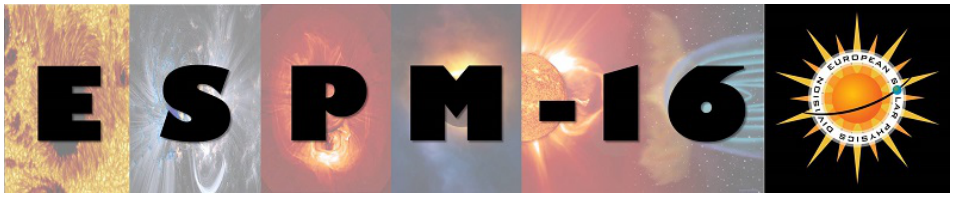

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Constraining the magnetic vector in the quiet solar photosphere and tracking the dynamics of small-scale magnetic features

Monday, 6 September 2021 11:37 (13 minutes)

With the advent of next generation high resolution telescopes, our understanding of how the magnetic field is organized in the internetwork (IN) photosphere is likely to advance significantly. We present high spatio-temporal resolution observations that reveal the dynamics of two disk-centre IN regions taken by the GREGOR Infrared Spectrograph Integral Field Unit (GRIS-IFU) with the highly magnetically sensitive photospheric Fe I line at 15648.52 Å. We apply inversions with the Stokes inversions based on response functions (SIR) code to retrieve the parameters characterizing the atmosphere, tracking the dynamics of small-scale magnetic features. We find linear polarization features (LPFs) with magnetic flux density 130–150 G and find LPFs appear preferentially at granule-intergranular lane boundaries. The weak magnetic field appears to be organized in terms of complex 'loop-like'structures, with transverse fields often flanked by opposite polarity longitudinal fields. We use snapshots produced from high resolution three-dimensional magnetohydrodynamic (MHD) simulations and employ SIR to produce synthetic observables in the same spectral window as observed by the GRIS-IFU. We then use a parallelized wrapper to SIR to perform nearly 14 million inversions of the synthetic spectra to test how well the 'true' MHD atmospheric parameters can be constrained statistically. Finally, we degrade the synthetic Stokes vector spectrally and spatially to GREGOR resolutions and consider the impact of stray light, spatial resolution and signal-to-noise. We studied a LPF exhibiting very similar magnetic flux density as those observed by the GRIS-IFU. Thus, we demonstrate that MHD simulations are capable of showing close agreement with observations.

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