金星探査機あかつきに対する太陽高エネルギー粒子被爆量の評価

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Evaluation of solar energetic particles exposure on the Venus orbiter Akatsuki

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Space weather researches have become more and more important, according to the expansion of the ”humanosphere” to the space. On the other hand, current space weather researches are mainly for circumterrestrial space, not for the deep space probes that are located far from the earth. We aim to forecast and evaluate the radiation hazard to such space probes far from the earth by using the data taken by the Solar Terrestrial RElations Observatory (STEREO). STEREO provides the images of the part of the Sun that is invisible from the Earth, but only EUV images and coronagraph images are available.

First, we examine the possibility of the evaluation of the radiation hazard by using EUV and coronagraph images. It is known that solar energetic particles (SEPs) flux is well correlated with the speed of coronal mass ejection (CME) measured by a coronagraph. We focused on two successive flare/CME events occurred on June 4th, 2011. It occurred in an active region that located on the invisible side of the Sun, and near the disk center as seen from Akatsuki (PLANET-C), the Venus Climate Orbiter that was orbiting the Sun at around 0.7AU. On June 5th, an abrupt decrease in the electric power of Akatsuki was observed, which may be attributed to the effect of SEPs associated with the flare/CME events.

We measured the velocity of the two CMEs using the coronagraphic images from STEREO and found that the second CME was much faster (about 2200 km s^{-1}) than the first one (about 800 km s^{-1}). Considering the time difference between the two events, it is likely that the second CME caught up the first one before they arrived at 0.7AU. The estimated arrival time is consistent with the timing of the power decrease of Akatsuki. According to a statistical study of CMEs and SEPs preformed by Gopalswamy et al (2004) SEP flux tends to become large if a preceding CME have been launched within 24 hours ahead of the onset time of the primary CME. Using the empirical relationship between the SEP flux and the CME velocity derived by Gopalswamy et al. (2004), we estimate the SEP flux of 10^2 - 10^4 cm^{-2} s^{-1} sr^{-1}.