep.

SDO/HMI magnetogram

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Yadav et al. (2019)

Rouppe van der Voort et al. (2024)

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Fig. 3. Vertical cuts, and *x* and *z* planeteen et al. (2019) at $\frac{1}{2}$ at $\frac{1}{2}$ *Hansteen et al. (2019)*

TIUX I *Emerging-flux regions*

G. J. M. Vissers et al.: Non-LTE inversions of low-atmosphere reconnection *Emerging-flux regions*

Vissers et al. (2020)

Fig. 3. Overview images which overlap between the two instruments at four di↵erent wavelengths taken at 12:15 UT. The red arrows point to solar north arrows indicate the direction to the direction to the green square indicate the direction to the green s \sim inversion code. The black dashed square is a close-up and \sim *Díaz Baso et al. (2021)*

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Emerging-flux regions C. J. D.: An observationally constructed model of strong model of strong magnetic reconnections in the solar ch

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de la Cruz Rodriguez & van Noort in prep.

Magnetic fields in the quiet-Sun

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de la Cruz Rodriguez & Leenaarts in prep.

6

 $\overline{2}$ $\overline{0}$

x [arcsec]

25

[arcsec]

 $\overline{0}$ 2

 $\overline{0}$ 2

x [arcsec]

Magnetic fields in the quiet-Sun

The mean radiative loss is $L \sim 4$ kW m⁻² (as in Vernazza et al. 1981)

de la Cruz Rodriguez & Leenaarts in prep.

 $0\qquad 2$

 $0\qquad 2$

 $\overline{2}$

 $\overline{0}$

x [arcsec]

Magnetic fields in the quiet-Sun

The mean radiative loss is $L \sim 4$ kW m⁻² (as in Vernazza et al. 1981)

Network fields and ubiquitous very small-scale flux must have a significant contribution to the energy balance

de la Cruz Rodriguez & Leenaarts in prep.

Magnetic fields in the quiet-Sun

Conclusions

This project has been funded by the European Union through the European Research Council (ERC) under the Horizon Europe program (MAGHEAT, grant agreement 101088184).

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SST public archive: https://dubshen.astro.su.se/sst_archive/