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Fluxgate Magnetometer onboard Aditya-L1 Spacecraft: First Results in Space

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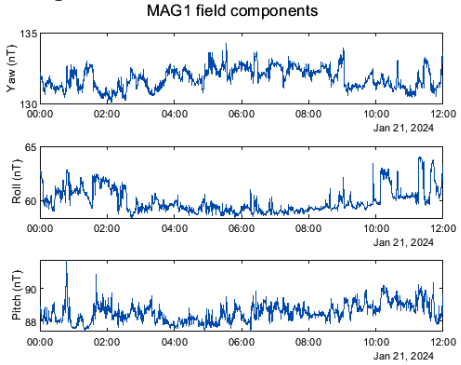
Aditya-L1 is the first Indian solar mission placed at an orbit around the first Lagrangian (L1) point to study the Sun [1]. A fluxgate magnetometer (MAG) is one of the seven payloads and one of the three *in-situ* payloads onboard namely ASPEX (Aditya Solar Wind Particle Experiment), PAPA (Plasma Analyser Package for Aditya) and MAG [2]. The MAG is to (i) measure the interplanetary magnetic field (IMF) coming from the Sun towards the Earth; (ii) observe the CMEs passing through L1 point; (iii) carry out space weather studies; and detect the signatures of solar plasma waves [3]. MAG is a set of two triaxial fluxgate sensors mounted on a 6 m long deployable boom where one set is placed at the boom tip and the other set in the middle of boom 3 m away from the spacecraft [4].

Aditya-L1 was launched from Sriharikota on September 2, 2023 and the MAG payload was switched ON for the first time on October 16, 2023 when the boom was in the stowed condition and since then the MAG payload was ON during the cruise phase from Earth to L1 point in the magnetic field range of ± 10,000 nT. During the cruise phase the magnetic contamination got stabilized so that it was subtracted from the total magnetic field as measured by the MAG sensors.

The Aditya-L1 spacecraft was inserted into a halo-orbit on January 06, 2024 and subsequently, the MAG boom is deployed on January 11, 2024. After the boom deployment, the MAG sensor range was reduced to ±5,000 nT from ±10,000 nT and the magnetic field measurements were carried out for an Earth day. No saturation in any axis of any sensor was observed and hence, the MAG sensor range was further reduced to ±256 nT and since then both the MAG sensors are operating in this range without any saturation.

After the boom deployment, once again the magnetic field measurements by both MAG sensors were made independently and since then are regularly carried out and the plots for January 21, 2024 indicate a general trend in each field component of MAG-1 and MAG-2 in 256 nT as shown in Figure 1.



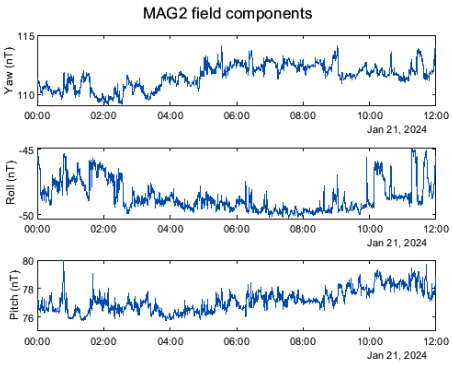


Figure 1: Sample plot with all the three components for MAG1 and MAG2 sensors observed on January 21, 2024.

Figure 1 indicates that the sensor noise and the magnetic field from spacecraft is embedded within this and is not separable from IMF as long as the axis offsets are not estimated. It is to be noted that these are uncorrected observations where the axis offsets are not accounted for. The spacecraft rotation was performed on April 22, 2024 about the yaw axis so that the y- and z-axis offsets for both the sensors can be estimated. The spacecraft was rotated away off-axis from the Sun line on May 01, 2024 and the x-axis offset was estimated. With the axis offset estimates in hand, the MAG payload verification activities are presently going on. The IMF in the halo-orbit around the L1 point by MAG payload onboard Aditya-L1 spacecraft are being obtained after invoking the differential between the two sensor sets.

The latest results obtained from the MAG onboard Aditya-L1 spacecraft shall be presented in this poster.

References

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