University of Zurich[UZH]

Introduction to UZH groups

Ben Kilminster

Sept. 7, 2021

Fostering Swiss collaboration towards a future circular collider

UZH professors in (astro) particle physics

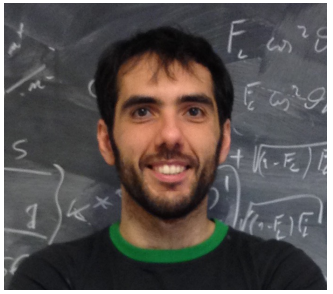
Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

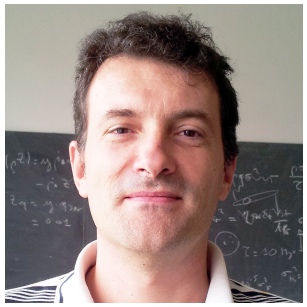
Florencia Canelli

Laura Baudis



Nico Serra

Stefano Pozzorini



Massimiliano Grazzini

Thomas Gehrmann

Adrian Signer (PSI)

Gino Isidori

Andreas Crivellin (PSI)

Philippe Jetzer

We have different hats

Also PSI

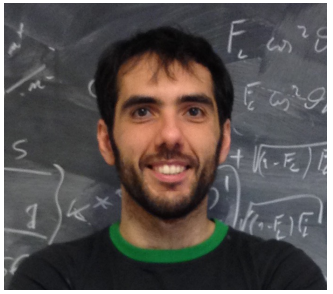
Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis



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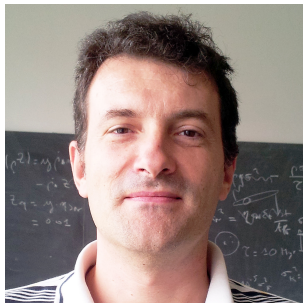

Massimiliano Grazzini

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Philippe Jetzer

Experimentalists

Ben Kilminster

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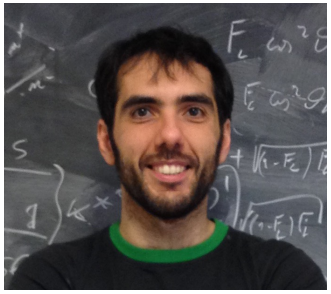

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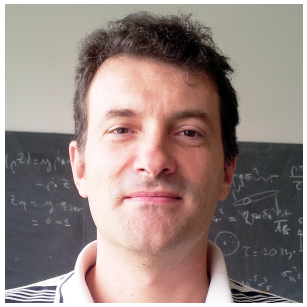

Massimiliano Grazzini

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Gino Isidori

Andreas Crivellin (PSI)

Philippe Jetzer

Theorists

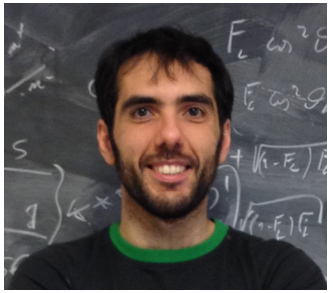
Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis



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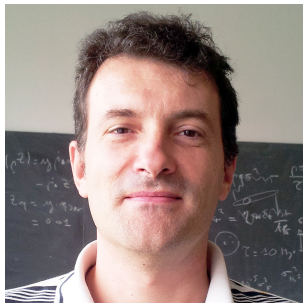
Stefano Pozzorini



Massimiliano Grazzini

Thomas Gehrmann

Adrian Signer (PSI)

Gino Isidori

Andreas Crivellin (PSI)

Philippe Jetzer

Higgs physics

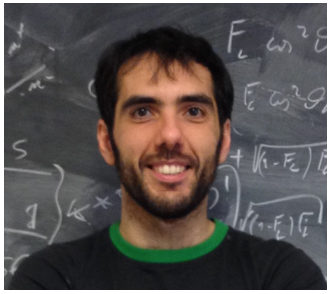
Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis



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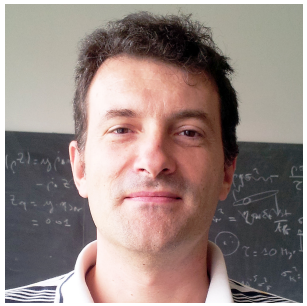

Massimiliano Grazzini

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Adrian Signer (PSI)

