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## Single shot thermal momentum imaging for high brightness photoinjector cathode

In state of the art photoinjector electron sources, cathode performance determines the lower limit of achievable beam emittance. Measuring the intrinsic emittance at the photocathodes in electron guns is of vital importance for improving the injectors. Traditional methods, like solenoid scan, pepper-pot, need multi-shots and therefore suffer from shot to shot jitter and are time-consuming. Here we propose a new method, named thermal momentum imaging. By tuning the gun solenoid focusing, the electrons' transverse momentum at cathode is imaged to a downstream screen. The new method enables a single shot measurement of cathode intrinsic emittance by measuring the beam spot size. An experiment was done at Photo Injector Test facility at DESY, Zeuthen site (PITZ) with Cs<sub>2</sub>Te cathode. Measurements of cathode intrinsic emittance, thermal momentum distribution, map of cathode intrinsic emittance and its correlation with QE are presented.

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