3D Display of Events on the Current OSCURA Testing Setup and Redesign of the OSCURA Testing Setup Copper Box

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1 Abstract for general Audience

This study focuses on two key objectives: improving the testing setup of OSCURA, an experiment with the goal to detect dark matter, and introducing an innovative 3D visualization method for particle events. The first objective involves redesigning OSCURA's setup to accommodate up to 21 Multi-Chip Modules vertically. This adjustment optimizes the use of particle beams, enhancing testing efficiency. Simultaneously, a new algorithm is developed to create 3D visualizations of particle events captured by 160 Charge-Coupled Devices within OSCURA testing setup. This algorithm accurately translates data into spatially faithful 3D representations, providing a realistic view of particle events such as muons, electrons and x-rays.

A central aspect of this research is the implementation of a sophisticated 3D image analysis algorithm. This algorithm serves as a foundational step toward advanced 3D particle tracking identification and analysis algorithms. These advanced algorithms discern particles of interest from background noise, laying the groundwork for precision improvements. The implications of this work are significant, particularly for studying interactions involving dark matter and fundamental particles in particle accelerator facilities. By introducing a novel framework, this research establishes a platform for more accurate investigations. Additionally, these findings mark a first stride in refining 3D imaging analysis techniques, hinting at future breakthroughs.