SOLAR FLARE DIAGNOSTIC IN AN UNPRECEDENTED FREQUENCY RANGE FROM MICROWAVES TO THZ FREQUENCIES: CHALLENGES FOR INTERPRETATION (FLAT)

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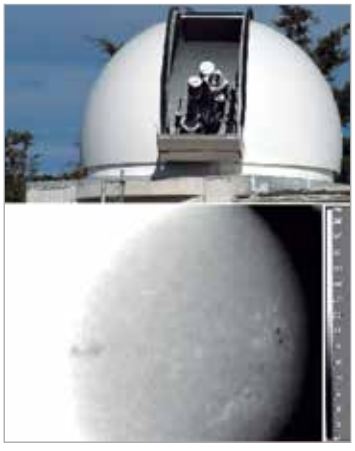
Solar-T

Ground- and space-based observations of solar flares from radio wavelengths to gamma-rays have produced considerable insights but raised several unsolved controversies. The last unexplored wavelength frontier for solar flares is in the range of submillimeter and infrared wavelengths. Although the central focus of this proposal is on the description of solar activity at sub-THz and THz frequencies, it will be essential to analyze their relationships to observations at other radio, visible and higher UV, X and gamma-ray energy frequency ranges, attempting to find new clues to understand the processes of energy build up and explosive release in active regions. To attain these objectives we propose a special effort along the declining phase of the current Solar Cycle 24 (2014-2018), maintaining, upgrading ongoing programs and implementing new experimental activities. The proposal includes new research and developments on THz detecting sensors, filters, materials and integrated systems for the current applications. Special efforts will be given for the interpretation of results from solar flare THz emission, associated emissions at other wavelengths, in radio, visible, UV, X- and gamma-rays. Attention will be given to high energy physical processes occurring in solar flare particle acceleration and their comparison to mechanisms in laboratory scale accelerators.



Two main instrumental results were the installation of the 30 THz telescope in Argentina and the flight of the SOLAR-T (3 and 7 THz photometers) on a stratospheric balloon over Antartica.

An important instrumental achievement was the successful installation of the new 30 THz 20-cm telescope and new generation FLIR camera on the same mount of the HASTA (H-α Solar Telescope for Argentina) an instrument installe at the El Leoncito "Carlos Cesco" site. The new 30 THz microbolometer camera FLIR model A645sc 25, exhibited detectability of 50 mK which is 5 times more sensitive than the previously used camera FLIR AM20 (detectability of about 100 mK). The 20 cm short focus telescope replaces the previously used 15 cm telescope. The net gain was improved by a factor close to 10. The optical arrangement allows the observation of the full Sun simultaneously with HASTA high quality and high cadence H-α HASTA observations, both installed on the same polar mount. The "first light" was successfully obtained on August 17, 2016.

Considerable efforts were dedicated the SOLAR-T mission (double 3 and 7 THz photometers) flown on a stratospheric balloon over Antarctica together with GRIPS experiment University of California, Berkeley; Space Science Laboratory (SSL). The mission was accomplished successfully. A system of two photometers was built to observe the Sun at 3 and 7 THz named SOLAR-T. One innovative optical setup allows observations of the full solar disk can detect small bursts with sub-second time resolution over a field of view larger than the Sun's diameter. The photometers use two Golay cell detectors at the focal planes of 7.6 cm Cassegrain telescopes. SOLAR-T has been flown coupled to U.C. Berkeley solar hard X-ray and gamma-ray imaging spectro-polarimeter GRIPS experiment launched on a NASA CSBF stratospheric balloon from U.S. McMurdo base on January 19, 2016, on a trans-Antarctic flight ended on January 30. The SOLAR-T performed perfectly, thus becoming space qualified. Solar disk brightness temperatures were determined, 5200K at 3 THz and 5300K at 7 THz and flares were also detected.

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