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The 8pi BGO Ball Array and Its Application to 3-Gamma PET

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Many nuclear science experiments require gamma-ray spectrometers that offer resolution, efficiency, and selectivity. Systems that excel at all three are rare, but the 8pi gamma-ray spectrometer finds a balance between them, making it a powerful tool for gamma-ray spectroscopy.
Over the past year at Simon Fraser University, the 8pi Bismuth Germanium Oxide (BGO) ball array has been brought into operation. It is an assembly of 132 BGO scintillator detectors arranged in an icosahedral geometry, covering nearly the full solid angle around a sample chamber. Coupled with a digital data acquisition system, the 8pi provides time-resolved gamma-ray spectroscopy with online event filtering capabilities. While currently operating with the BGO ball array, the 8pi can also facilitate 20 Compton-suppressed High-Purity Germanium (HPGe) detectors for high-energy resolution spectroscopy.
The current BGO ball configuration supports various nuclear science experiments such as the detection of rare 3-gamma positronium decays, which is relevant to Positron Emission Tomography (PET) scans. While positron annihilation typically results in 2-gamma emissions, about 0.5% of the time, 3-gamma emission occurs. Using conservation laws, a single 3-gamma detection is sufficient to calculate the location of positron annihilation, unlike traditional PET, which requires multiple 2-gamma detections. This offers a new approach to PET imaging which is difficult to study with simple gamma-ray spectrometers. But with 8pi, these 3-gamma measurements are practical due to its unique combination of capabilities. This talk will review the 8pi spectrometer's current status and application to PET.

Keyword-1

Gamma-ray spectrometer

Keyword-2

Positron Emission Tomography

Keyword-3

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