Radiation dose

The total radiation dose received by the spacecraft is one of the key factors that determines the lifetime of the satellite. As the total dose increases there is a general degradation in the power available on the satellite and degradation in performance of other components.

Satellites are carefully designed to withstand the radiation levels for the orbit in which they operate. The designs takes into account the probability of a solar energetic particle event occurring, but the statistics on solar energetic particle events are poor, particularly the very large events that do most damage.

Satellite design also takes into account the radiation dose arising from the radiation belts. However, they are usually based on static average models of the radiation belts which do not take into account some of the rapid variations and periods of enhanced radiation levels that may last for a few days or more. An enhanced flux for a period of a few days can result in a high risk to satellite operations.

The radiation dose also depends on the satellite orbit. For example, satellites in medium Earth orbit pass through the heart of the radiation belts where the flux of high energy electrons peaks. These satellites usually require more protection than those at geostationary orbit where the radiation belt flux is generally lower, but still significant. Satellites in low Earth orbit usually pass underneath the radiation belts, except for polar orbiting spacecraft which pass through the foot of the radiation belts in the northern and southern Polar Regions. The South Atlantic Anomaly region which extends over the Antarctic peninsula is a particularly hazardous as the weakness in the Earth's magnetic field enables the radiation belts to penetrate to lower altitudes.

Bursts of solar energetic particles provide a particular hazard since they are unpredictable at present. Furthermore the extent to which these particles can penetrate the Earth's magnetic field depends on energy and location. To help deal with these events, the SPACECAST project will be constructing a radiation dose tool to convert the flux to a radiation dose behind a given shield which can be used for different orbits inside the Earth's magnetic field. This will be designed for a quick look analysis and will be available later on in the project.