Workshop on Ground-based Instrumentation for Solar Astronomy

A one day workshop on **Ground-based Instrumentation for Solar Astronomy** was organised by the Udaipur Solar Observatory, PRL and the Indian Institute of Astrophysics (IIA) on 13th February 2020 during the **38th Annual Meeting of the Astronomical Society of India** at IISER Tirupati. The objective of the workshop was to discuss the ongoing instrumentation efforts at different institutions/observatories engaged in ground-based solar observations in different wavelengths. The workshop also provided a platform for discussions and possible collaborations on Instrumentation and Science using the 0.5 m Multi Application Solar Telescope (MAST) at USO and the proposed 2 m National Large Solar Telescope (NLST). The Workshop comprised four sessions as follows -

1. MAST back end instrumentation and observations
2. NLST - The main telescope, proposed science and back end instruments
3. Coordinated observations with other Ground and Space-based instruments
4. Adaptive Optics and high resolution imaging for solar observations

Participants of the Workshop included Scientists, Engineers, PhD students, and Post-docs from USO-PRL, IIA, NCRA, and MPS Göttingen.

Swachhta Pakhwada at USO, 1 -15 February 2020

Staff members and students of USO/PRL took the "Swachhta Shapath" on 31st January, 2020 in the Seminar Hall. Mass cleanliness and sanitation drive was carried out in the office premises on 10th February, 2020. This involved cleaning the area around the canteen and workshop. A quiz competition was held on 12th February as per the instructions the PRL Swachhta Committee, on the topic of 'Swachhta'. Twelve staff members, including students and trainees, participated in the quiz. An essay competition with the theme "Beat the Plastic Pollution" was also conducted on 13th February 2020 in which seven staff members took part. The cleaning of office rooms, removal of waste materials/records from the office rooms were carried out on a routine basis during the Pakhwada period.

Visit of B.Sc. Students from Pandit Deendayal Petroleum University Gandhinagar

A group of 26 B.Sc. students and 5 faculty members from **Pandit Deendayal Petroleum University (PDPU)** Gandhinagar visited USO-PRL on 31st January 2020. After a brief introduction on the Sun and research activities at USO, the group were shown the GONG and e-CALLISTO facilities in the campus.

Fizeau Mask Interferometry of Solar Features Using the Multi-application Solar Telescope at the Udaipur Solar Observatory

*(**A. Raja Bayanna**, P. Venkatakrishnan, Sridharan Rengaswamy, Shibu K. Mathew)*

A. Raja Bayanna

Efforts are made to demonstrate high-resolution observations of the solar atmosphere using aperture masking interferometry. Covering the telescope pupil with a Fizeau mask, consisting of two small circular apertures separated by a vector distance known as the baseline, is the first step towards interferometric imaging. A mask with two circular holes of diameter 7 cm each and separated by a distance of 19 cm was placed in the pupil plane of the Multi-application solar telescope (MAST) at Udaipur Solar Observatory. The experiment was extended with baselines of 29 cm and 38 cm. Observations were carried out in two spectral bands, centred at 656.3 nm (Hα) and 861.0 nm (near-infrared; NIR) using filters of bandwidth 1 nm and 330 nm, respectively. We find that both in Hα and the NIR, fringes were visible above the background at a large number of places showing a ubiquitous distribution of unresolved sources uniformly over the field of view (Figure 1). It is seen that the fringe period and the fringe contrast decreases with an increase in the baseline length (Figure 2). The measured fringe visibilities at baselines of up to 38 cm, indicates a resolution several times higher than the seeing limit. In order to understand the effect of the spectral bandwidth on fringe visibility, the latter was calibrated using numerically estimated speckle transfer function including the bandwidth decorrelation function.The calibrated visibilities indicate that it is advantageous to observe at NIR due to the large atmospheric coherence diameter and coherence time despite the larger bandwidth. The results of the present experiment are encouraging to attempt diffraction limited imaging with sparse aperture sampling using Golay masks.

