

## OBSERVING TIME PROPOSAL FORM FOR NEW SOLAR TELESCOPE (NST)

### Important Notes:

#### Two Proposal Submission Deadlines:

- 15 April 2015 for Session 1 (May 1 - June 30)
- 1 June 2015 for Session 2 (July 1 - 31 and September 15 - October 31)

1. Time window available for 2015: May 1 - July 31 and September 15 - October 31;
2. For the information of NST and BBSO, please visit <http://www.bbso.njit.edu>;
3. For the instrument information, feel free to contact Prof. Wenda Cao at [wcao@bbso.njit.edu](mailto:wcao@bbso.njit.edu);
4. Final decision on telescope allocation for session 1 and session 2 will be made no later than April 25 and June 15 2015, respectively by BBSO Telescope Allocation Committee (TAC). High priority may be given to the PIs who produced good scientific results from the previous observations, to the proposals with scientifically challenging and achievable objectives, and the observing proposal with coordinated observations.

**Make sure to submit your proposal in PDF format to Wenda Cao (TAC chair) via [wcao@bbso.njit.edu](mailto:wcao@bbso.njit.edu) before the deadlines**

Qualified internal and external applicants:

1. Internal applicants refer to the scientific staff residing at BBSO, scientists and students in NJIT's Center for Solar-Terrestrial Research, and BBSO partners.
2. External applicants refer to the scientists and students from the institutes or universities in USA recognized by NSF or NASA.
3. The PI must have a PhD degree or be a PhD student with the supervisor as the Co-I.

### Acknowledgement Requirement:

Please acknowledge BBSO and the instrument PIs in the paper relevant to this observation:  
*BBSO operation is supported by NJIT, US NSF AGS-1250818 and NASA NNX13AG14G*

# 1 General Information

## 1.1 Applicant Name and Affiliation

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PI: Zeng, Zhicheng NJIT  
Co-I\*: Cao, Wenda; Ji, Haisheng BBSO/NJIT/Purple Mountain Observatory

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\*Note that Co-Is have the same data access rights as the PI. Please coordinate data access among team members.

## 1.2 Proposal Information

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- Renewal or continuation
- Linked to an US NSF funding
- Linked to an NASA funding
- Linked to a PhD thesis in preparation and led by a PhD student
- A coordinated observation with a ground-based telescope
- A coordinated observation with a space-based observatory (e.g. IRIS or Hinode)

## 1.3 Observing Conditions

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- Good Seeing
- Sky Clarity
- Low Water Vapor
- Specific Solar Activity
- Quiet Sun Observation
- Solar Limb Tracking

## 1.4 Preferred Observing Date and Time\*

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- Fixed Date: 13 - 19 June 2015
  - Flexible Date: 5-7 days, this July
  - Fixed Observing Time: 18:20:45 UT - 19:00:05 UT
  - Suggested Observing Time: 16:30:00 UT - 22:30:00 UT
  - Observing Conditions Permitting
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\*Note that Fridays may be occupied for telescope engineering time.

## 2 Scientific Rationale

### 2.1 Title

**Magnetic activities along inter-granular lanes and their role for coronal heating and material ejection**

### 2.2 Abstract

Following previous notable achievements made with NST, we would like to observe magnetic activities (reconnection) along inter-granular lanes driven by convection motions with the aim to explore the nature of magnetic reconnection and its roles in coronal heating and small-scale jet events. Since it is believed that the small-scale reconnection is ubiquitous in the lower atmosphere, we have no preference for specific regions, though we have a preference for active regions. We will apply coordinated observations by IRIS and/or HINODE.

### 2.3 Short Summary of the Request

We would like to observe high-resolution magnetograms with NIRIS and small-scale activities with VIS in  $H_\alpha$ . High-resolution observations of photosphere with BFI at  $\text{TiO } 7057 \text{ \AA}$  is required. For the purpose of this scientific aim, we require VIS observations extend to  $H_\alpha$  continuum for a precise co-alignment with photosphere and corresponding magnetogram.

### 2.4 Scientific Rationale

Coronal heating is a long standing problem in astrophysics. For solving this problem we need simultaneous high-resolution observations from the solar photosphere (including magnetogram) to the corona. This requires both ground-based and space-based observations for cold and hot atmosphere respectively. Thus, for NST and its instrument NIRIS, it is a timely topic considering HINODE, SDO and IRIS are working very well in orbit. With the advent and successful running of NST, solar observation has entered the era of 0.1 arc second. This permits us to carry out case studies for a single coronal heating event, accumulating original high-resolution observational evidences for a final resolving of the coronal heating problem. In previous studies made with NST by Ji, Cao and Goode (2012), they reported the first direct observations of dynamical events originating in the sun's photosphere and subsequently lighting up the corona. In their paper, continuous small-scale, impulsive events have been tracked from their origin in the photosphere on through to their brightening of the local corona. For two heating events, Yang et al. (2015) found that the two events are rooted at one side of magnetic polarity inversion line. Even with low-resolution HMI magnetograms, they found that one event is apparently accompanied by the disappearance of a tiny magnetic element while, in another event, weakening of a magnetic concentration area is found. Changes for granules are also found during the two events.

