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The hardware and software architecture of the MTCA.4 BPM electronics for the DESY's PETRA IV accelerator

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The PETRA IV accelerator at DESY represents the forefront of synchrotron radiation science, demanding advanced instrumentation to deliver the requested beam quality. This paper describes the hardware and software architecture of the MicroTCA.4-based BPM electronics, prototyped collaboratively by Instrumentation Technologies (I-Tech) and DESY. The project was based on the legacy of the Libera Brilliance+ (LB+) BPM system and the Libera Base software architecture. While LB+ is based on the MicroTCA.0 architecture, the project required full compatibility with MicroTCA.4. By leveraging the existing front-end electronics and the mature software framework, the project focused on the platform compatibility challenges while keeping risks under control and expediting prototyping. The new key hardware components include a BPM-optimized RTM module developed by I-Tech and the DAMC-UNIZUP AMC processing board from DESY. After two years of tests at PETRA III, the validated prototype is ready to be industrialized and deployed for PETRA IV. The BPM application became hardware-agnostic, supporting multiple BPM boards while maintaining platform independence. This flexibility enhances system versatility and establishes its role in PETRA IV's FOFB architecture. By harmonizing innovative hardware design with robust software solutions, this work underscores a seamless transition from legacy technology to next-generation systems, offering valuable insights for future accelerator advancements.

Footnotes

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Author: ŠKOBERNE, Martin Anton (Instrumentation Technologies (Slovenia))

Co-authors: BARDORFER, Aleš (Instrumentation Technologies (Slovenia)); CARGNELUTTI, Manuel (Instrumentation Technologies (Slovenia)); LEBAN, Peter (Instrumentation Technologies (Slovenia)); OBLAK, Matej (Instrumentation Technologies (Slovenia)); PAGLOVEC, Peter (Instrumentation Technologies (Slovenia)); REPIČ, Borut (Instrumentation Technologies (Slovenia)); ČERNE, Robert (Instrumentation Technologies (Slovenia)); KUBE, Gero (Deutsches Elektronen-Synchrotron DESY); LAMAACK, Jonas (Deutsches Elektronen-Synchrotron DESY); DUHME, Hans-Thomas (Deutsches Elektronen-Synchrotron DESY); GOEPPERT, Florian (Deutsches Elektronen-Synchrotron DESY); LENSCH, Timmy-Jan (Deutsches Elektronen-Synchrotron DESY)

Presenter: ŠKOBERNE, Martin Anton (Instrumentation Technologies (Slovenia))

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