Philippe Jetzer

QCD physics

Ben Kilminster

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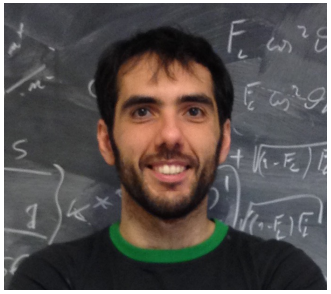

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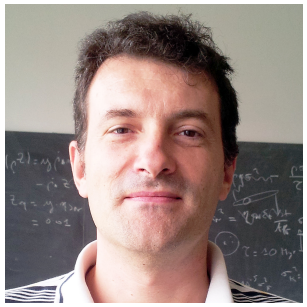


Massimiliano Grazzini

Thomas Gehrmann

Adrian Signer (PSI)

Gino Isidori

Andreas Crivellin (PSI)

Philippe Jetzer

Flavor universality violation physics

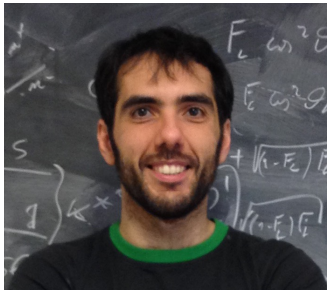
Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis



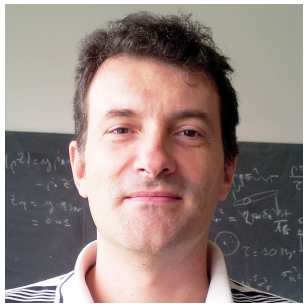
Nico Serra

High PT

Low PT

Theory

Stefano Pozzorini



Massimiliano Grazzini

Thomas Gehrmann

Gino Isidori

Andreas Crivellin (PSI)

Adrian Signer (PSI)

Philippe Jetzer

Astroparticle

Ben Kilminster

DAMIC

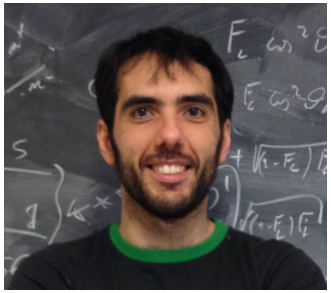
Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis

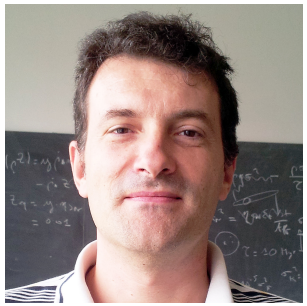
XENON, DARWIN



Nico Serra

Grav. Waves, LISA

Stefano Pozzorini



Massimiliano Grazzini

Thomas Gehrmann

Gino Isidori

Andreas Crivellin (PSI)

Adrian Signer (PSI)

Philippe Jetzer

Neutrinos

Ben Kilminster

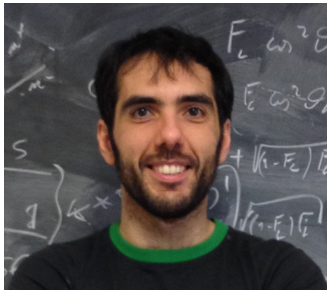
Cristina Botta

Lea Caminada (PSI)

Florencia Canelli

Laura Baudis

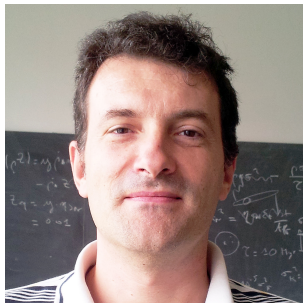
GERDA, LEGEND



Nico Serra

SHIP

Stefano Pozzorini



Massimiliano Grazzini

Thomas Gehrmann

Gino Isidori

Andreas Crivellin (PSI)

Adrian Signer (PSI)

Philippe Jetzer

BSM

Ben Kilminster

Cristina Botta

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Florencia Canelli

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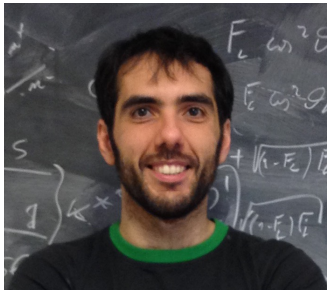

