

# Design of electric field measurements in the future mission FACTORS targeting transverse ion acceleration in the terrestrial polar magnetosphere

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Transverse ion acceleration (TIA) in the terrestrial polar magnetosphere is one of science targets in the future mission FACTORS. Although plausible mechanisms of the TIA have been discussed in a lot of studies, they are still unclear. Since the TIA is believed to be a source for escaping ions in the polar region, understanding the TIA process is crucial in studying scenarios of time evolution in the earth's atmosphere. There is a strong view that the energy source for the TIA is plasma waves. Since there are various plasma waves as candidates for the energy source including both of electrostatic and electromagnetic modes, measurements of electric field components of plasma waves are significant in the FACTORS mission. However, there are some issues to be fixed for precisely measuring electric fields by the satellites. For example, three axial measurements of electric fields are essential even though we don't have experiences installing three axial electric field sensors on former satellites. To meet the scientific objectives of the FACTORS mission, we design a new measurement system of electric field components of plasma waves considering the following points: (1) development of three axial electric field sensors, (2) implementation of an interferometry mode for identifying phase velocities of observed plasma waves with short wavelengths, and (3) computer simulations for precise calibrations of electric fields. The development of three axial electric field sensors is very new because we have been using long wire antennas that are deployed using satellite spins. We need to develop new antennas deployed by their own mechanisms for the FACTORS mission. Since 6 units of electric field sensors in number are installed on the satellite, their mass resource should be reduced drastically. As for the interferometry mode, knowing phase velocities of observed plasma waves allows us to interpret plasma wave modes consulting plasma wave dispersions. Since the interferometry mode uses electric field sensors as monopoles, it requires a lot of resources in receivers and telemetries. The design considering the use of the interferometry mode is inevitable. Three axial electric field sensors and the interferometry mode provide us with unique observation data of electric field components. To achieve quantitative and precise observations, precise calibrations of electric fields picked up by sensors are crucial. Electric field sensors on board satellites show complicated characteristics in space plasmas. In particular, their characteristics for plasma waves with short wavelengths are more complicated. We evaluate the characteristics of electric field sensors in space plasmas with help from computer simulations. In the present paper, we introduce the current design of the electric field measurement system in the FACTORS mission and discuss crucial aspects to be considered for measuring electric fields in the FACTORS mission.

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