A New Solar-Proton Fluence Model for ISO Specification

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Solar energetic protons degrade performance and reliability of spacecraft systems, such as single-event effects, total dose effects of electronic components, and especially displacement damage of solar cell. On designing a solar cell panel, a low energetic solar proton fluence model is needed to estimate radiation damage (power loss) over mission life. Nowadays solar panel area of spacecraft is increasing as spacecraft mission life becomes longer (15–18 years). Thus an accurate solar proton model is strongly required for the cost-minimum design from the aerospace industry. The solar proton flux model, JPL-91 proposed by Feynman et al., is currently used widely for solar cell designing. However, it is known that the JPL-91 model predicts higher fluences of protons than values actually experienced in space, especially after 7 years on orbit. In addition, the model is based on several assumptions on solar proton events, and also needs Monte-Carlo simulations for calculating fluences. In this study, we propose a new solar proton model especially focused on solar cell designing. The newly-proposed model is an empirical model which is constructed directly upon proton flux measurement data taken by instruments onboard spacecraft. The proton data are integrated over time, and are summarized against mission duration. This method has no assumptions or no dependence on solar-proton event selection both of which are needed in JPL-91. Our model shows lower fluences in longer missions compared to JPL-91. It is easy to use this model because its method is straightforward. This model has been proposed to ISO (International Organization for Standardization) TC20/SC14/WG4 and has been discussed as a new standard solar proton model.