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Real-time detection of alpha-particles and gammas using a fast optical camera

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Real-time detection of alpha-particles is an essential requirement for a variety of applications, such as in nuclear medicine, nonproliferation, and other security applications. We present a new imaging technique for alpha-particles using a fast optical camera focused on a thin scintillator. Detection of alpha-particles is based on their interaction in a thin layer of LYSO fast scintillator, which produces a localized flash of light. The light is collected with a lens to a Tpx3Cam, an intensified optical camera with single photon sensitivity. Bump-bonded onto the Timepix3 readout chip in the optical camera is an optical sensor with 256×256 pixels, each with dimensions of 55×55 μm^2, providing excellent spatial resolution and a temporal resolution in the order of a few nanoseconds. The interaction of photons with the camera is reconstructed by means of a custom algorithm, capable of discriminating single photons using time and spatial information, as well as by means of a centroiding algorithm, which combines position information, Time of Arrival, and Time over Threshold for each particle hit. Measurements of the detection efficiency, time resolution, and discriminating power of this technique will be presented.

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