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Test Beam on monolithic pixel sensors test structures in the 65 nm technology for the ALICE ITS3 upgrade

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The ALICE ITS3 (Inner Tracking System 3) upgrade project together with the CERN EP R&D on monolithic sensors are exploring the Tower Partner Semiconductor Co. 65 nm ISC process.
The ITS3 project aims to build the first fully cylindrical tracker by using wafer scale, ultra thin (less than 50 µm) bent MAPS with a material budget down to 0.07% radiation length per layer.
Four different pixel test structures were designed to validate the sensor technology through an extensive characterization both with laboratory and in-beam measurements.
In particular, this work will focus on the Analogue Pixel Test Structure - Operational Amplifier (APTS-OPAMP), which is equipped with a fast in-pixel OPAMP buffer to explore the sensor timing performance.
To perform the timing measurements, a test beam with positive hadrons (120 GeV/c) was performed in June 2023 at CERN-SPS facility.
This work will show the integration of the two different readout systems for OPAMP structure: an Oscilloscope with 40 GS/s sampling frequency and 13 GHz bandwidth, and a readout board that has a 4 MHz sampling rate. A summary of the results will also be presented: a time resolution of about 75 ps demonstrates a big improvement compared with the 180 nm technology fastest sensors, without any loss in terms of charge collection efficiency. Moreover, by selecting only the tracks passing under the electrode, a time resolution of 50 ps can be achieved.

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