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High-Speed Direct-Detection Electron Detector for the TEAM Project

P. Denes,* M. Battaglia,** D. Contarato,* D. Doering,* P. Giubilato***, D. Gnani*, B. Krieger* and V. Radmilovic*

* Lawrence Berkeley National Laboratory, Berkeley, CA 94720,
** Department of Physics, University of California Santa Cruz, CA 95064
*** Dipartimento di Fisica, Universita` degli Studi, Padova, I-35131, Italy

Monolithic CMOS Active Pixel Sensors (APS), first described in 1967 [1],[2] are widely used today in both low- and high-end digital photography. The same technology can, with suitable modification, be used as a direct detector of electrons [3],[4]. For the TEAM (Transmission Electron Aberration-corrected Microscope) project [5]. a 400 frame-per-second APS-based detector has been developed. This detector was engineered through a sequence of design optimizations including precise modeling of electron interactions in the detector together with radiation hardening [6],[7] together with improvements in imaging modes [8]. The detector has a pixel pitch of 9.5 μm, with a Point Spread Function (PSF) of roughly 8 μm at 300 keV. In a "cluster counting" mode, the PSF can be reduced to 2 μm, as shown in FIG. 1.

The operation of the TEAM detector, together with initial experimental results, will be described. Current developments, in technology further advanced than that used for TEAM will also be described.

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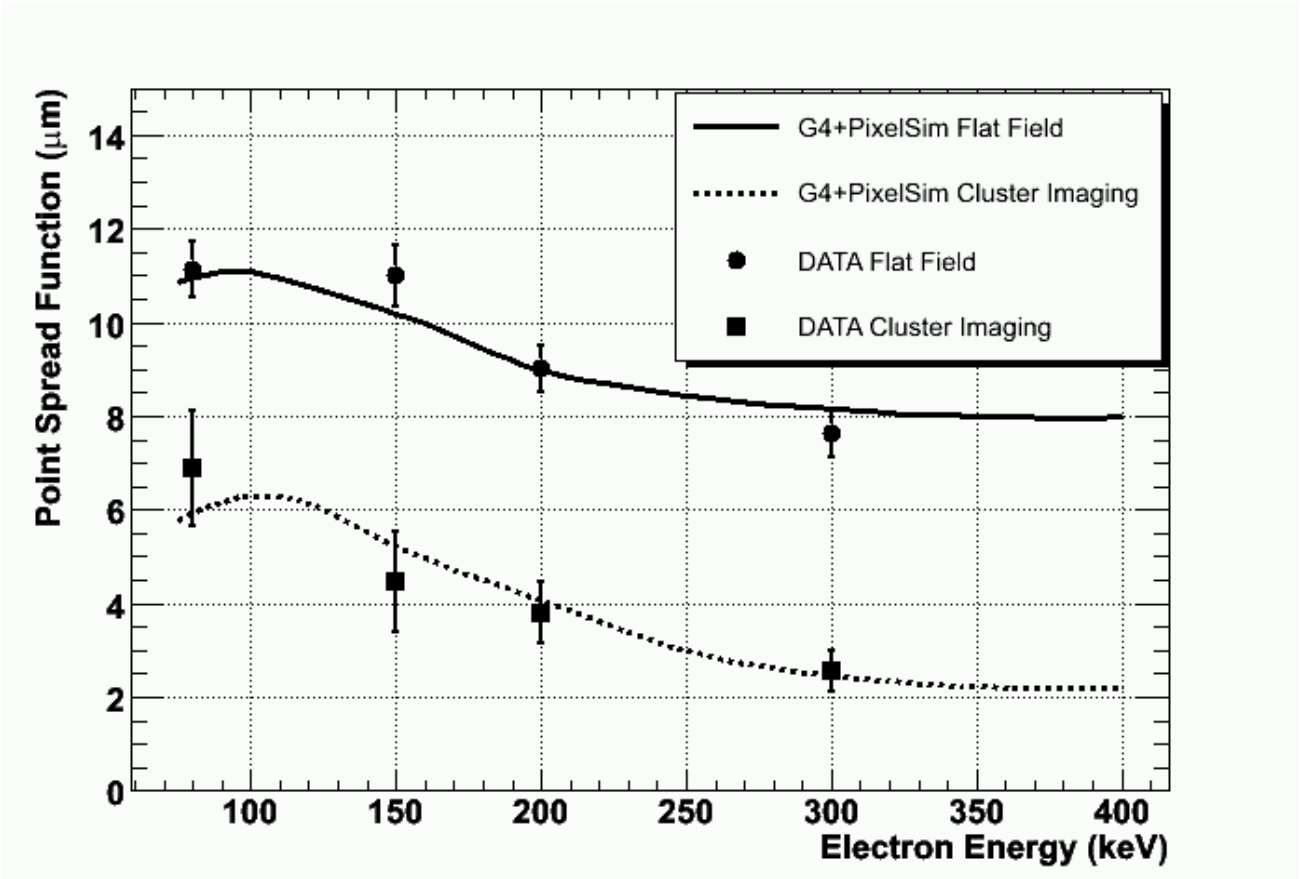

FIG. 1. Point Spread Function in the TEAM detector as a function of electron energy. Points represent measured values in "integrating" and "counting" imaging modes, and curves represent predictions from simulation.

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