Paper ID: 9820
oral
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44th SYMPOSIUM ON SAFETY AND QUALITY IN SPACE ACTIVITIES (D5)
Space Weather Prediction and Protection of Space Missions from Its Effects (3)

Author: Mr. Chijioke (CJ) Nwosa
Space Generation Advisory Council (SGAC), South Africa

Dr. Peter Martinez
South African Astronomical Observatory, South Africa

SPACE RADIATION EFFECTS ON SOUTH AFRICA'S SUMBANDILASAT

Abstract

The hostile space environment poses a great risk to orbiting spacecraft. Hazardous components of the space environment include trapped radiation, plasma, Solar Energetic Protons, Galactic Cosmic Rays, residual atmosphere, and meteoroids resulting in surface charging, component degradation, Single Event Effects, contamination, orbital decay, and hyper-velocity impacts. Commercial-Off-The-Shelf (COTS) components have in recent years been widely used as a cost effective alternative to radiation hardened components in space systems; though they increase the system's vulnerability to space radiation effects. SumbandilaSat, South Africa's first national, locally built micro satellite is an 81kg LEO satellite and technology demonstrator which began operations in space in September 2009. It was developed using COTS based components. Very limited radiation testing was possible during the satellite's component selection phase. It was decided to focus only on Total Ionizing Dose (TID) testing on certain components since TID testing is much simpler and cheaper than other forms of radiation testing. Assessing the feasibility of this COTS based approach by examining the in-orbit performance of SumbandilaSat is therefore imperative to the development of future South African indigenous satellites. To predict the level and type of radiation SumbandilaSat has been exposed to, various space weather prediction models have been used to simulate the radiation environment. Telemetry gathered from SumbandilaSat for the first 16 months of operation was used to identify possible radiation effects on the On-Board Computer (OBC). This paper attempts to compare the modeled charged particle population to the radiation effects detected on SumbandilaSat with a view to quantifying the probable causes and its severity.