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Background Rejection for the ALPHA-g Anti-Hydrogen Detectors

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The ALPHA-g experiment recently made the news for the first direct measurement of the gravitational free-fall of anti-hydrogen. Crucial to this milestone is a detector system capable of accurately recording the vertical position of annihilating anti-atoms, with two critical requirements: precise localization of anti-hydrogen annihilations into the “up” or “down” regions, and effective discrimination against the cosmic ray background.

To accomplish this, the annihilation products are tracked using a radial time projection chamber detector, and fitted to a common vertex. Simultaneously, a secondary barrel scintillator detector records the time of flight of these products. This timing information is used as part of a multivariate analysis to reject externally incident cosmic rays.

This presentation showcases the cosmic ray background rejection used in the published measurement, as well as the calibration and analysis campaign to unlock time-of-flight-based background rejection for forthcoming ALPHA-g measurements of the gravitational behavior of anti-hydrogen.

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