Effects of large storms on the radiation belts and their implications on the ISS exposure

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Abstract:

The effect of the March 1991 storm is well known for protons: a second belt was created in the 30 MeV range. This event is not the only one ever recorded (see Smart and Shea, Adv. Space Res., 17-2, 147, 1996, Hudson et al., Adv. Space Res. 21-4, 597, 1998). But at the contrary, storms can also decrease the radiation belts, making losses on the high energy populations at their outer edge, like in March 1989. We want here to review the effect of intense storms on the radiation belts, especially on high energy protons, in order to understand what can be their worst consequences on the proton belt, and why proton monitors are needed. We will discuss especially on the worst cases ever able to be recorded on the high energy protons and what effects they can have on the doses and SEUs the International Space Station can encounter.

As for the electrons, the biggest effect are not necessarily related to the same storms. As the duration of CMEs is around one day, the acceleration of high energy electrons cannot take place enough to increase their fluxes by large factors. But in the solar declining phase, the storms related to corotating interaction regions (CIRs) can be longer though less intense. They drastically increase these fluxes, especially in the outer belt, causing ESD switches. New models of the electron radiation belt shall absolutely take this phenomenon into account. We will discuss on the real activity to take into account in the models. Worst cases will also be discussed to predict their effects on the ISS exposure during long time periods, but also on some hour delay related to EVAs.