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Chromospheric Recurrent Jets in a Sunspot Group and Their Intergranular Origin

Jie Zhao[1] , Jiangtao Su[2,3] , Xu Yang[4,5] , Hui Li[1,6] , Brigitte Schmieder[7,8,9] , Kwangsu Ahn[4,5] , and Wenda Cao[4,5]

[1] Purple Mountain Observatory, CAS, [2] National Astronomical Observatories, CAS, [3] School of Astronomy and Space Science, University of Chinese Academy of Sciences, [4] Center for Solar-Terrestrial Research, NJIT, [5] Big Bear Solar Observatory, NJIT, [6] School of Astronomy and Space Science, USTC, [7] LESIA, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Université de Paris, [8] Centre for Mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, [9] SUPA, School of Physics & Astronomy, University of Glasgow

e-mail: zhaojie@pmo.ac.cn

High-resolution observation of solar magnetic field is rarely obtained in the past. In this work, we present the photospheric vector magnetic field of a sunspot group in NOAA Active Region 12585 (N07°, W25°) which is observed on 2016 September 7 by the full-Stokes Near InfraRed Imaging Spectropolarimeter (NIRIS; Cao et al. 2012; Ahn et al. 2016) mounted at Big Bear Solar Observatory (BBSO). The Stokes profiles are sampled around a center wavelength of 1.56μm, which represents the magnetic feature at deep photosphere. The obtained vector magnetic field has a spatial resolution as high as 0.166″ and a temporal resolution as high as 73s.

In between the sunspot group, a recurrent fan-like jet is well-identified in the chromospheric line of Ha, observed by the Visible Imaging Spectrometer (VIS; Cao et al. 2010) with a spatial resolution of 0.058″ and a temporal resolution of 33s.

Although the phenomenon of fan-like jet has been extensively studied in the past (Schmieder et al. 2021), and most of the works show the important role of magnetic field in driving it, the details of how the activity happens and how the associated magnetic field evolves are missing. In the present work, with the high-resolution observations at three different layers in between the photosphere and chromosphere, a comprehensive interpretation has been achieved for the fan-like jet event.

Since the fan-like jet occurs repeatedly, an isolated jet event is selected for study to avoid the mixture of two consecutive events. The kinetic features of the fan-like jet itself and the ones at the footpoints of the jet have been investigated. For the jet, a maximum projected velocity of 42 km s^{-1} and a Doppler shift of the order of 20 km s^{-1} is derived. For the footpoints at the chromophere, a long-lasting heating is suggested according to the lifted center of Ha line profile. For the footpoints at the photosphere, magnetic parasitic polarities along the intergranular lanes are identified with very high resolution pattern, accompanied by high-velocity converging flows (4 km s^{-1}). Specifically, horizontal magnetic field around 1000 G is generated impulsively along the intergranular lanes, which is reported for the first time.

Overall, all the kinetic features at the different layers through the photosphere and chromosphere favor a convection-driven reconnection scenario for the recurrent fan-like jets and evidence a site of reconnection between the photosphere and chromosphere corresponding to the intergranular lanes.

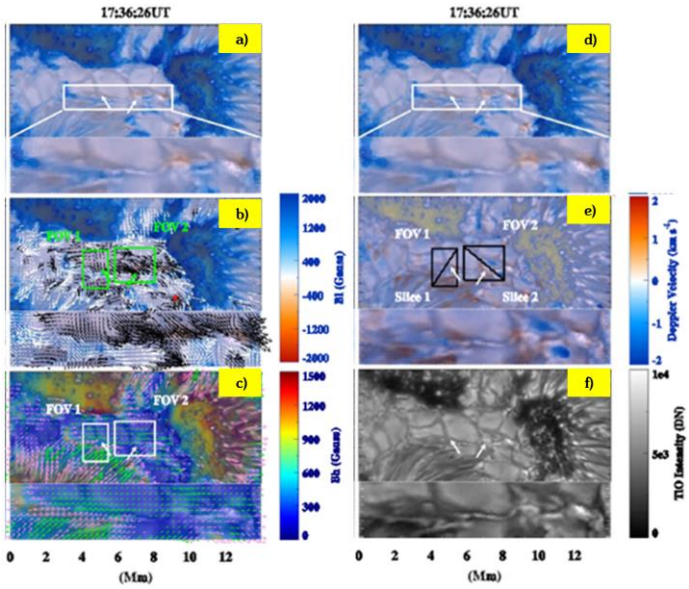

Figure 1: Composite images of TiO with LOS magnetic field (B_l; panels a,b,d)), horizontal magnetic field (B_h; panel c)), and Doppler velocity (V_{Dop}; panel e)) at the time of fan-like jet event are displayed, while the TiO image is displayed in panel f) for comparison. The arrows in panel b) show the surface flow and the ones in panel c) show the horizontal field, with white (pink) and black (green) colors represent positive and negative B_l, respectively.

References:
Zhao, J. et al. 2022, ApJ, 932, 95
Schmieder, B., Joshi, R., & Chandra, R. 2021, arXiv:2111.09002