

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;
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 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

PI: **Jing, Ju** New Jersey Institute of Technology

Co-I*: **Xu, Yan** New Jersey Institute of Technology

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

1.2 Proposal Information

- 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

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

1.4 Preferred Observing Date and Time*

- Fixed Date: 8 - 14 June 2015
 - Flexible Date: 5 - 7 days
 - Fixed Observing Time: 18:20:45 UT - 19:00:05 UT
 - Suggested Observing Time: 16:00:00 UT - 23:00:00 UT
 - Observing Conditions Permitting
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*Note that Fridays may be occupied for telescope engineering time.

2 Scientific Rationale

2.1 Title

High Resolution Observation of Active Region Filaments

2.2 Abstract

We are going to study the twist structure of active-region filaments. We will also study the morphological and dynamic properties of the mass motions in and around filaments.

2.3 Short Summary of the Request

A twisted magnetic flux bundle, i.e., a magnetic flux rope, is a crucial configuration for hosting chromospheric material showing as a filament. To a great extent, our knowledge of the magnetic reconnection/eruption scenario depends on how well we can characterize in quantitative detail the structure and topology of a magnetic flux rope and its embedding field. Moreover, mass motions in and around filaments have attracted a great deal of attention from solar physicists, since the investigation of this motion may provide important clues to magnetohydrodynamic instability in filaments and also sheds light on the still not well understood filament formation process. Using BBSO high-resolution off-band $H\alpha$ filtergrams, Zirker, Engvold, & Martin (1998) found a type of filament motion that is in the form of counter-streaming flows, at speeds of 5–10 km s⁻¹. Another type of large-amplitude oscillatory mass motion was also identified using the BBSO $H\alpha$ camera system (Jing et al., 2003; Jing et al. 2006). The oscillatory motion is along the filament axis with a very high velocity amplitude of ≥ 30 km s⁻¹, and are often associated with nearby flares.

Observation of twist structure of filaments and detection of mass motions require high spatial resolution images and time-series of observations over several hours. The high resolution ability of the NST instruments is very suitable for our scientific goal. We will collect BFI G-band or TiO images, VIS $H\alpha$ images and NIRIS Stokes data, which forms the key components of the expected data set for the proposed study.

Jing, J., Lee, J., Spirock, Thomas J., Xu, Y., Wang, H., & Choe, G. S.: 2003, *Astrophys. J.* 584, L103

Jing, J., Lee, J., Spirock, Thomas J., & Wang, H., 2003, *Sol. Phys.* 236, 97

Zirker, J. B., Engvold, O., & Martin, S. F. 1998, *Nature*, 396, 440

2.4 Results from Previous NST Observations

Taking advantage of the high-resolution and high-cadence of the NST, we found the rapid formation of sunspot penumbra that is closely associated with the C7.4 flare of NOAA active region (AR) 11515. The formation of penumbra is substantiated by the transformation of the solar granulation pattern into penumbral fibril structure, and is accompanied by the persistent penumbral darkening and the horizontal field enhancement.

2.5 List of Relevant Publications

Jing, J., Lee, J., Spirock, Thomas J., Xu, Y., Wang, H., and Choe, G. S.: 2003, *Astrophys. J.* 584, L103

Jing, J., Lee, J., Spirock, Thomas J., Wang, H., 2003, *Sol. Phys.* 236, 97

Wang, H., Liu, C., Wang, S., Deng, N., Xu, Y., Jing, J. & Cao, W. 2013, *ApJ*, 774, L24

2.6 Expected Results

We expect to observe the twisting structure in filaments in great detail and how it evolves. We also expect to capture the mass motion in and around filaments.

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

This section is devised for you to address following issues:

1) what types of data are urgently needed?

We plan to obtain time series of high resolution G-band or TiO images, H α imaging spectroscopic data and magnetograms, using BFI, VIS and NIRIS respectively.

2) what are the typical cadence, preferred observing mode, wavelength points for VIS line scan and NIRIS line scan range?

When seeing is good, we would like our observations to have the highest cadence available. Typical cadence desired is 10-20 s. If seeing is not very good, the cadence can be lower to save data volume. For VIS, we would like 5 wavelength points at 0.0, ± 0.4 and ± 1.0 Å. For NIRIS, we propose to obtain Stokes IQUV spectra for the Fe I 1564.85 nm line covering ± 1.3 Å range.

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

Yes.

4) other space-borne and ground-based instruments for coordinated observations?

No.

*VIS line scan currently includes 11 optional wavelength points of 0.0, ± 0.2 , ± 0.4 , ± 0.6 , ± 0.8 , ± 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

We would like to observe active-region filaments on disk. Specially, an ideal target would be a filament that locates in a complex active region with strong potential of flare productivity. Our proposed observations require good seeing conditions.