

Effects of SPS on the Space Plasma Environment

Hideyuki Usui, Hiroshi Matsumoto, Yoshiharu Omura

Radio Science Center for Space and Atmosphere, Gokasho, Uji, Kyoto, 611-0011, Japan

Tel: +81-774-38-3817, Email: usui@kurasc.kyoto-u.ac.jp

Regarding the effects of Solar Power Station/Satellite (SPS) on the space plasma environment, we particularly focus on two elements which are intense microwave emission and active plasma emission from the SPS system. We basically analyze the influence of these two factors on the space plasma by performing electromagnetic Particle-In-Cell simulations.

Effects of intense microwave emission

In order to study the feasibility and the implications of SPS, we conducted several rocket experiments of microwave power transmission (MPT) in the space plasma environment. In addition to the success of MPT in space, the rocket experiments observed electrostatic plasma waves excited around the local plasma frequency in association with the microwave emission. Through the corresponding computer simulations, it was revealed that the electrostatic wave generation is due to the nonlinear three-wave coupling process occurring in the ionospheric plasma. The simulations also predicted electron heating by the excited electrostatic waves [1]. In addition to the above three-wave coupling process, intense microwave emission in space plasma environment may cause other nonlinear effects such as Ponderomotive force due to non-uniform spatial distribution of emitted microwave. This force may disturb the plasma density in the path of microwave beam. In the present paper, we will show some of the results of computer experiments in association with the nonlinear effects of intense microwave emission on the space plasma environment.

Effects of plasma emission from SPS

A large-scale spacecraft such as SPS utilizes high voltage power and can cause large potential gap with respect to the ambient plasma. In this situation, serious environmental interaction can be expected such as spacecraft anomalies due to arcing, sputtering, and electromagnetic interference. In minimizing the undesirable effects caused by spacecraft-environment interactions, we need to quantitatively investigate the spacecraft charging and its control. One of the practical methods to control the spacecraft potential is the use of plasma contactor which actively emits plasma in order to neutralize the spacecraft charging. We are particularly interested in the transient processes of the spacecraft charging and its neutralization as well as the effect on the plasma environment [2]. Meanwhile, electric propulsion using ion engine can be utilized in the transport of SPS from the Low-Earth-Orbit to the geostationary orbit. Spacecraft interactions with the contaminated plasma environment which consists of exhausted plasma plume, neutral gas, and ambient plasma are to be quantitatively investigated. In addition, it is reported that the global influence of exhausted products from ion engine will become a serious environmental problem in the plasmasphere, magnetosphere, and ionosphere. In the present paper, we will discuss the influence of plasma emission from SPS on the environment as well as the system itself with the results obtained in PIC simulations.

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