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)

• <u>1 June 2015</u> 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:Deng, NaNew Jersey Institute of TechnologyCo-I*:Wang, HaiminNew 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

 \Box Renewal or continuation

☑ Linked to an US NSF funding

 \blacksquare Linked to an NASA funding

□ Linked to a PhD thesis in preparation and led by a PhD student

 \blacksquare A coordinated observation with a ground-based telescope

 \square A coordinated observation with a space-based observatory (e.g. IRIS or Hinode)

1.3 Observing Conditions

 \square Good Seeing

Sky Clarity

☑ Low Water Vapor

 \Box Specific Solar Activity

Quiet Sun Observation

 \Box Solar Limb Tracking

1.4 Preferred Observing Date and Time*

☑ Fixed Date: 8 - 14 June 2015

 \Box Flexible Date: 5 - 7 days

 \square Fixed Observing Time: 18:20:45 UT - 19:00:05 UT

☑ Suggested Observing Time: 14:00:00 UT - 23:00:00 UT

Observing Conditions Permitting

*Note that Fridays may be occupied for telescope engineering time.

2 Scientific Rationale

2.1 Title

High Resolution Spectroscopic Study of Small-Scale Jets

2.2 Abstract

We are going to carry out an observing campaign coordinating New Solar Telescope (NST) at the Big Bear Solar Observatory (BBSO), Dunn Solar Telescope (DST) at the National Solar Observatory (NSO), Interface Region Imaging Spectrograph (IRIS) and Hinode in June 8-14, 2015. The interesting targets are quiet Sun jets (i.e., Rapid Blueshifted Excursions (RBEs)) and jet-related phenomena in active region, such as Ellerman Bombs and penumbral bright dots.

2.3 Short Summary of the Request

Small-scale dynamics in the quiet Sun play an important role in coronal heating and mass transport for the solar wind. In particular, jets, mostly in the form of spicules, may be responsible for carrying energy and momentum sustaining heating and flows. The recent discovery of type II spicules is of particular importance due to their high speed, rapid heating, and large vertical extent. Their on-disk counterpart is believed to be "Rapid Blueshifted Excursions" (RBEs; Langangen et al. 2008). Although the dynamic properties of type II spicules and RBEs have been extensively studied, their formation mechanism is still unclear and need further exploration (e.g., Deng et al. 2015). The disk observations of RBEs in quiet Sun and coronal hole will allow us to study their statistical and magnetic properties in detail.

Recently, using IRIS observation, Tian et al. (2014) discovered subarcsecond short-lived brightenings above sunspot penumbra in the transition region. The formation mechanism of these bright dots and their vertical extent are still unclear. The chromospheric observation will help to address these questions.

The high resolution ability of the NST instruments is very suitable for our scientific goal. We will collect TiO images, VIS H α images, FISS H α and Ca 8542 spectra, and NIRIS Stokes data. These data will be valuable for the jet study.

Langangen, O. et al. 2008, ApJ, 679, L167Tian, H., Kleint, L., Peter, H., et al. 2014, ApJL, 790, L29

2.4 Results from Previous NST Observations

Using NST observations, we found a rapid formation of a δ sunspot associated with the 2012 July 2 C7.4 flare. We also studied two successive three-ribbon flares on 2012 July 6. A study of penumbral bright dots is underway.

2.5 List of Relevant Publications

Deng, N., Chen, X., Liu, C., Jing, J., Tritschler, A., Reardon, K. P., Lamb, D. A., Deforest, C. E., Denker, C., Wang, S., Liu, R., & Wang, H. 2015, ApJ, 799, 219

Wang, H., Liu, C., Deng, N., Zeng, Z., Xu, Y., Jing, J. & Cao, W. 2014 ApJ, 781, L23

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

Deng, N., Tritschler, A., Jing, J., Chen, X., Liu, C., Reardon, K., Denker, C., Xu, Y. & Wang, H. 2013, ApJ, 769, 112

2.6 Expected Results

The high resolution observation from NST for jets and small-scale energy release events will enable a better understanding of their physical properties and origins.

3 Observing Programme

3.1 Instrumentation Requirements*

- \square Adaptive Optics (AO-308)
- ☑ Broad-band Filter Imager (BFI)
- ☑ Fast Imaging Solar Spectrograph (FISS)
- \square Visible Imaging Spectrometer (VIS)
- ☑ Infrared Imaging Spectro-polarimeter (NIRIS)
- \Box Cryogenic Infrared Spectrograph (CYRA)
- \Box 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 need time series of high resolution TiO images, VIS (H α) or FISS (H α and Ca 8542) observation, and NIRIS magnetograms. We are aware that VIS and FISS cannot be used simultaneously. We may observe with VIS for the first half and with FISS for the second half of the observing run. Or if it is feasible, we may observe with VIS in the morning and with FISS in the noon and afternoon.

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 highest cadence available. Typical cadence desired is 10-20 s. If seeing is not very good, the cadence can be lower to save data volumn. For VIS, we would like 5 wavelength points at 0.0, ± 0.5 (if possible), ± 1.0 Å. If ± 0.5 Å cannot be achieved, we would like ± 0.4 Å. For NIRIS, we propose three modes. 1. For active region/sunspots observation, obtain Stokes IQUV spectra for the Fe I 1564.85 nm line covering ± 1.3 Årange. 2. For quiet Sun observation, obtain Stokes I and V spectra for the Fe I 1564.85 nm line covering ± 1.3 Årange. 3. For quiet Sun, obtain high cadence Stokes V images that are fixed to one wavelength at the line wing of Fe I 1564.85 nm to perform image reconstruction or make deep magnetograms.

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

Yes.

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

NSO/DST has approved our observing proposal for June 8-14, 2015. IBIS will observe Ca 8542 and H α lines. FIRS will observe 10830 line. The space mission IRIS has agreed to support our observation in June 8-14. We will also apply for Hinode support.

*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

If the seeing is extremely good so that AO is able to lock granulation, we would like to observe quiet Sun near disk center or coronal hole. Otherwise, we would like to observe sunspots on disk. If there is a complex active region that is likely to produce flares, we would like to target it.