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Challenges towards Low-Power and Fast-Timing MAPS

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Monolithic Active Pixel Sensors (MAPS) are an attractive solution for scientific applications that require excellent position and time resolution. MAPS integrate both sensor matrix and readout circuitry on a single silicon wafer, making them cost-effective and efficient.

The ALPIDE sensor, initially designed for the ALICE Inner Tracking System (ITS2) at CERN, was the base for applications to space-based tracking detectors, with the Limadou HEPD-02 marking the first implementation of MAPS technology in space. ALPIDE implements a 30 μm pixel pitch with an analog power of 5 mW/cm^2 to achieve 1 μs time resolution. The total power consumption is dependent on the data transmission rate and can be kept below 15 mW/cm^2. This makes it an ideal choice for space-based applications with limited power budgets and heat dissipation capabilities. The ALPIDE evolution for the new ITS3 is a 300mm wafer-scale MAPS, where options are explored to tune balance between power consumption and timing performance.

In the exploration for achieving the ultimate time resolutions, the MONOLITH project has made significant progress towards sub-10 ps resolution using MAPS based on BiCMOS Si-Ge technology. A prototype implementing a 100 μm pixel pitch proven 40 mW/cm^2 analog power operation to achieve 80 ps resolution and 360 mW/cm^2 to achieve 30 ps resolution. This remarkable advancement has the potential to expand the applications of MAPS and open up new possibilities for research and development across multiple fields.

This talk will cover the challenges in developing MAPS with low power consumption and fast timing capabilities, as well as showcase the latest developments.

Eligibility for ”Best presentation for young researcher” prize

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Session Classification: Research and Development of novel instrumentation for particle meaurements in space

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