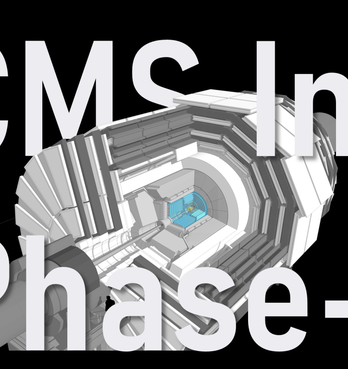
University of Zurich[UZH]

PROF. BEN KILMINSTER'S GROUP

YOUR NEXT PIXEL DETECTOR

CMS Inner Tracker Phase-2 Upgrade



The Compact Muon Solenoid (CMS) is one of the multipurpose detectors at the Large Hadron Collider (LHC), consisting of different subdetectors optimized for position and energy measurements of particles produced in collisions.

The upcoming High-Luminosity LHC upgrade is planning to increase its luminosity by a factor of ten, allowing the LHC to produce more data, enabling more precise measurements and the potential to observe rare processes not currently detectable. The CMS will also undergo significant upgrades to handle the increased data rates and harsher operational conditions expected in the HL-LHC era, continuing its role in pushing the frontiers of particle physics.

UZH group contributes significantly to the conception, development, and construction of the Tracker Endcap PiXel detector (TEPX) in the CMS Phase-2 inner tracker system, a high-end pixel system designed for HL-LHC's harsh pileup with improved tracking capabilities.

Great Precision

$50 \times 50\ \mu m^2$ pixel size
Super camera with 2 Gigapixels

Radiation Hard

40 MHz pp collision
$3\ GHz/cm^2$ Hit rate

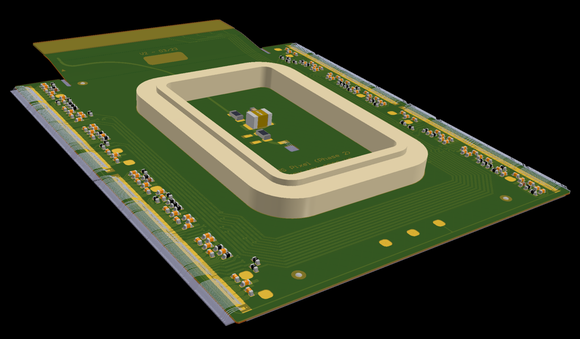
Reduced Noise

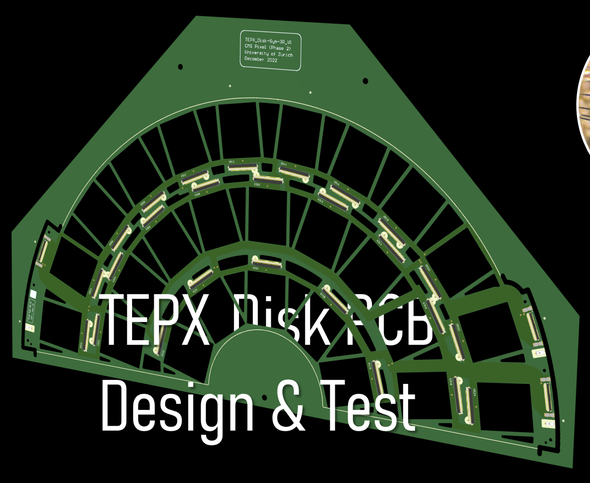
Less than 1% of signal from minimum ionization particle

Ultra Fast

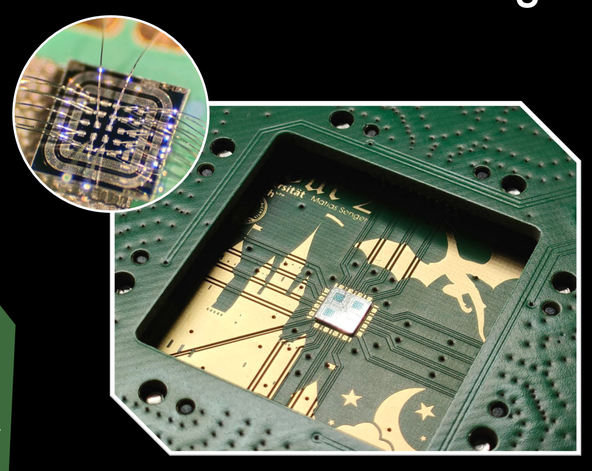
30 picoseconds time resolution with Novel LGAD technology* introducing 4D tracking era

