

## 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:** Penn, Matt National Solar Observatory

**Co-I\*:** Schad, Tom University of Hawaii

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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:
  - Flexible Date: November 2015
  - Fixed Observing Time:
  - 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

**CYRA observations of CO 4666nm**

### 2.2 Abstract

Observations of the dynamics in the cool chromospheric plasma using CO 2331nm and 4666nm are proposed. We will evaluate the ability of CYRA to return high spatial resolution, rapid cadence observations of the quiet Sun intensity, velocity and line width parameters.

### 2.3 Short Summary of the Request

We will make exploratory observations with CYRA using the intensity spectra of CO at 2333nm and 4666nm to search for the emergence of cool magnetic bubbles as recently seen in Ca 854.2nm.

### 2.4 Scientific Rationale

Observations of the fundamental lines of CO at 4666nm resulted in dramatic changes to models of the solar (at stellar) atmosphere (Ayres 1981, Wiedemann et al, 1994). The spectral lines reveal the existence of large quantities of cool gas in the upper photosphere and lower chromosphere.

Observations of these CO lines have resulted in a better understanding of the quiet Sun dynamics (Uitenbroek 2000) and of the radiative relaxation frequency of the solar atmosphere (Penn et al 2011). An anti-correlation between the CO line strength and quiet Sun magnetic fields has been shown (Uitenbroek 2000), but these lines have not been used to explore the solar magnetic field in detail.

Recent work from Ortiz et al (2014) reveal the emergence of cool magnetic bubbles in the quiet Sun, with temperatures 250K below the surrounding gas and which rise through the solar photosphere and chromosphere (and corona?) at roughly 5 km/sec. Using the known anti-correlation of the CO line and magnetic fields, and through exploring the variation of the CO spectral line parameters, we will search for signatures of these cool magnetic bubbles using data from CYRA.

### 2.5 Results from Previous NST Observations

No science observations with CYRA have been made yet.

## 2.6 List of Relevant Publications

Ayres 1981, ApJ 234 1064

Ortiz et al 2014, ApJ 781 126

Penn et al., 2011 ApJ 734 47

Uitenbroek, 2000, ApJ 531 571

Wiedemann et al 1994, ApJ 423 806

## 2.7 Expected Results

# 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

Use the CYRA correlation tracker to track on granulation or a small sunspot while producing large FOV scans of the quiet Sun areas in either CO 2333nm or 4666nm for several hours during each clear day.

## 3.3 Target and Conditions

Clear skies with reliable CYRA tracking using the correlation tracker.