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CMOS Pixel Sensors for High Precision Beam Telescopes and Vertex Detectors

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CMOS sensors of the MIMOSA (standing for Minimum
Ionising particle MOS Active pixel sensor) series are developped
at IPHC since a decade and have ended up with full scale devices
used in beam telescopes and in demonstrators of future vertex
detectors. The sensors deliver analogue, unfiltered, signals and are
therefore limited to read-out frequencies of ˜1 kframe/s. Since
a few years, a fast architecture is being developed in collaboration
with IRFU, which aims to speed up the read-out by 1-2 ordres of
magnitude. The first full scale sensor based on this architecture
was fabricated recently and is being tested. Made of 660,000
pixels (18 mu;m pitch) covering an active area of ˜2 cm²,
it delivers zero-suppressed binary signals, which allow running
at ˜10 kframes/s. It will equip the beam telescope of the
E.U. project EUDET and serve as a forerunner of the sensor equipping
the 2 layers of the PIXEL detector of the STAR experiment at RHIC.
The contribution to the conference will overview the main
features and test results of this pioneering sensor.
It will next describe its evolution towards
read-out frequencies approaching 100 kframes/s, as required for the
vertex detectors of the CBM experiment at FAIR and at the ILC.
Finally, the issue of radiation tolerance will be addressed, in the
context of a newly available CMOS process using a depleted substrate.
A prototype sensor was fabricated in a such CMOS process. The
talk will summarise beam test results showing, for the first time, that
fluences of 10¹⁴ n_{eq}/cm² may be tolerable for CMOS
sensors.
Overall, the talk provides an oveview of the status and plans of
CMOS pixel sensors at the frontier of their achievements and outreach.

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