

Sounding rocket observation of the thermosphere-ionosphere-magnetosphere coupling

ABE, Takumi^{1*} ; SAITO, Yoshifumi¹

¹Japan Aerospace Exploration Agency

The polar ionosphere is an open window of the Earth atmosphere to the outside space such as the magnetosphere and the solar wind, because energy and/or mass tends to be injected along the magnetic fields via various physical processes. In this connection, there exist numerous unique and unrevealed phenomena in the polar ionosphere.

Sounding rocket is a powerful platform which provides opportunity to make a vertical sounding through the lower thermosphere, ionosphere and magnetosphere while satellite generally flies in a horizontal direction, and it has an advantage so that it can enable us to make a brief survey of the upper atmosphere in the vertical direction. The Institute of Space and Astronautical Science (ISAS) of Japan Aerospace Exploration Agency (JAXA) has conducted sounding rocket experiments in Norway to investigate the upper atmospheric dynamics and chemistry induced by the auroral energy input. The primary objectives of these experiments include various topics; pulsating aurora, ozone chemistry affected by the auroral activity, fine structure of the auroral arc, and the cusp ion outflow. These subjects arise from phenomena that is caused by interaction between the solar wind or magnetospheric plasma and the upper atmosphere. It is necessary to make a comprehensive observation of the energy input, the response and consequences for better understanding of the causal relationship.

There are several candidates of the sounding rocket experiment which should be conducted in the auroral region for a direct measurement of the energy input from higher altitudes and the ionospheric response. To obtain the high-time resolution data of the ionospheric ion outflow which is one of the most significant phenomena of the magnetosphere-ionosphere coupling, it is necessary for the sounding rocket equipped with plasma and field instruments to reach up to 1000 km altitude. For such an experiment, it will be a key to get information on the wave-particle interaction which may play an important role in accelerating ionospheric ions. It is well known that the polar lower thermosphere has a significant response to auroral energy input from higher altitudes. This indicates an existence of energy inputs from the magnetosphere probably in the form of electric fields or energetic particles. It is important to understand quantitatively the momentum transfer between the neutrals and plasma by observing the neutral wind and ion drift simultaneously. The sounding rocket experiment to elucidate such a neutral-plasma coupling is also under consideration.

Thus, we are considering several candidates of the sounding rocket experiments which should be conducted in the auroral region to investigate the upper atmospheric response against the energy input from higher altitudes. In this presentation, we will briefly introduce some of the promising experiments.

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