Numerical modeling of soft X-ray emission around the magnetosphere under various solar wind conditions

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Since the first discovery of X-ray emissions from the comet Hyakutake (Lisse et al., 1996), the charge exchange between heavy ions in the solar wind and neutral atoms has been understood as a bright source of the soft X-ray (Cravens 1997). GEO-X (Geospace X-ray imager, Ezoe et al., 2020) mission was proposed to visualize global structures of the magnetosphere by measuring the soft X-ray emission through the charge exchange between oxygen ions in the solar wind and hydrogen atoms from the Earth's atmosphere (geocorona). The proposal has been approved as a very-small satellite mission by ISAS. By observing the emission at the low-latitude orbit 60 Re from the Earth, a global map of the dayside magnetosphere and its response to the solar wind variations can be obtained with a spatial resolution of 0.2 Re within 1-hour time resolution.

For this purpose, we have developed a global MHD simulation model of the magnetosphere by using the public MHD code CANS+ (Matsumoto et al., 2019). The model can provide spatial distributions of the plasma mass density, pressure, and velocity necessary to calculate the X-ray intensity. Thus we can understand how the global intensity map reflects the magnetospheric dynamics. We have conducted MHD simulations under various solar wind conditions. The model predicts the X-ray emission is bright (~5 kev cm^(-2) sec^(-1) str^(-1)) elongated along the dayside current sheet under a southward IMF condition, whereas the emission is weak and blurred in the magnetosheath under a northward IMF condition. Under a very low-beta solar wind condition, we find that the X-ray intensity reflects the bulk motion of plasma from the dayside reconnection region, thus providing an opportunity to visualize the reconnection region as in the solar corona. This talk presents these MHD modeling of the X-ray emission for the GEO-X mission.

Keywords: solar wind charge exchange, globa MHD simulation, GEO-X mission