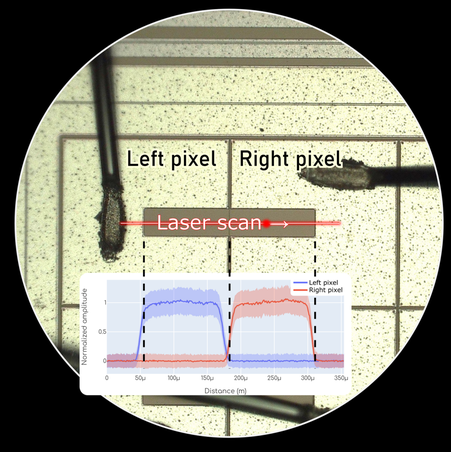
TEPX Module Testing





Readout board design



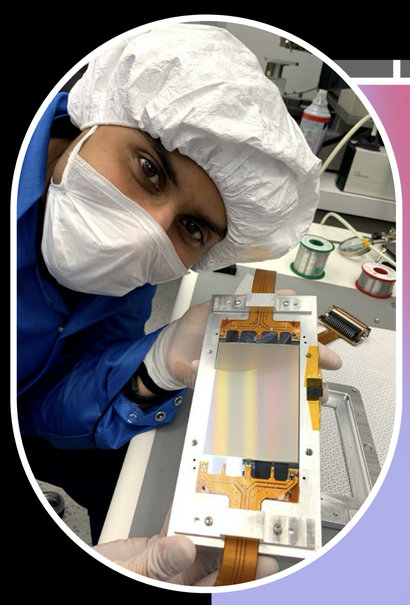


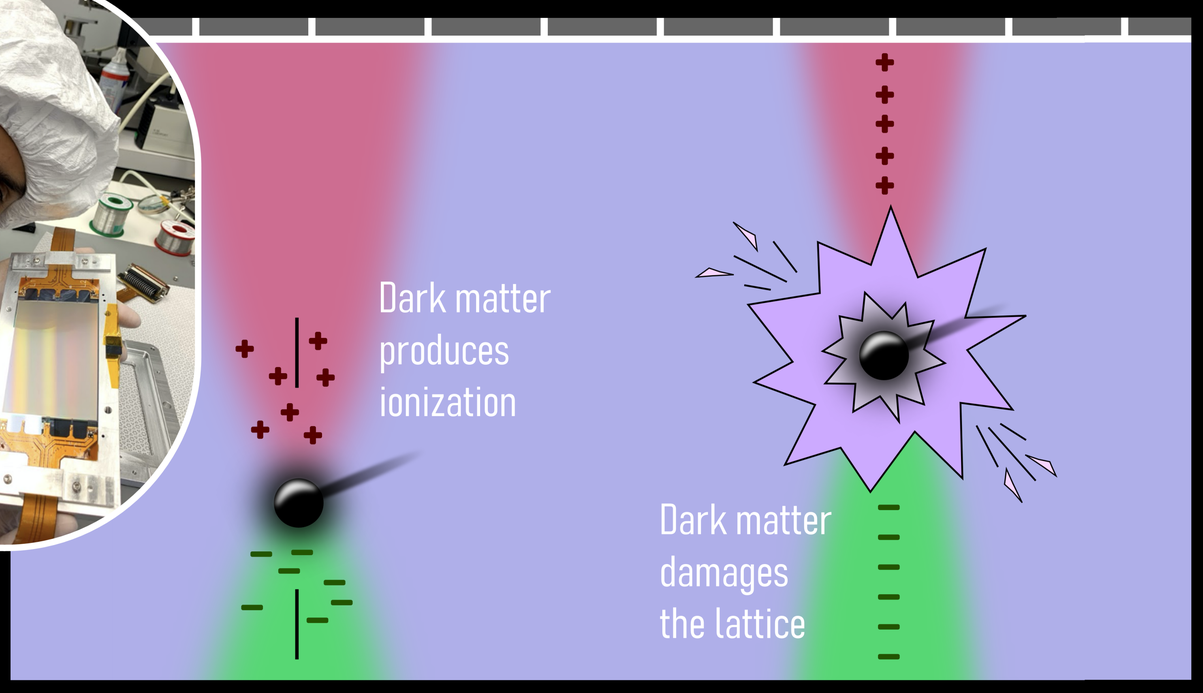
LGAD sensor R&D

*LGAD: Low Gain Avalanche Detectors

Dark Matter in CCDs

The DAMIC experiment uses high-resolution sensitive charge-coupled devices (CCDs) to capture the elusive signals of dark matter through ionization. Located in underground facilities to reduce background noise from cosmic rays, DAMIC's sensitive CCDs are uniquely poised to observe the rare interactions that could reveal the presence of dark matter. UZH is pioneering a new technique to use radiation damage to find evidence of dark matter in CCD detectors.





Damage as Evidence

exploring full potential of the detector

Accumulative Data

increasing the chances of detecting rare DM interactions

Enhanced Sensitivity

to DM particles with low mass or low energy not producing strong ionization signals

Durable Record

allowing for retrospective analyses with improved techniques or theories in the future