Also with NST observations, we discovered the first evidence of magnetic reconnection driven by advection in a rapidly developing large granule using high spatial resolution observations of a small surge event (Zeng, Cao and Ji) (Figure 1). The results suggested that heating events and small-scale ejections are caused by magnetic activities in inter-granular lanes driven by constant granule convection. It appears that ubiquitous small-scale magnetic activities produce outflow of cold matter and hot matter (Yang et al. 2015). We need further well-devised multi-wavelength high-resolution observations, especially, high-resolution magnetograms to confirm this physical picture.

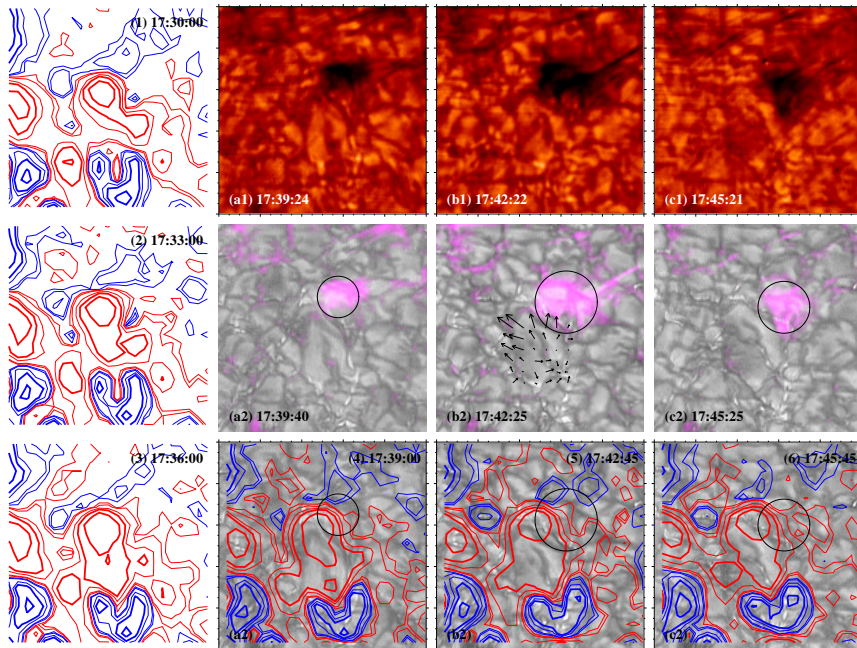


Figure 1: (a1-c1): A series of 10830 Å filtergrams showing the evolution of the surge and underlying granules. (a2-c2): Simultaneous TiO images (gray) overlaid with the surge (pink) extracted from (a1-c1). Black circles encompass the surge's roots, which anchor in the intergranular area. In panel b2, we over plot the transverse proper motion obtained through FLCT method on the large granule beside the surge, with maximum speed about  $2 \text{ km s}^{-1}$ . (1)-(6): Time series of contours of line-of-sight magnetic field. The contours are overlaid on simultaneous TiO images when they are available. Red and blue contour represent positive and negative magnetic field, respectively, with contour levels at  $\pm 10$ ,  $\pm 30$ ,  $\pm 50$  (thick contours), and  $\pm 100$  Gauss (thick contours).

## 2.5 Results from Previous NST Observations

See above

## 2.6 List of Relevant Publications

Ji, H., Cao, W., & Goode, P.R. 2012, ApJ, 750, L25

Yang, X. et al. 2015, CHA&A, 39, 66

Zeng, Z., Cao, W. and Ji, H. 2013, ApJ, 769, L33

## 2.7 Expected Results

Lots of well-sampled heating events located in inter-granular lane area accompanied by possible signature of magnetic changes. Statistical studies are possible.

## 3 Observing Programme

### 3.1 Instrumentation Requirements\*

- Adaptive Optics (AO-308)
- Broad-band Filter Imager (BFI)
- Fast Imaging Solar Spectrograph (FISS)
- Visible Imaging Spectrometer (VIS)
- Infrared Imaging Spectro-polarimeter (NIRIS)
- Cryogenic Infrared Spectrograph (CYRA)
- Other

\*Note that FISS and VIS can't be used simultaneously. CYRA can't operate with all other instruments simultaneously.

### 3.2 Observational Strategy

1) What types of data are urgently needed?

Simultaneous TiO 7057 Å imaging, VIS observations around H $\alpha$ , magnetograms at 1.56  $\mu$  with NIRIS are equally important.

2) What are the typical cadence?

For TiO 7057 Å imaging, we need cadence of 15 seconds. For VIS line scan, we need  $\pm 0.6$ ,  $\pm 0.8$ ,  $\pm 1.0$  Å at the cadence of 10 seconds. As for NIRIS, as a first step, we would like to have only V-component with high cadence,

3) Whether you desire image reconstruction especially for VIS data?

Yes.

4) Other space-borne and ground-based instruments for coordinated observations.

As stated above, we will apply coordinated observations by IRIS and/or HINODE. If it is not successful, we will try to follow the regions targeted by IRIS and/or HINODE.

\*VIS line scan currently includes 11 optional wavelength points of 0.0,  $\pm 0.2$ ,  $\pm 0.4$ ,  $\pm 0.6$ ,  $\pm 0.8$ ,  $\pm 1.0$  Å. Please specify the cadence and wavelength points carefully since your decision will affect the total amount of data we collect. The minimum cadence is 25 sec for a 11-point line scan and 3-4 sec for a 2-point line scan.

### **3.3 Target and Conditions**

The scheduled observations require very good seeing condition.