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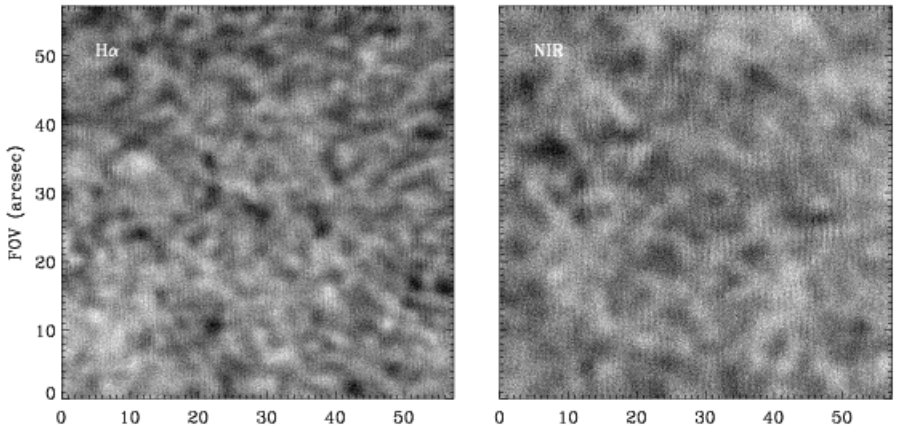

Figure 1. Cut-outs of images obtained using Fizeau mask with smaller baseline (19 cm). Images on the left and right are actual images showing the fringes observed in Hα and NIR wavelengths on 27th April and 1st May 2018, respectively.

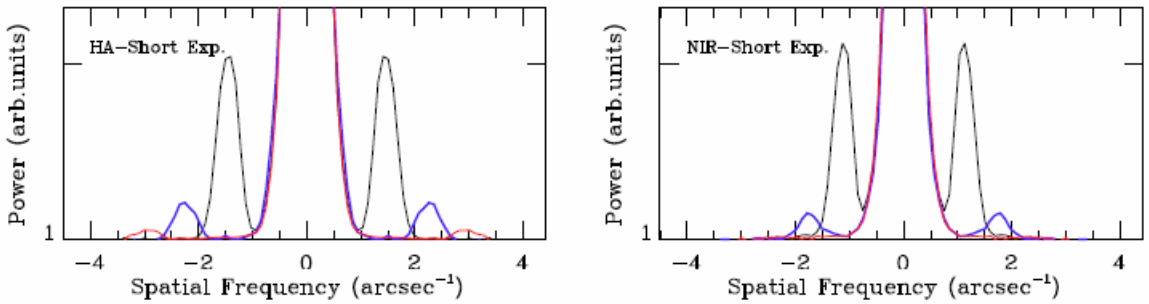

Figure 2. Averaged power spectrum of the observations with H$\alpha$and NIR filters are shown on the *left* and *right panels*, respectively. Black, blue, and red colours indicate baselines of 19 cm, 29 cm, and 38 cm, respectively.

Identification of Pre-flare Processes and Their Possible Role in Driving a Large-scale Flux Rope Eruption with Complex M-class Flare in the Active Region NOAA 12371

(**Prabir K. Mitra**, Bhuwan Joshi, Avijeet Prasad)

