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Design of Nupix-A2, a Monolithic Active Pixel Sensor for Heavy-ion Physics

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The High-Intensity heavy-ion Accelerator Facility (HIAF) is under construction to generate intense beams of primary and radioactive ions for various research fields. Among the different detector technologies, the Monolithic Active Pixel Sensor (MAPS) stands out due to its integration of the pixel matrix and readout circuit into a single silicon substrate. Hence, a MAPS named Nupix-A2 has been developed in a 130-nm High Resistivity CMOS process. The Nupix-A2 can simultaneously measure energy, arrival time, and position of the particle hits. What is more, the Nupix-A2 offers two operation modes, the full-readout mode and fast-readout mode, for different applications. It comprises a 128×128 pixel array, a digital-to-analog converter array, and a digital control module. The size of each pixel is 30 μm×30 μm. The Nupix-A2 can measure energy deposition from 300 e- to over 50 ke- and time duration from 13 μs to 140 μs. The S-cure shows the performance of the comparator, while the transfer noise (TN) is approximately 14.3258 e-, and the threshold is ~300.112 e-. For the energy path, while using the test capacitor to inject charge, a maximum Integral Non-Linearity (INL) of 1.568% was observed within the 0 to 23.58 ke- range. As for the time path, when the range is 40 μs with the charging current at ~4 nA, the maximum INL value is 2.88%. This paper will discuss the design and preliminary test of the Nupix-A2.

Minioral

Yes

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No

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