

火星地表面における放電現象検出用交流磁界受信機の開発

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Development of AC magnetic receiver for the detection of discharge events on Mars

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The discharges in the Martian low-pressure atmosphere are likely to be existed, however, observation of discharges has never been carried out in the previous landing explorations on the Mars. Although the Mars global surveyor (MGS) tried to detect electromagnetic waves from the Martian discharges, Gurnett et al., 2010 reported that the intensity of terrestrial-like discharges is that 1/10000 weaker than terrestrial events. However, if the events are 'slower' than Earth's cloud to ground discharge, such events radiate electromagnetic wave. The electromagnetic waves generated near the ground level cannot reach to the orbiter because the ionosphere of the Martian environment with weak intrinsic magnetic field can be reflect all of the electromagnetic waves. Thus, discharge measurement on the Martian ground is necessary and important.

For observation of the Martian discharges, 1-axis electric field and 2-axes magnetic field up to 50 kHz are required to make sure the direction-finding of the lightning-excited electromagnetic waves. The combination measurement of one vertical electric field and two horizontal magnetic field (B) is essential in order to detect the propagation direction of the electromagnetic waves generated by the Martian discharge because it enable us to estimate the Poynting vector ($P = E \times B$). Low frequency electromagnetic waves are important for monitoring atmospheric events because of their long-distant propagating characteristics more than 1000 km. An AC magnetic field receiver with the orthogonal loop antenna is designed for the direction-finding function. We will present the specification of the AC magnetic receiver and the results of the prototype receiver. Our instrument is designed for electromagnetic wave measurements that have never been operated on the Martian surface. Therefore it will be first measurement of electromagnetic waves on the Martian surface.