The γ-ray and Cosmic Ray Connection: *Ulysses* HET Secondary Radioisotope Measurements and Cosmic Ray Propagation

J. J. Connell (Univ. of Chicago), J. A. Simpson (Univ. of Chicago)

Cosmic rays constitute a super-thermal gas of charged particles magnetically confined within the Galaxy. Galactic cosmic ray nuclei and electrons are a major source of the diffuse γ-ray background. Thus, understanding diffuse γ-ray production requires understanding cosmic ray propagation in the Galaxy. While propagating though the interstellar medium, cosmic ray nuclei undergo nuclear spallation reactions, producing both stable and unstable secondary nuclei. Measurements of secondary radioisotopes are crucial probes of cosmic ray propagation. The abundances of some secondary radioisotopes (^{10}Be, ^{26}Al, ^{36}Cl, etc.) show the average density of material cosmic rays traverse and relate to the confinement times of cosmic rays in the Galaxy. The fact that the average density ($\sim$0.25 atom/cm^3) found from these measurements is much lower than the density in the Galactic disk suggests that cosmic rays spend most of their time in a Galactic halo. Thus, these measurements are a critical constraint on Galactic halo models. The abundances of electron capture isotopes and their daughter nuclei (for example, ^{49}V and ^{51}V) test the role of cosmic ray reacceleration. Electron capture is strongly suppressed during cosmic ray propagation because the nuclei are effectively stripped of their electrons. Electron capture is only possible via electron pick-up during propagation, a highly energy dependent process more likely at low energy. If cosmic rays experience significant reacceleration, the observed cosmic ray electron capture isotopes will be less abundant than otherwise expected and their daughters correspondingly more abundant. The *Ulysses* High Energy Telescope (HET) is a cosmic ray isotope spectrometer with sufficient mass resolution ($\sim$0.28 amu at Fe) and collecting area to measure these rare isotopes. The latest HET measurements of the radioactive secondary cosmic ray isotopes will be presented, and the implications for cosmic ray propagation discussed.