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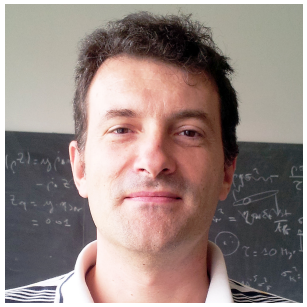
Stefano Pozzorini



Massimiliano Grazzini

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Philippe Jetzer

Experimental technologies relevant for FCC

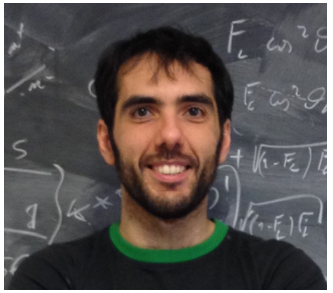
CMS experiment

Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli



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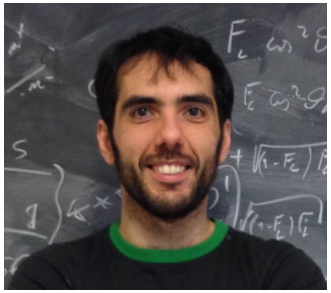
LHCb experiment

Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli



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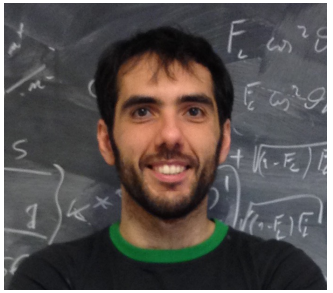
Detector development

Ben Kilminster

Cristina Botta

Lea Caminada (PSI)

Florencia Canelli



Nico Serra

Level-1 trigger for HL-LHC: Cristina

Silicon pixel detector: Ben, Lea, Florencia, Nico (Olaf)

Detector development

Ben Kilminster

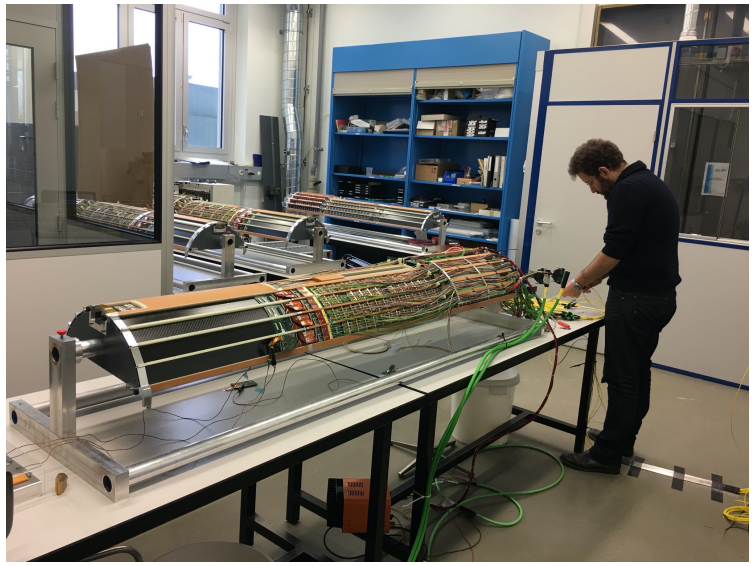
Lea Caminada (PSI)

Florencia Canelli

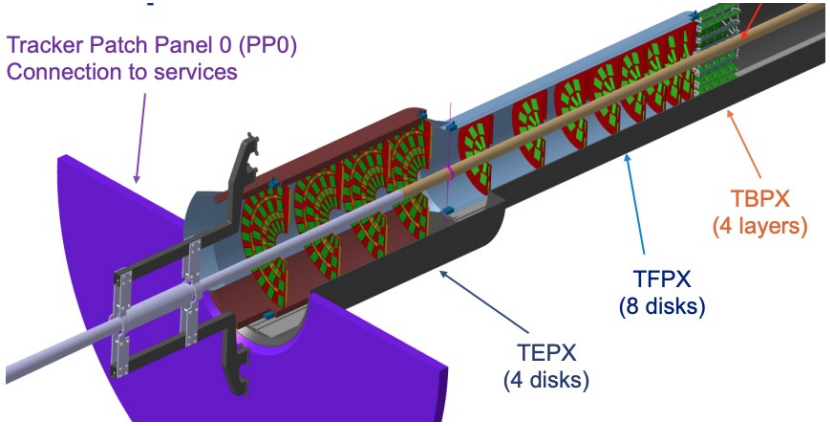
CMS Phase-1 and phase-2 pixel detector upgrades
Collaboration between UZH, PSI, ETH

