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MTE and QE Behavior of Cs_3Sb Photocathodes under Varying Wavelengths at Room and Cryogenic Temperatures

The ASU cryogenically cooled DC electron gun offers an advanced platform for photocathode testing at room and cryogenic temperatures. Using a four-dimensional phase space reconstruction via the pinhole scan technique, we measure the Mean Transverse Energy (MTE) of alkali antimonide photocathodes, providing comprehensive experimental validation of the theory predicting reduced (MTE) near the photoemission threshold. Our results demonstrate this reduction across multiple wavelengths at both room and cryogenic temperatures, addressing a gap where such validation was previously lacking.

While reducing cathode temperature lowers MTE, it often compromises quantum efficiency (QE). In this work, we also demonstrate a cooling method that preserves QE for extended periods, achieving lower MTE alongside higher QE. We corroborate our measurement through simulation and cross-platform measurement validating this technique for detailed photocathode characterization and advancing electron source development.

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