Omni-purpose detectors based on stacks of CMOS active pixel sensors

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INTRODUCTION

Spatial, time or energy resolutions ?
➡ fast/precise electronics conflict with granularity

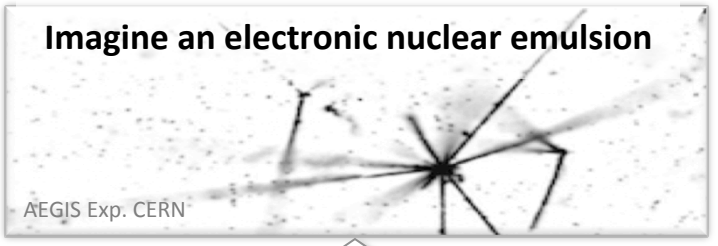
Thin or thick sensitive volume ?
➡ no simultaneous measure of low/high penetrating radiations

Tracking or calorimetry ? Low or high dynamic ?
➡ antagonist optimization

Single pixel sensor limitations

CONCEPT & CHALLENGES

Imagine an electronic nuclear emulsion



Stack of CMOS active pixel sensors
- 5D points: 3D space + 1D time + 1D Energy
- Sensitivity to various particle types / energies
- Point-to-point easy correlation

Imagine a miniaturized multi-detector

Mostly existing technologies…to be combined

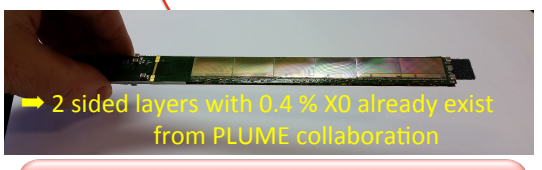
Pixel sensors	Integration	Data acquisition
Fully/partially depleted for sensitivity/efficiency Small pixel / slow r-o Large pixel / fast r-o Smart pixel limits data throughput	Large area: butting or stitching Cooling: µchannels, air flow Elec-connections: embedded flex, stitching	Exploit sensor smartness to extract only relevant info Still, more physical information = more bandwidth

Key technical features
- Specialized pixels available
- Controlled (in)sensitive thickness
- "Unlimited" nb of sensors

EXPECTED IMPACTS

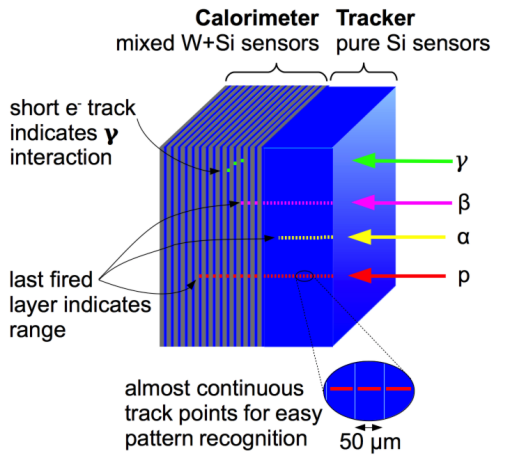
Charge particle tracker

3 points
- Helix seed fit
- Higher spatial resolution
- Combined time & space res.
- Higher Rad.Tol. by redundancy



- high hit density environment
- Low momentum particles

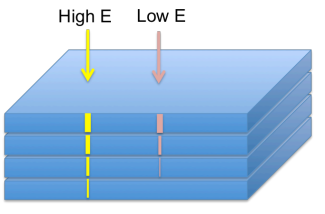
Multi-species detector



- Radio-emitters detection
- Medical imaging
- Nuclear physics

X-ray spectro-imager

Stack
- Higher counting dynamic
- Higher QE @ high E
- Location of point source detection
- Energy spectrum from counting



- Non destructive tests in Industry
- Synchrotron instrumentation