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MONOLITH - picosecond capability in a high granularity monolithic silicon pixel detector

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The MONOLITH H2020 ERC Advanced project aims at producing a high-granularity monolithic silicon pixel detector with picosecond-level time stamping. To obtain such extreme timing the project exploits: i) a fast and low-noise SiGe BiCMOS electronics; ii) a novel sensor concept, the Picosecond Avalanche Detector (PicoAD), that uses a patented multi-PN junction to engineer the electric field and produce a continuous gain layer deep in the sensor volume. The result is an ultra-fast current signal with low intrinsic jitter in a full fill factor sensor. A proof-of-concept monolithic PicoAD demonstrator provided full efficiency and 13 ps at the center of the pixel, while the time resolution raised to 25 ps in the inter-pixel region. The first batch of PicoAD prototypes with different geometries and gain-layer implant doses was delivered in January 2024; testbeam results will be shown.

In addition, a prototype without internal gain layer was produced in 2022. Testbeam measurements showed full efficiency and 20 ps time resolution at a power consumption of 1 W/cmˆ2 and a sensor bias voltage HV = 200 V. This prototype after being irradiated up to 1x10ˆ16 neq/cm2, still provides an efficiency of 99.7% and 45 ps at HV = 300 V.

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