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:	Chae, Jongchul	Seoul National University
Co-I*:	Cho, Kyuhyun; Song, Donguk	Seoul National University
Co-I*:	Cho, KyungSuk; Lim, Eunkyung	Korea Astronomy and Space Science Institute

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

1.2 Proposal Information

 \blacksquare Renewal or continuation

□ Linked to an US NSF funding

 \Box Linked to an NASA funding

 \blacksquare Linked to a PhD thesis in preparation and led by a PhD student

 \square A coordinated observation with a ground-based telescope

 \Box 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

 \Box Quiet Sun Observation

 \Box Solar Limb Tracking

1.4 Preferred Observing Date and Time*

 \blacksquare Fixed Dates: 15 - 19 June 2015

 \Box Flexible Date: 5 - 7 days

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

Ø Suggested Observing Time: 16:30:00 UT - 22:30:00 UT

□ Observing Conditions Permitting

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

2 Scientific Rationale

2.1 Title

Observations of Chromospheric Oscillations and Waves in Sunspots

2.2 Abstract

We propose to continue to observe oscillations and waves in sunspots with the FISS and NIRIS of the NST, hopefully coordinating with IRIS and Hinode. From previous observations we detected the shock merging in the chromosphere of sunspots. We will carry out new observations to detect oscillations and waves at the different layers of the atmosphere: the photosphere, temperature minimum, chromosphere, transition region and corona. The expected result is the finding of the connection of the different layers by propagating waves and shocks.

2.3 Short Summary of the Request

We request five days of telescope time under the fine observing conditions to observe regions of small sunspots with the FISS and NIRIS of the NST. Three days will be used for the standard FISS observation and two days will be used for non-standard observations.

2.4 Scientific Rationale

The chromosphere of a sunspot abounds in oscillations and waves, so that these oscillations and waves can be exploited for the investigation of thermodynamic structures and magnetic structures of sunspots. For this goal, it is very important to identify oscillations and waves, and to understand the relevant physical processes. Combining the magnetic field information and chromospheric velocity field information is important so that the simultaneous observations with the FISS and NIRIS are required. It is also important to combine the NST observations of the chromosphere and the IRIS observations of the transition region, and the SDO observations of the corona. This time we particularly attempt to carry out non-standard FISS observations. We will record the spectral profiles of the Fe I 5434, a non-magnetic line whose formation height ranges from the photosphere to the temperature minimum. With this line, we will be able to investigate the connection between the photosphere and the chromosphere

2.5 Results from Previous NST Observations

From previous observations, we have found that the fibrils in the superpenumbra of a sunpot are powered by sunspot oscillations. The most important result is the finding that shock waves often merge each other.

2.6 List of Relevant Publications

Chae et al. 2014, ApJ, 789, 108 Chae et al. 2015, ApJ letter, 2006, in preparation

2.7 Expected Results

The expected result is the finding of the connection of the different layers by propagating waves and shocks. We particularly expect to find how chromospheric oscillations develop near the temperature minimum.

3 Observing Programme

3.1 Instrumentation Requirements*

 \square Adaptive Optics (AO-308)

☑ Broad-band Filter Imager (BFI)

☑ Fast Imaging Solar Spectrograph (FISS)

 \Box Visible Imaging Spectrometer (VIS)

☑ Infrared Imaging Spectro-polarimeter (NIRIS)

□ 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

Basically we aim to obtain 20 s cadence data from the FISS, which constrains the width of the scan to 20 arc seconds. The standard setup will record the dual band: one around the H α line and theother around CaII 854.2 nm line simultaneously. The non-standard setup will use the single band around the Fe I543.4 nm.

3.3 Target and Conditions

The best target is a small and round sunspot well separated from other sunspots. Thus the targets will be found in least-active active regions.