Topic: Flare Dynamics in the Lower Solar Atmosphere

Project Title:
Study of Flare Footpoint Emissions Using Advanced Observing Tools

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Project Information:
Observations of flares at sub-arcsecond resolution with sub-second cadence in lower solar atmosphere have been very rare, but are crucial in understanding the initiation and energy release process of solar eruptions. Recent completion of the 1.6-m New Solar Telescope (NST) at Big Bear, the 1.5-m German GREGOR solar telescope on Tenerife (Canary Islands), and the Yunnan 1-m Telescope in China, in combination with a fleet of advanced space-borne instruments, RHESSI, Hinode, and Solar Dynamic Observatory (SDO), will enable a detailed study of flare dynamics at unprecedented resolution, cadence and wavelength coverage. Combining observations of three observatories in this project will maximize the chance to obtain suitable data sets. We will concentrate on the following two interrelated topics, for which high-cadence and high-resolution observations are highly desirable, to address some of the most important questions regarding the physics of flare footpoint emissions.

1. We will investigate the nature of flare elementary bursts, i.e. burst in the time scale around or below 1 second. We have previously successfully obtained high-quality photospheric/chromospheric flare observations with the Dunn Solar Telescope (DST) at the National Solar Observatory/Sacramento Peak (NSO/SP). The 1.6-m NST, 1.5-m GREGOR, and Yunnan 1-m Telescope are capable of advancing such observations. RHESSI data analysis with newly developed demodulation tool is complementary to optical observations. The observations will allow us to study the detailed evolutional properties of flare footpoints and their relation to photospheric magnetic fields. In particular, we recently found that the conjugate footpoints may move inward in the early phase of flares before the well-known separating motion. We will investigate possible relationship between this physical phenomenon and the implosion mechanism as proposed by Hudson (2000).
2. Using multi-wavelength visible and infrared continuum observations, we will systematically study the structure of white-light flares (WLFs). Among the most notable results in our previous studies have shown that the time profiles and the spatial characteristics of core and halo in WLFs behave quite differently. This is presumably due to different heating mechanisms such as direct heating and backwarming radiation. New observations are planned in multiple wavelengths to assess the viability of heating mechanisms in the core and halo. We will also explore the usage of imaging spectroscopy to further diagnosis the properties of flare kernel emissions.
The proposed research will extensively use data from space missions, RHESSI, SDO, and Hinode. It is in direct response to the solicitation of the Living with a Star (LWS) Focus Science Team addressing the "Flare Dynamics in Lower Atmosphere". It is closely relevant to one type of research in NRA: "Analysis of Footpoint Emissions to Understand Energy Transport of Flares".

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Summary: no summary

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