Prabir K. Mitra

Often, a flare is preceded by pre-flare (and/or precursor) phases where small-scale energy release can be observed in mostly soft X-ray (SXR), extreme ultra-violet (EUV), and optical wavelengths. In this work, we show how a series of small-scale precursor activities lead to the destabilization of a meta-stable flux rope which is analogous to the 'Domino effect'. Our observation suggests that the active region underwent a prolonged phase of flux enhancement followed by a relatively shorter period of flux cancellation prior to the onset of the flare which led to the build up and activation of a hot channel (shown by the yellow arrow in Figure 1(a)). Non-Linear Force Free Extrapolation results reveal a set of twisted flux rope co-spatial to the hot channel (sky colored lines in Figure 2). Our analysis reveals strong, localized regions of photospheric currents of opposite polarities at the adjacent precursor location (the location of the pink lines in Figure 2), thereby making the region susceptible to small-scale magnetic reconnection. Precursor reconnection activity from this location (shown by the red arrow in Figure 1(a)) induced a slipping reconnection in the yellow lines shown in Figure 2. This slipping reconnection was observed as a moving flash along a semicircular arc from the precursor location towards the northern leg of the hot channel (indicated by the red arrow in Figure 1(b)) which led to the destabilization of the flux rope (shown by the blue arrows in Figure 1(b)).

https://doi.org/10.1007/s11207-020-1596-2

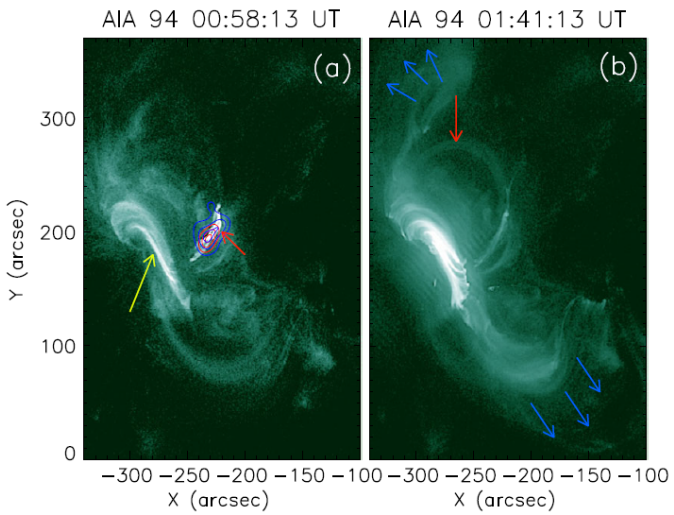

Figure 1. Panel (a): AIA 94 Å images of AR NOAA 12371 showing the activated hot channel and the adjacent precursor activity (indicated by the yellow and the red, respectively). Panel (b): The moving flash that triggered the eruption of the hot channel (long the arc indicated by the red arrow). The eruption of the hot channel is shown by the blue arrows. The contours in panel (a) represent RHESSI X-ray sources in 6 – 12 keV (red) and 12 – 25 keV (blue) bands.

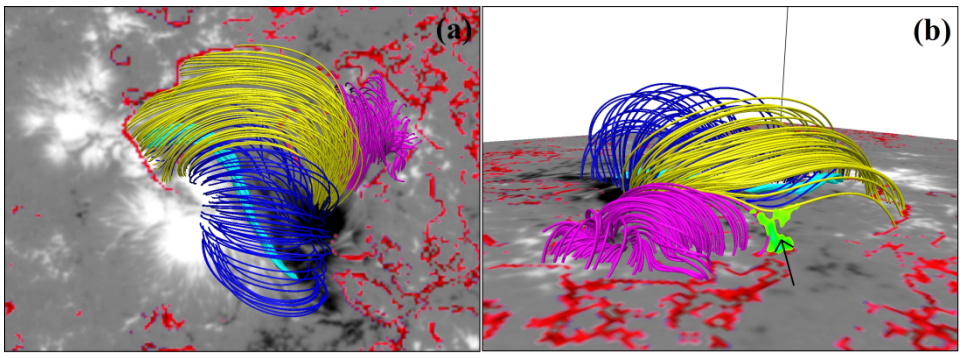

Figure 2. Model coronal field lines showing the pre-flare configuration of AR NOAA 12371 from top (panel (a)) and side (panel (b)) views. The arrow in panel (b) indicates a quasi-separatrix layer. The red areas in the background are characterized by high Q-values which is susceptible for slipping reconnection.