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The TDCpix readout ASIC: a 75 ps resolution timing front-end for the NA62 Gigatracker hybrid pixel detector

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The TDCpix is a novel pixel readout ASIC for the NA62 Gigatracker detector. NA62 is a new experiment being installed at the CERN Super Proton Synchrotron. Its Gigatracker detector shall provide on-beam tracking and time stamping of individual particles with a time resolution of 150 ps rms. It will consist of three tracking stations, each with one hybrid pixel sensor. The peak flow of particles crossing the detector modules reaches 1.27 MHz/mm² for a total rate of about 0.75 GHz. Ten TDCpix chips will be bump-bonded to every silicon pixel sensor. Each chip shall perform time stamping of 100 M particle hits per second with a timing accuracy better than 200 ps rms and a detection efficiency above 99%. The TDCpix chip has been designed in a 130 nm CMOS technology.

It will feature 45 × 40 square pixels of 300 × 300 μm² and a complex End of Column peripheral region including an array of TDCs based on DLLs, four high speed serializers, a low-jitter PLL, readout and control circuits. This contribution will describe the complete design of the final TDCpix ASIC. It will discuss design choices, the challenges faced and some of the lessons learned. Furthermore, experimental results from the testing of circuit prototypes will be presented. These demonstrate the achievement of key performance figures such as a time resolution of the processing chain of 75 ps rms and the capability of time stamping charged particles with an overall resolution below 200 ps rms.

quote your primary experiment

NA62

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