A radio spectro-polarimeter was developed at the Gauribidanur radio observatory (Longitude: 77-2707', Latitude: 13-3612') to study the characteristics of the polarized radio waves that are emitted by the impetuous solar corona in the 50 - 500 MHz frequency range. The instrument has three major components: a Cross-Polarized Log-Periodic Dipole Antenna (CLPDA), an analog receiver, and a digital receiver (spectral analyzer). Here, we elaborate the design and developmental aspects of the CLPDA, its characteristics and briefs about the configurations of the analog and digital receivers, setting up of the spectro-polarimeter, stage-wise tests performed to characterize it. To demonstrate the instrumental capability, the estimation of the solar coronal magnetic field strength (B vs heliocentric height), using the spectral data obtained with it, is exemplified.

Throughout the above band, the CLPDA has a gain, return loss and polarization cross-talk of ≈ 6.6 dB, -10 dB, and -27 dB, respectively. The design constraints, the procedure to tune its impedance and to minimize its dimension, etc. are elaborated. The analog receiver has a noise figure of ≈ 3 dB and a receiver-noise-temperature (Trcv) of about 290 K. The digital receiver can sweep and cover the above bandwidth in 4 ms (instantaneous bandwidth of ≈1.1 MHz). The spectral data acquired for ten successive sweeps is integrated (for 100 µs) and averaged onboard. The above parameters give a receiver-input-density (Srsv) of ≈ 5.3 × 10^{-3} and ≈ 5.3 × 10^{-5} at 50 and 500 MHz, respectively. The observed spectral data shows a Signal-to-Noise Ratio and Dynamic range of about 30 dB and 40 dB, respectively, at 50 MHz. The average polarization isolation / cross-talk of the CLPDA varies from ≈30 dB to ≈24 dB over an azimuthal angle of ≈+5° with respect to the reference position angle (0°). The average degree of circular polarization (DCP) is ≈100% at the reference position and found to decrease gradually and reaches ≈ 80% at an azimuthal angle of ≈+45°. The variation of the cross-talk and DCP as a function of azimuthal angle were used to have a one to one mapping in order to establish an association between cross-talk and DCP; the latter gives an uncertainty of ≈ 0.2, and 20% in DCP for ≈30, 20, and 10 dB cross-talk, respectively. The Stokes-I and Stokes-V spectrum of the type-V burst observed on March 30, 2018 with the sp was used to determine the associated magnetic field strength (B) as a function of heliocentric height. It was found that B(r) = 16.8 ±0.5 r–3.3 G.

### Background

- **Solar transients:** Transient disturbances in interplanetary medium and near-Earth space.
- **Solar radio bursts:** Relates to transients like coronal mass ejections (CMEs) and flares originate in above radial distance range.
- **Solar transients:** Magnetically driven.
- **Magnetic Field Strength:** Using Polarization properties.

### Design and development of CLPDA

- **Frequency range:** 50-500 MHz corresponds to 2R_o - 1.05R_o.
  \[ f_i = \sqrt{N_i} \] with \( N_i = 10^{-7} \)
  \[ f_e = \text{plasma frequency} \]
  \[ N_e = \text{electron no. density} \]
  \[ r = \text{radial distance} \]

- **Fig:** Sun-Earth Connection (Courtesy: NASA)

- **Solar transients:** Transits disturbances in interplanetary medium and near-Earth space.
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- **Two radio antennas, oriented orthogonally to each other (coaxially): Cross-Polarized Log-Periodic Dipole Antenna (CLPDA).**

### Design of CLPDA

- **Frequency:** \( f_i - f_e : 50 - 500 \) MHz (BW: 10:1)
- **Gain:** 6.5 dB
- **Half Apex Angle:** 27°
- **Design Constant:** 0.857
- **Spacing Factor:** 0.07
- **Characteristic Impedance:** 50 Ω
- **Total number of elements:** 19
- **Antenna length:** 3 m

### Characterization of the CLPDA

- **Fig:** The VSWR profiles of the 50 - 500 MHz prototype LPDA. (with and without tuning)
- **Fig:** Smith chart of the prototype LPDA
- **Fig:** Gain of LPDA as a function of \( r \) and \( \alpha \) (Courtesy: R. Carrel)

### Observations

- **Fig:** Power received from the two output ports when CP signal was received by the CLPDA. The left and right panels correspond to left and right CP signals, respectively.
- **Fig:** Stokes-I and Stokes-V spectra of a type-V burst observed on March 30, 2018.
- **Fig:** DCP (with an uncertainty of 3%) and Magnetic field strength associated with a type-V radio burst, as a function of heliocentric distance.

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