Abstract submitted to: American Geophysical Union, Fall Meeting 2012
San Francisco, California, 3 – 7 December 2012
http://fallmeeting.agu.org/2012/

Real Time Space Weather Support for Chandra X-ray Observatory Operations

Stephen L. O'Dell
NASA, Marshall Space Flight Center
Huntsville, Alabama USA

J. Scott Miller
Qualis Corporation, Jacobs ESSSA Group
Huntsville, Alabama USA

Joseph I. Minow
NASA, Marshall Space Flight Center
Huntsville, Alabama USA

Scott J. Wolk, Thomas L. Aldcroft, and Bradley D. Spitzbart
Harvard-Smithsonian Center for Astrophysics
Cambridge, Massachusetts USA

Douglas A. Swartz
Universities Space Research Association, Marshall Space Flight Center
Huntsville, Alabama USA

NASA launched the *Chandra X-ray Observatory* in July 1999. Soon after first light in August 1999, however, degradation in the energy resolution and charge transfer efficiency of the Advanced CCD Imaging Spectrometer (ACIS) x-ray detectors was observed. The source of the degradation was quickly identified as radiation damage in the charge-transfer channel of the front-illuminated CCDs, by weakly penetrating ("soft", 100–500 keV) protons as *Chandra* passed through the Earth's radiation belts and ring currents. As soft protons were not considered a risk to spacecraft health before launch, the only on-board radiation monitoring system is the Electron, Proton, and Helium Instrument (EPHIN) which was included on *Chandra* with the primary purpose of monitoring energetic solar particle events. Further damage to the ACIS detector has been successfully mitigated through a combination of careful mission planning, autonomous on-board radiation protection, and manual intervention based upon real-time monitoring of the soft-proton environment. The AE-8 and AP-8 trapped radiation models and Chandra Radiation Models are used to schedule science operations in regions of low proton flux. EPHIN has been used as the primary autonomous in-situ radiation trigger; but, it is not sensitive to the soft protons that damage the front-illuminated CCDs. Monitoring of near-real-time space weather data sources provides critical information on the proton environment outside the Earth's magnetosphere due to solar proton events and other phenomena. The operations team uses data from the Geostationary Operational Environmental Satellites (GOES) to provide near-real-time monitoring of the proton environment; however, these data do not give a representative measure of the soft-proton (< 1 MeV) flux in *Chandra*'s high elliptical orbit. The only source of relevant measurements of sub-MeV protons is the Electron, Proton, and Alpha Monitor (EPAM) aboard the Advanced Composition Explorer (ACE) satellite at L1, with real-time data provided by NOAA's Space Weather Prediction Center. This presentation will discuss radiation mitigation against proton damage, including models and real-time data sources used to protect the ACIS detector system.