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Novel 3D-Projection Pixelated Detector for Next-Generation High-Energy Physics Experiments

We are proposing a single, homogeneous, and cost-effective calorimetry system capable of seamlessly achieving particle identification, tracking, and energy measurement. While 3D-projection readout, opaque liquid scintillators, and metal doping have each been investigated separately, this project for the first time combines all three into a fully homogeneous and active detector with unprecedented control over energy resolution and shower development. The integration of liquid scintillator with ultra-short scattering lengths ensures that optical photons are highly localized without the need for optical segmentation,
while heavy-metal loading offers tunable electromagnetic (EM) shower containment, allowing precise control over the detector response. This combination is a major departure from traditional sampling calorimeters and provides a novel approach to optimizing detector performance across different experimental applications. This project is built upon a solid foundation of established expertise and successful studies of its individual components. We present a rare opportunity to blend multidisciplinary expertise at the forefront of innovation in particle and nuclear physics, non-proliferation and medical imaging research.

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