URSI-RCRS 2024, ARIES/GEHU, Bhimtal, India, 22 - 25 October, 2024

A low cost Solar radio observation facility using LWA-CALLISTO

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The transient radio emission associated with solar eruptive events is often called a radio burst to emphasize the brief, energetic, and eruptive characteristics of the underlying energy release process. The Sun's radio emission can increase very rapidly in just a few seconds during such outbursts, and it can outshine the entire Sun at radio wavelengths. To observe the solar radio bursts in the frequency range of ~20 MHz to 80 MHz, a low cost solar radio observation facility has been indigenously developed and installed at the Udaipur Solar Observatory, Physical Research Laboratory, Udaipur. It is operational from January 2024. This paper aims to present an overview of the system along with some preliminary observations including the exploration of the coronal sources of the observed bursts. It is often seen that Log periodic dipole antennas (LPDA) is widely used for the solar radio observations in the HF/VHF band due to simple structure, high bandwidth and high beam width but the size of LPDA becomes very cumbersome in HF band due to the large half wavelength (7.5 m @ 20MHz). Therefore a compact antenna of a reasonable size is required for HF band observations. We have developed a compact ~1.5 m triangular Long Wavelength Array (LWA) antenna and active balun circuit indigenously. The Half power beamwidth of the antenna is ~100 degree, total gain of the antenna with active balun is 34 dB and return loss is better than -10 dB in the entire band. The back-end system of the facility consists of an up converter and CALLISTO receiver developed by ETH Zurich. The CALLISTO receiver is widely used for solar radio observations due to high sensitivity and high dynamic range, which are -120dBm and 100 dB respectively. Further we compared LWA-CALLISTO observations with the existing 4m LPDA-CALLISTO observations and realized that LWA is highly sensitive to detect weak solar radio events as compared to LPDA due to its better SNR. The total cost of the entire system is almost $2000, which is reasonably low, and useful for the low budget astronomy. Finally, we present a few observations taken from the new system, providing a brief account of the observed solar bursts and their source region characteristics by employing multiwavelength imaging from AIA/SDO and coronal magnetic field modeling.