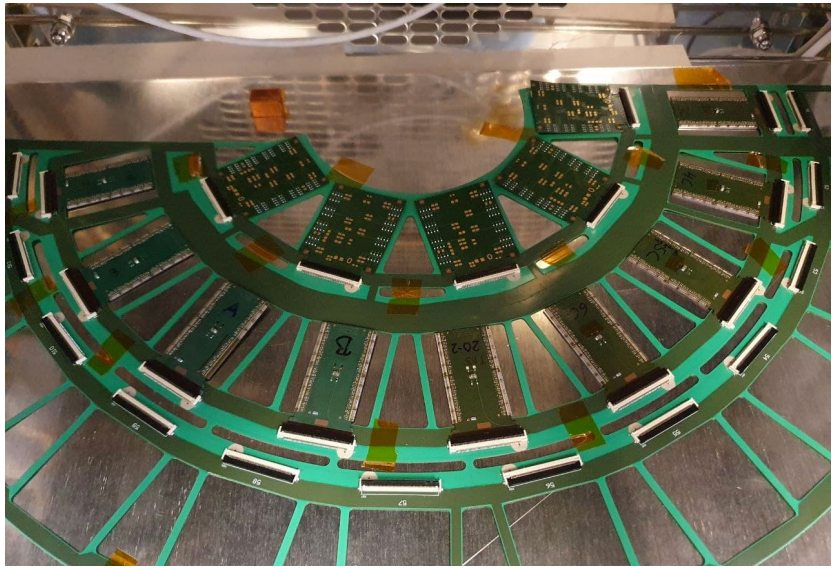
Focus on silicon pixel detectors

Detector design & construction



Lightweight mechanics/cooling
System electronics
Module design

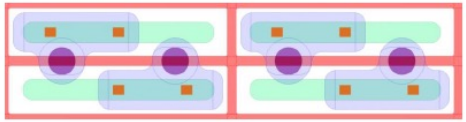




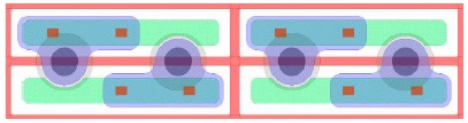
Lightweight PCB with TEPX detector modules

CMS Tracker module and sensor activities at UZH

- Coordination of sensor performance Task Force :
  - Work towards final design choices for the Inner Tracker:
    - Choice of sensor technology for innermost layer (3D or planar)
    - Definition of pixel sensor cell geometry (50x50 vs 25x100, standard vs “bricked” 25x100)

