

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

## 1 General Information

### 1.1 Applicant Name and Affiliation

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### 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 Vapour
- Specific Solar Activity
- Quiet Sun Observation
- Solar Limb Tracking

## 1.4 Preferred Observing Date and Time\*

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Flexible Date: in July 2015

Flexible Date: 7 days

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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## 2 Scientific Rationale

### 2.1 Title

**Fine-scale and spectral studies of Solar Filaments**

### 2.2 Abstract

Filaments on the Sun often exhibit a wide variety of phenomena. Through the studies of these, one can arrive at the underlying mechanism that leads to the observed phenomena. We propose to observe the longitudinal oscillation of filament threads using FISS and VIS instruments. While FISS would provide the Doppler information, VIS would give us high-resolution images in different line positions.

### 2.3 Short Summary of the Request

We wish to observe a filament with clearly distinguishable threads. This would require very good seeing as the filament threads are often as fine as  $0.2''$ . The filament should be closer to disc centre, whereby the projection effects in the thread velocity would be minimal.

### 2.4 Scientific Rationale

Filaments are composed of closely spaced fine threads, of widths less than  $0.2''$  (Lin et al. 2005). Large scale 'counter-streaming', i.e. flows in opposite directions in closely spaced threads are famously reported by Zirker et al. (1998). A filament channel, with fibrils in  $H\alpha$  aligned along its length, is essential for the formation of a filament (Martin et al. 1998).

For a filament in the developing stages, the mechanism of mass accumulation can be studied in detail using spectroscopic data, coupled with magnetic field and extreme ultra-violet (EUV) observations. On the other hand, for a well-formed filament, oscillations in the threads can be observed. Recently, Chen et al. (2014) have shed new light on the mechanism of counter-streaming by observing not oppositely-directed flows but distinct patches of upflows and downflows. Luna et al. (2014) have observed longitudinal oscillations, with  $\sim 80$ -minute periodicity, in filament threads as a response to episodic jets in neighbouring active region. It is also possible through such studies to determine the magnetic field in the filament, which otherwise is difficult to observe.

## 2.5 Results from Previous NST Observations

N/A

## 2.6 List of Relevant Publications

Chen, P.F., Harra, L.K. & Fang, C. 2005, *Astrophys. J.*, **784**, 50

Luna, M., Knizhnik, K., Muglach, K., Karpen, J.T., Gilbert, H., Kucera, T.A. & Uritsky, V. 2014, *Astrophys. J.*, **785**, 79

Martin, S.F. 1995, *Solar Phys.*, **182**, 107

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

## 2.7 Expected Results

By observing oscillations in filaments threads, we plan to investigate the mass flow in the filament body. This also has an implication on the dynamic support that continuous motion in filament threads provide, and the magnetic field in the filament spine.

# 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: photospheric TiO images

### 3.2 Observational Strategy

We request observations from FISS and VIS for about two hours each. Field-of-view of H $\alpha$  observations from FISS has to be about 80". The VIS should image at 5 line positions,  $\pm 0.6 \text{ \AA}$ ,  $\pm 0.2 \text{ \AA}$ , and the H $\alpha$  line centre at a cadence of 20 s. If the conditions are not favourable for using both the instruments on the same day, FISS could be used one day and VIS the next day.

### 3.3 Target and Conditions

The target should be a filament, quiescent or active region, located close to the disc centre. The threads should be clearly visible so that their longitudinal oscillations can be studied. The central portion of filament spine should be covered. The proposed observations require good seeing conditions under which adaptive optics is able to lock on solar granulation. We would also like to obtain diffraction limited images after applying speckle reconstruction to all the images.