JOHNS HOPKINS UNIVERSITY Applied Physics Laboratory

SOR-98048
December 3,1998
IDH01ADXSOR

TO: Distribution

FROM: R. H. Maurer

SUBJECT: STEREO RADIATION ENVIRONMENT

The STEREO Radiation Environment has been analyzed and predicted by Janet Barth of GSFC and the results of the calculations have been reviewed by J. D. Kinnison and R. H. Maurer of APL. Some basic assumptions in the calculation are:

1. The current epoch of SOLAR MAXIMUM extends for seven years from 1998.4 – 2005.4 with the peak year being 2000.4 – 2001.4.

2. SOLAR proton fluence and dose is only significant during SOLAR MAXIMUM years since levels are about two orders of magnitude lower in SOLAR MINIMUM years.

3. The earliest possible STEREO launch date (single or dual) is October 2002 or 2002.8. With even the five year goal, this means that STEREO's SOLAR MAX years are from 2002.8 to 2005.4 or 2.6 years duration with the remaining 2.4 years being at SOLAR MIN.

4. Given Janet Barth's analysis for one, two and three years for STEREO, we will choose the three year levels since they will cover both the two year requirement and the five year goal (due to SOLAR MIN years). These levels are considered benign in any case (compared to other APL missions).

Figure 1 shows the Solar Proton Fluence integral spectron incident upon the spacecraft and the solar arrays for one, two and three years. The solar proton fluence greater than 10 Mev for the years is 5.2×10^{10} protons per square centimeter. For the energy of 4 Mev the fluence is 1.4×10^{11} protons per square centimeter. Cover slide thickness will determine the proton energy cut-off, but both these fluence values are low enough that crude conversion to equivalent 1 Mev electron fluence (a factor of 1,000 for Ga As cells; a factor of 3,000 for silicon cells) yields 5.2×10^{13} - 1.4×10^{14} electrons/cm^2 for Ga As and 1.5×10^{14} – 4.2×10^{14} electrons/cm^2 for silicon.

Figure 2 shows the radiation total dose versus depth curve. The dose is the response in silicon after transport through aluminum shielding. The double slab geometry curve passes through 10 Kilorads (Si) at about 30 mils and represents components near the spacecraft periphery. The spherical shell geometry curve passes through 10 Kilorads (Si) at 90 mils and represents components toward the center of the spacecraft.

Since the depths of 30 and 90 mils are shallow for both geometries (we typically use 75 and 500 mils for the slab and sphere respectively), we judge that 10 Krads (Si) is a reasonable

value for the STEREO parts hardness level. No other design margins for conservatism need to be employed since the predicted environment is at the 95% confidence level meaning that there is only a 5% chance that it will be exceeded during the three solar active years.

Thus, the STEREO component total dose hardness level is 10 Krads (Si).

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