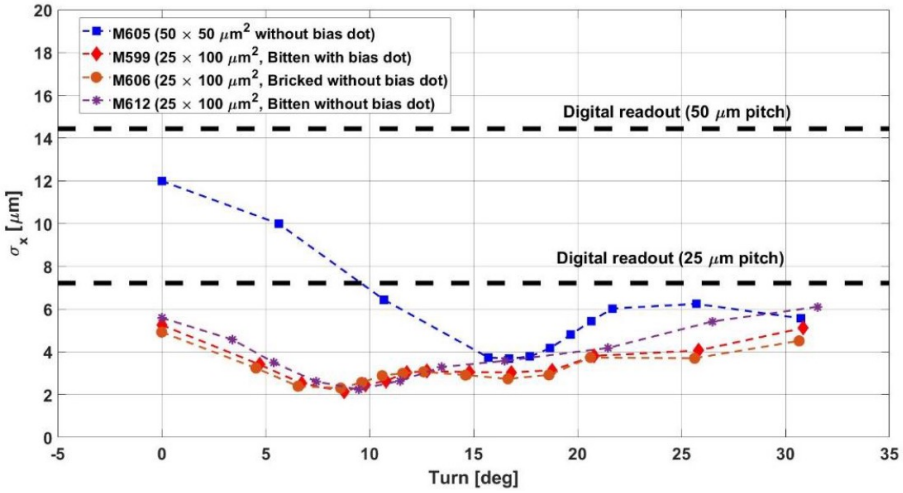


M569 : 25 × 100 μm^2, Non – Bitten without bias dot

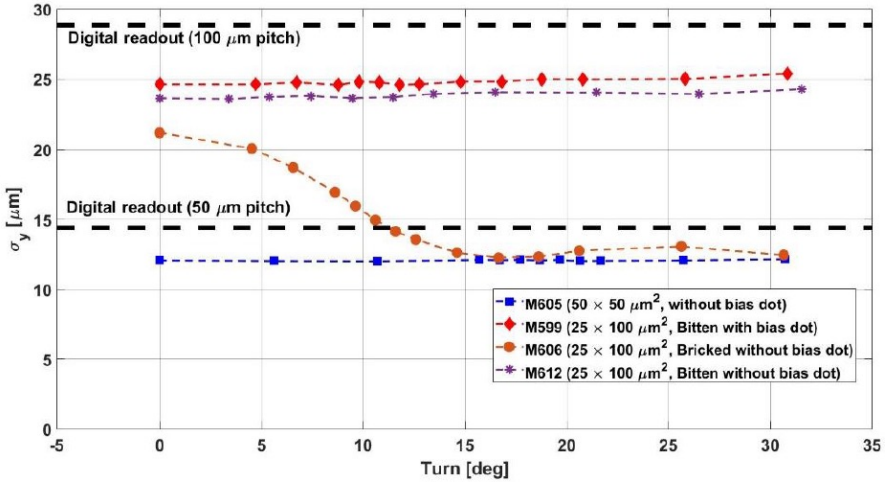


M612 : 25 × 100 μm^2, Bitten without bias dot

σ_x: Resolution along short axis (25 μm)

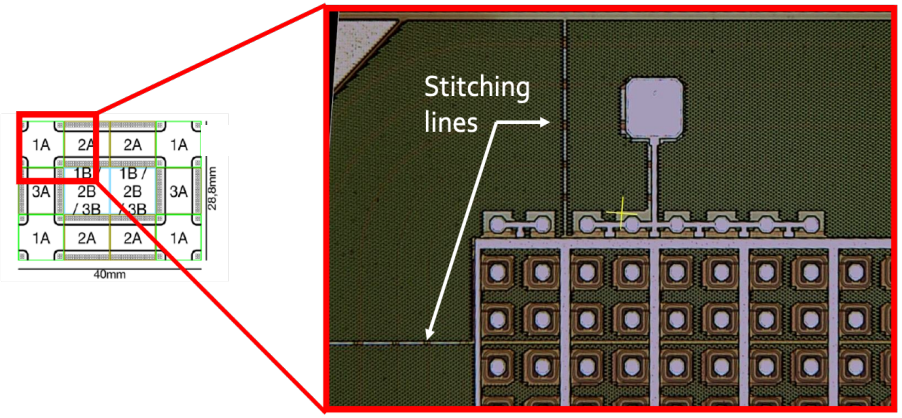


σ_y: Resolution along long axis (100 μm)



Passive CMOS sensors for HEP

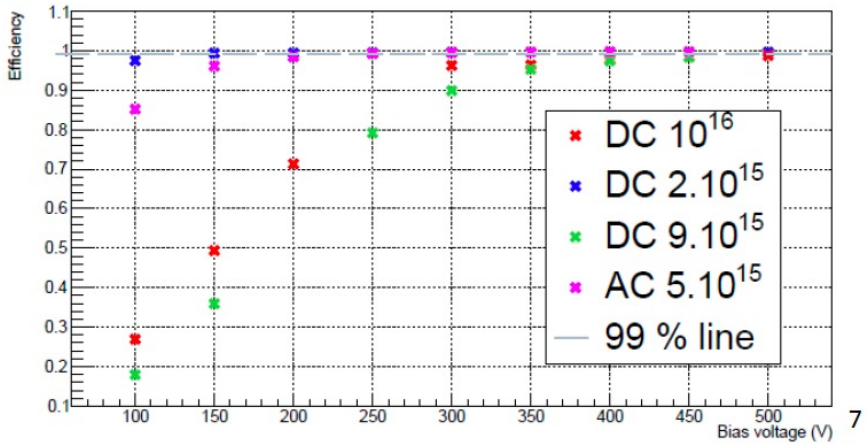
- Common project with ETH and Bonn University: investigation of the use of LFoundry 150 nm CMOS technology for the production of passive sensors.
- The low production costs, the design precision and flexibility are attractive features for the use in large size HEP trackers
- Challenges: demonstrating the radiation hardness of the technology, backside processing for achieving good quality depleted sensors, stitching required since sensor size >> reticule size

