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Calibration of Charge Diagnostics using Electrons from a Laser Plasma Accelerator

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The results of calibrating three independent charge measurement diagnostics with electron bunches from a laser wakefield accelerator are presented. The detectors used are phosphor screens (type DRZ), an integrated current transformer (ICT/Toroid), and a cavity-based dark current monitor (DaMon). The simultaneous use of all three measurement techniques allowed the cross-calibration of the DRZ, ICT, and DaMon for other applications, e.g. future implementation in beam driven plasma wakefield acceleration experiments at FLASHForward. Results show that the use of the DaMon permits non-destructive detection of ultrashort electron bunches with an improved dynamic range when compared to conventional diagnostics such as phosphor screens and ICTs. This originates from the insensitivity of the DaMon to the electromagnetically noisy plasma environment and its strong response to electric charge passing through its cavity. Therefore, the DaMon enables the detection of low bunch charges down to the ~ 10 fC regime opening up new possibilities of precise charge measurements for plasma-based acceleration.

Primary author: Mr BOHLEN, Simon (DESY/University of Hamburg)

Co-authors: Dr PALMER, Charlotte (DESY); LIPKA, Dirk (DESY); Ms TAUSCHER, Gabriele (DESY/University of Hamburg); SCHWINKENDORF, Jan-Patrick (DESY/University of Hamburg); Dr OSTERHOFF, Jens (DESY); Dr DALE, John (DESY); LUND-NIELSEN, Jorgen (DESY); NEUGEBAUER, Jörg (DESY); Mr GOLDBERG, Lars (DESY/University of Hamburg); Dr SCHAPER, Lucas (DESY); QUAIST, Martin (DESY/University of Hamburg); Dr STREETER, Matthew (DESY); KONONENKO, Olena (DESY/University of Hamburg); Dr D'ARCY, Richard (DESY); VILCINS, Silke (DESY)

Presenter: Mr BOHLEN, Simon (DESY/University of Hamburg)

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