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Development of ultra-fast diamond-sensor based systems for Advanced Accelerator Diagnostics

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We report on the activities of the University of California-funded Advanced Accelerator Diagnostics (AAD) Collaboration to develop ultra-fast diamond-sensor-based detection systems. Results are presented on the performance properties of monocrystalline diamond, including charge collection efficiency and time, and radiation tolerance. We follow with presentations of diagnostic-system prototypes completed or under development by the collaboration that pushes the state-of-the-art in terms of radiation tolerance, position sensitivity, and detector system bandwidth. These include a pass-through quadrant monitor with a resolution of 1% of beam width aimed at cavity-based FELs such as CBXFEL with pulse rates of 50 MHz. A different prototype is being developed for a wire-free monitor for real-time profiling of intense proton beams, geared towards improving the efficiency and yield of isotope-production facilities. Progress is also being made on next-generation XFEL detectors with multi-bunch operation requiring 5-10 GHz measurement rates. Above 1-2 GHz, detection systems enter the "RF region"for which challenges arise in all four areas of charge collection speed, signal path integrity, high-bandwidth signal transport, and amplification and digitization. Progress on all these fronts, and remaining challenges, will be presented.

Footnotes

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