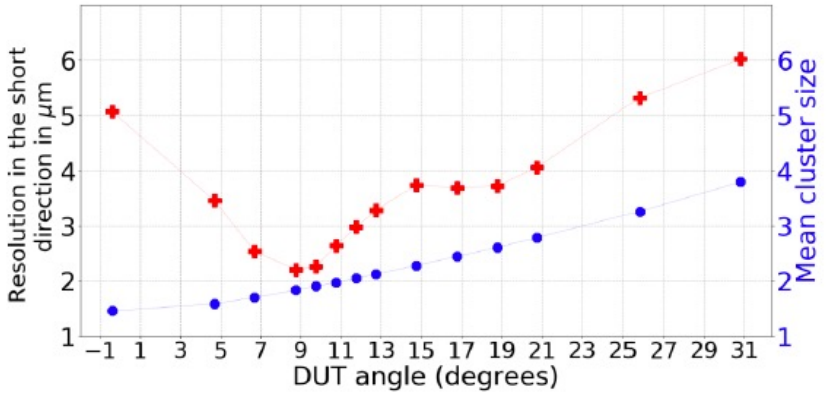


Wafer Layout: RD53A compatible sensors on 8” Lfoundry wafers

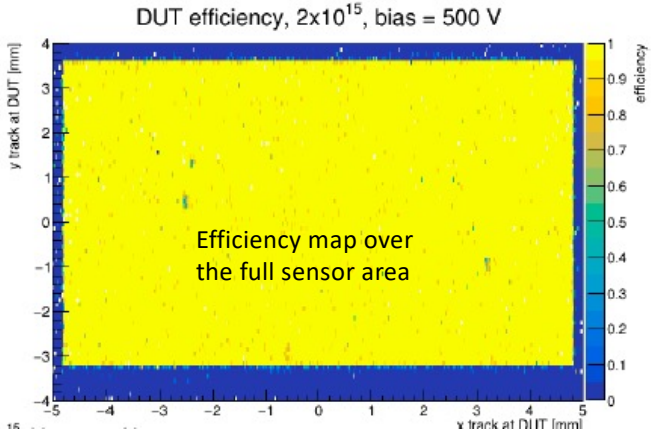
Passive CMOS sensors: results

Position resolution of 25x100 pixel cells





- Homogeneity of charge collection and hit efficiency over the fill sensor area: feasibility of stitching process demonstrated
- Hit efficiency of 99% up to a fluence of 1e16 n_{eq}/cm^2: radiation hardness demonstrated
- Spatial resolution comparable to standard HEP pixel sensors



HV MAPS for LHCb Upgrade II

Cover inner part of tracking stations downstream of spectrometer magnet

→ active area ≈ 18 m^2

Specifications / challenges:

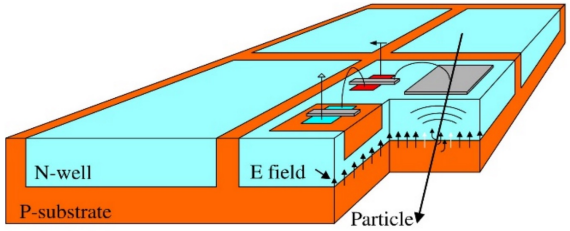
→ **time resolution**
(3 ns to assign hits to correct BX)

→ **power consumption**
(material budget: LV, cooling)

→ **operating temperature**
(material budget: cooling)

→ **readout format**
(material budget: data links)

→ **radiation hardness**
(up to 3 x 10^{14} neq /cm^2 × safety factor)



