Time-variability in the All-Sky 511 keV Emission

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Abstract

The interactions of low-energy cosmic rays with asteroids might lead to a measurable variable gamma-ray foreground emission within our Solar System. Siegert (2024) modeled the spatial distribution of all relevant asteroid populations, including the Main Belt Asteroids, Jovian and Neptunian Trojans, as well as the Kuiper Belt to determine their density profiles and calculate their appearances by line-of-sight integrations. The signal is expected to vary in time due to the relative motion of Earth and the asteroids. In addition, the Solar cycle will enhance and suppress the signal on an 11 yr timescale. In this work we are using INTEGRAL/SPI data to search for this time-variable foreground albedo in both, the 511 keV line and the ortho-Positronium (oPs) continuum. We are using 20 yr of data, including high-latitude observations, and covering almost two orbits of Jupiter and its trojans around the Sun, giving us the best opportunity to search for such a signal. Because the signals are expected to vary in time, a standard analysis is not possible for which reason, we split the dataset into monthly parts to calculate the expected responses and recombine them for a global fit. Since the Galaxy is bright in the bulge at 511 keV, we can determine its variability on a two-year timescale, which allows us to constrain the possible contributions from all asteroid families.

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