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MTE measurements at the ASU cryogenically cooled DC electron gun

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The ASU cryogenically cooled DC electron gun represents a state-of-the-art platform for testing novel photocathodes at room and cryogenic temperatures. The key electron beam diagnostic tool of this setup is the four-dimensional (4D) phase space reconstruction using the pinhole scan technique. In this work, we use the 4D phase space measurement to extract the Mean Transverse Energy (MTE) obtained from cathodes in this gun. We also establish the limits and accuracy of the 4D phase space and emission area measurements and estimate their effects on the MTE extracted. The results, validated through simulations and complementary measurements establish the use of the 4D phase space measurement technique to obtain the MTE. Using this approach, we measure the MTE from alkali antimonide photocathodes at varying temperature and electric field conditions. This study provides a robust foundation for future experiments with the ASU electron gun and beamline, paving the way for advanced photocathode characterization under cryogenic conditions.

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