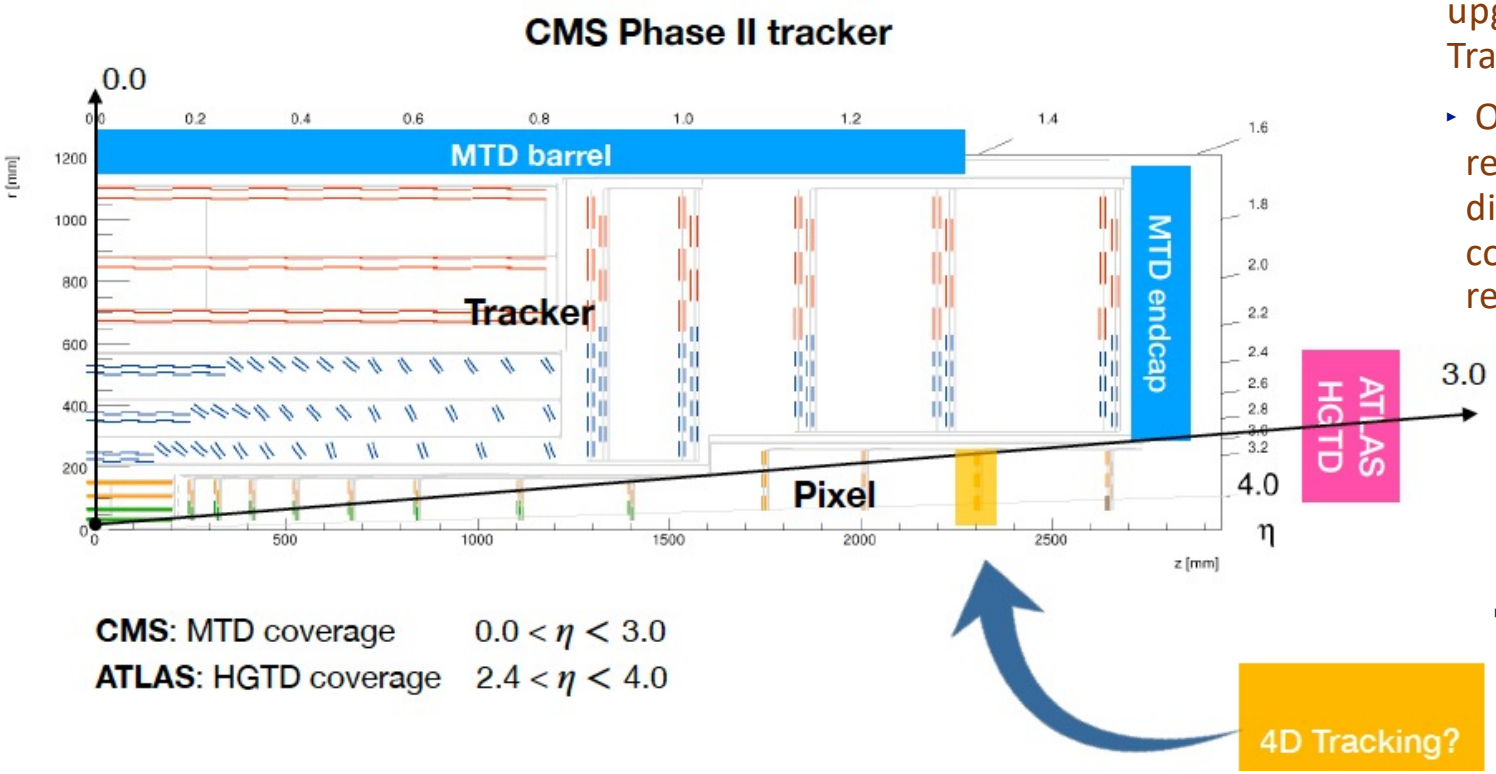
[I.Peric, NIM A582(2007)876]

Development based on MuPix/ATLASPix sensors

Framework TDR for Upgrade II in preparation

UZH (O. Steinkamp) with
Bonn, Heidelberg, KIT,
Birmingham, Edinburgh,
Liverpool, Manchester, RAL

4D Tracking



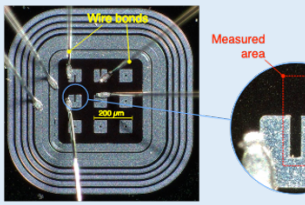
- Many options open for a Phase3 upgrade (~2030) of the CMS Inner Tracker:
  - One possible scenario is the replacement with of one or two TEPX disks per side with 4D sensors combining good spatial and time resolution
  - Development proceeds on the sensor, ASIC, physics reconstruction side

