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Innovative Back-Side Illuminated SiPMs (BSI-SiPMs): first results from the IBIS project

Wednesday 8 October 2025 14:00 (20 minutes)

INFN, in collaboration with FBK (Fondazione Bruno Kessler), is developing a novel type of Silicon Photomultiplier (SiPM) — the Back-Side Illuminated (BSI) SiPM — within the framework of the IBIS and IBIS_NEXT projects (Innovative Back-Side Illuminated SiPMs). This new sensor architecture introduces a clear separation between the charge collection and multiplication regions of the device, enabling the implementation of a charge-focusing mechanism. This approach offers several key advantages: a near-100% fill factor even for devices with small microcells, significantly enhanced sensitivity down to vacuum ultraviolet (VUV) wavelengths through optimised surface treatments, improved radiation hardness thanks to a reduced high-field region, and simplified integration with readout electronics via bump bonding, as all electrical contacts are located on the same side of the sensor.

The BSI SiPM technology is particularly well suited for experiments employing the Cherenkov technique — such as the ePIC experiment at the EIC — and for future upgrades of ALICE 3 and LHCb. It is also highly promising for noble liquid detectors — such as DUNE — and paves the way towards high resolution imaging with SiPMs in several other applications.

We present the first results from characterisation studies of prototype sensors from the IBIS RUN 1, fabricated by FBK with single-photon avalanche diode (SPAD) pitches ranging from 15 µm to 35 µm. Detailed measurements of key performance parameters — carried out in dark conditions, within a climatic chamber, and at cryogenic temperatures (77 K) — will be reported.

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