R008-04
Zoom meeting D ：11/3 AM2 (10:45-12:30)
11:30〜11:45

あらせ衛星の直方体形状による衛星電位スピン変調と衛星表面帯電モデルとの比較

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Spin-modulated components in the spacecraft potential distorting the electric field measurement of the Arase satellite

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The Arase satellite measures the electric field with the electric field detector (EFD) of the Plasma Wave Experiment (PWE), employing the Wire Probe Antenna (WPT), which consists of the two dipole antennas of 32 m tip-to-tip with a spherical probe (6 cm diameter) attached at each end of the wires (length: 15 m). The potential difference between a pair of the probes provides the electric field vector, while the instrument also records the floating potential of each probe separately (Vu1, Vu2, Vv1, and Vv2). These antennas are extended orthogonal to the spin axis, which is roughly parallel to the sun direction. Normally, E-field measurements are not much affected by fluctuations of the satellite potential because it can be cancelled by differentiating potentials between two probes. However, we found that the satellite potential has significant spin-modulated components that cause serious impact on the E-field measurement. The purpose of this study is to examine the fluctuation of the satellite potential to identify the characteristics and cause of the spin-modulated component. Waveform analyses of the probe potential show that spin-modulated components appear in the spacecraft potential Vsc calculated as the average of Vu1, Vu2, Vv1, and Vv2. A statistical analysis of this modulation reveals that the spacecraft potential Vsc almost always has four fairly-regular peaks per spin; the peaks appear at specific spin phases when the sun illuminates the satellite from the directions of the four corners of its body. To understand how those potential variations are induced, we simulated the Vsc fluctuation associated with the satellite spin, assuming a simple current balance model for the satellite surface. In this model, the net flux of photoelectrons is proportional to the effective emitting area. The result is that the projected area of the spacecraft to sunlight changes by as much as 20% during a satellite spin and this variation play the main role in the Vsc fluctuations. It is also revealed that this spin modulation of the sun-illuminated area arises because of the cuboid body of the Arase satellite. In addition, five particle instruments (LEP-e, LEP-i, MEP-e, MEP-i, and HEP) equipped on two sides of the body make an asymmetry of 12% in the effective emitting area. We discuss that this spin-dependence of the photoelectron emission quantitatively explains the observed modulation of Vsc.

本発表では、ジオスペース探査衛星「あらせ」の衛星電位のスピン変調成分と衛星本体の形状の関係について報告する。あらせ搭載の Plasma Wave Experiment (PWE) では、 4 本のワイヤアンテナ Wire Probe Antenna (WPT, 長さ 15-m, Tip-to-Tip 長 約 32-m) で衛星とプローブ間の電位 Vu1, Vu2, Vv1, Vv2 を常時測定している。アンテナは衛星スピン面内の直交２系統で、ほぼ太陽に対して垂直に張られている。Vu1, Vu2, Vv1, Vv2 の平均値から衛星電位 Vsc を求めることができるが、常時 Vsc に 0.1 V 程度のスピン変調がみられることがわかった。Vsc のスピン変調は毎スピンに 4 つのピークをもち、ピークのタイミングは衛星固定座標系での太陽位置に依存している。衛星表面帯電モデルを用いて、あらせ衛星本体のスピンによる日照面変化を考慮したところ、衛星本体が直方体であること、および２面に取り付けられている粒子観測機の存在が日照面変化に寄与しており、観測されたスピン変調を非常によく説明することがわかった。