

SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE
ACTIVITIES (D5)

Space Weather Prediction and Effects on Space Missions (3)

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RADIATION ENVIRONMENT AND ITS EFFECT ON SPACECRAFT SIGNAL AND COMPONENTS

Abstract

In a world increasingly dependent on electricity and electronics, the "space weather" outside the atmosphere can have serious effects, in particular on human communications. Currently more than 200 communication satellites circle the Earth in synchronous orbit. A large magnetic storm can greatly increase the number of fast ions and electrons which hit those spacecrafts; such ions and electrons are similar to the ones emitted by radioactive substances and can create serious problems. The simplest effect is an electric charge on the spacecraft and its components, usually negative charge, raising its voltage to hundreds or even thousands of volts. Charging by itself has little effect on the spacecraft's operation, although on a scientific satellite it would seriously distort observations. However, if different parts of the spacecraft are charged to different voltages, the current between them can cause damage. Particles with higher energy can permanently degrade solar cells. Also, high-energy particles can penetrate the circuitry and cause either damage or false signals which lead to unintended responses by satellites. This paper will present the principle of how space weather or space radiation environment cause complete and partial breakdown of satellite instruments and circuitry using Nigerian satellites as case study.