

A Proposal Summary

New Jersey Institute of Technology (NJIT) has been operating Big Bear Solar Observatory (BBSO) since July 1, 1997. Our current four year NSF grant started on March 1, 2004. This grant has been providing primary, backbone support for BBSO. Over the past three years since this grant started, the observatory has remained highly productive – both scientifically and in the development of requisite instrumentation. We have graduated 9 Ph.D.s, produced over 100 publications, and have had successful observing campaigns utilizing BBSO's new high order adaptive optics (AO) system. Further successful campaigns exploited our new near infrared magnetograph. In parallel, BBSO has reached the final stages in building its 1.6 meter clear aperture, off-axis New Solar Telescope (NST). The first-light of this telescope is expected in Fall 2007 with the commissioning phase to be completed about the time this proposal's funding would start. We anticipate that, over the next 5 to 10 years, the AO equipped NST will be the prime U.S. facility for high resolution studies of the Sun. Further, the NST will be an essential testbed for the 4-meter Advanced Technology Solar Telescope (ATST).

The instrumentation tasks (first two should be completed under current support) to be finished are:

1. Commission the NST into routine operation.
2. Integrate 96 actuator active optics system to NST.
3. Integrate visible and near infrared vector magnetograph systems to NST.

Using the aforementioned instruments and data from BBSO's rich archive, as well as space-based data from a number of new NASA missions, the highlights of the proposed scientific programs include (???LIST IS WEAK BECAUSE THE FOCUS SHOULD BE TO USE THE NST'S UNIQUE CAPABILITIES–WHERE IS THE NEW DIFFRACTION LIMIT ESSENTIAL???):

1. High cadence and high resolution studies of solar flare emissions. These observations will provide details of flare energy precipitation on sub-arcsecond spatial scales and sub-second temporal scale. In particular, we will attempt to understand the physics of our new discovery: flare ribbons initially contract before the well-known separations.
2. Comprehensive studies of vector magnetic fields associated with flares, filament eruptions and CMEs, to understand the triggering mechanism of the eruptions and atmospheric restructuring after the eruptions. In particular, we will attempt to understand the physics of our recent discovery: photospheric magnetic fields changes rapid and irreversibly associated with flares.
3. Study of flow fields in flare productive active regions will be advanced using high resolution, high cadence and continuous observations. In particular, we will investigate the structure and evolution of shear flows along flaring neutral lines and in new flux emergences.
4. Sustained sub-arc second resolution studies of active regions and the quiet sun. In particular, we will address the problems of the energy source of coronal heating, from the high resolution observations of footpoint motion, magnetic reconnection, and chromospheric signatures of energy release.

Finally, we address the two merit criteria required for an NSF proposal:

Intellectual merit: We will obtain and use the highest quality datasets, while developing and applying analytical tools to attack a number of critical, leading-edge problems in solar research. The NST will play a crucial, leading role in the advances in solar physics over next few years.

Broader Impact: Solar magnetic storms can impact human technologies in what is broadly called "space weather". At BBSO, high quality data and analytical tools will aid precise predictions of space weather. Further, BBSO is taking the lead in developing the next generation in solar instrumentation, while training the next generation of scientists who build instruments. An integrated approach to research and education is at the heart our efforts, which is reflected in this proposal.