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RADIATION SAFETY ISSUES FOR HIGH LATITUDE SPACE STATIONS

Abstract

For some reasons, high latitude space stations are considered to be more beneficial as compared with mid-latitude ones. However, special radiation safety issues should be taken into account for high latitude space stations. Typical ISS orbit is 400 km altitude and 51.6 degrees inclination that gives the dose equivalent averaged in ISS compartments as high as 0.7 mSv/day in undisturbed radiation conditions when there are no solar particle events (SPE). In such conditions, Earth's radiation belts (ERB) and galactic cosmic rays (GCR) give practically equal contribution to the total daily dose. Current ISS orbit has been well protected during relatively seldom powerful SPEs, when daily dose increased up to 10 times maximum as compared to that in undisturbed conditions. At higher orbit inclinations, ERB contribution to the total dose decreases slightly as the space station ERB-crossing-time decreases while GCR contribution increases as the time spent by the space station at lower geomagnetic cutoff rigidity increases. As a result for higher orbit inclination, total dose becomes higher and may reach 1.0 mSv/day. In undisturbed radiation environment, expected doses at high-latitude orbits are still acceptable as compared with current space radiation exposure limits for crewmembers. However, penetration of SPE fluxes is known to be more effective for high latitude orbits and may cause up to 100 times increase of the total dose registered in undisturbed conditions in case of powerful SPE accompanied by strong magnetic storm. Special radiation safety actions should be applied to the space station crewmembers at high latitude orbit. First of all, SPE forecasting should be more reliable. Then, additional shielding of the compartment and local shielding of the crewmember body should be recommended for usage aboard the high-latitude space stations to satisfy the crewmember radiation safety dose limits and to avoid deorbiting and the flight cancelling. Total dose accumulated during SPE should in all cases be less than 100 mSv to eliminate acute radiation effects. Water and polyethylene are considered as the best candidates for extra physical shielding accounting contribution of secondary particles and neutrons generated in the space station walls and in the crewmember body. Some of the physical shielding methods have been already successfully applied in the Russian Segment of the ISS and proved their effectiveness for future space stations.