Working with PSI on TDC design

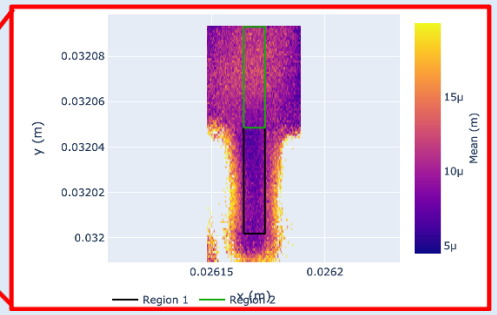
LGAD sensor studies

- CMS group at UZH investigating different flavours of LGAD sensors – Work in the framework of AIDAInnova and RD50 Collaboration

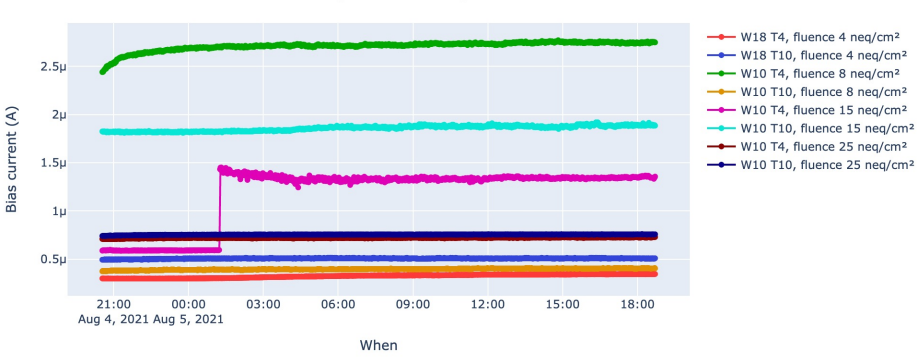
AC LGADs



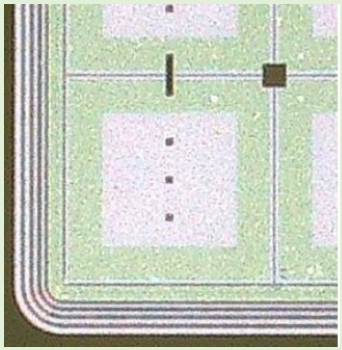
Position resolution

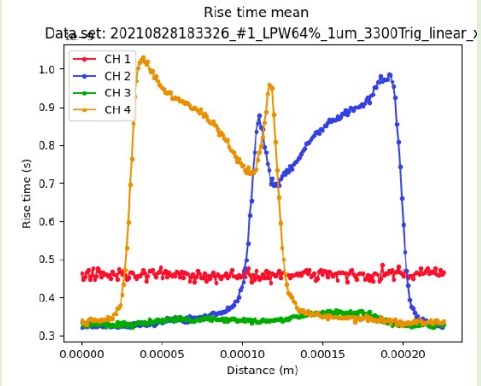


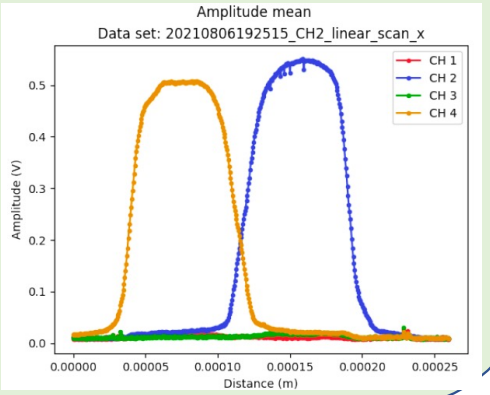
Time stability of the ETL LGAD



Trenched LGADs







UZH activities towards FCC

- Started a project for Tracking @ FCC:
  - In the framework of SNF Switzerland-Belgium common research grants: collaboration with the Vrijie Universiteit Brussel (VUB)

DMAPS development:
- Sensor production and testing in Lfoundry 110 nm and TSI 150 nm CMOS technology in collaboration with PSI
- Detector simulation of the FCC-ee Tracker :
  - Implementation of the sensor performance measured on the new DMAPS devices
  - Optimization of Tracker geometry

Physics studies:
- Design of a deep learning deep b- and c-tagger for FCC-ee
- FCNC in top quarks with charm jets at FCC-ee
- measure the relative contributions of $H \rightarrow jj$, $H \rightarrow cc$, $H \rightarrow bb$ at FCC-ee

Swiss collaboration