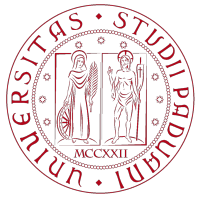

UNIVERSITÀ
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Michele Verdoglia
TFPA PhD retreat at LNGS
Presentations

TECHNOLOGIES FOR FUNDAMENTAL RESEARCH IN PHYSICS AND ASTROPHYSICS

Detectors, Lasers and Optics

High spatial and temporal resolution pixelated radiation sensors for next generation experiments in fundamental physics

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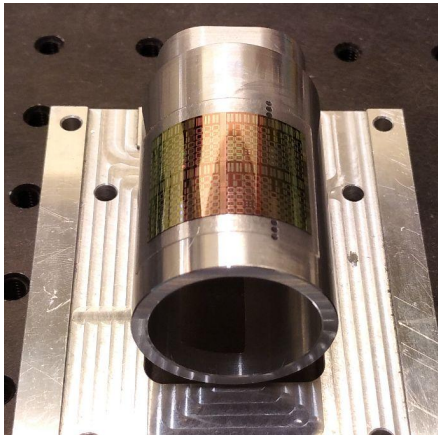
BACKGROUND

Vocational Training Certificate: Cook

Corresponding Business expert in Foreign Languages

Bachelor & Master degree in Physics

Characterization of bent MAPS 65nm CMOS for ALICE ITS3 upgrade



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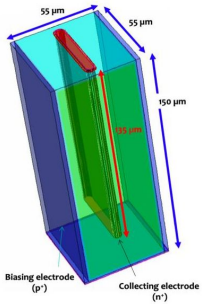
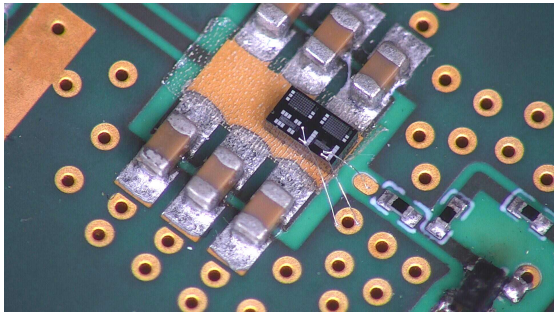
CURRENT POSITION

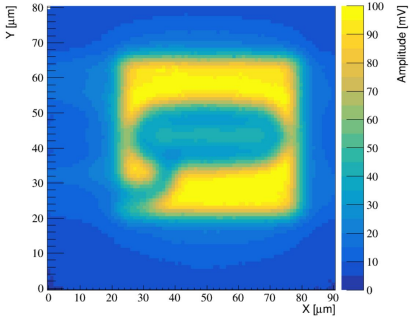
PhD Student of **Padova University** in the Technologies for Fundamental Research in Physics and Astrophysics (TFPA), project based at the **INFN laboratories in Cagliari**
Supervisors: **Alessandro Cardini** & **Adriano Lai**

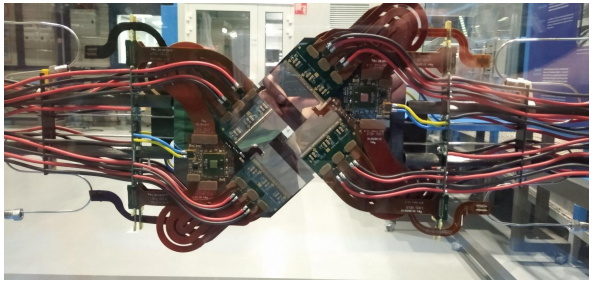
Research topic: High spatial and temporal resolution pixelated radiation sensors for next generation experiments in fundamental physics

Activities: R&D in future tracker technology, sensor characterization with μ-focussed laser setup and at test beam, ASIC verification and characterization, GEANT4 simulations, data analysis, design and commissioning of the setups.









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Characterisation of 3D trench silicon pixel sensors irradiated at $1{\cdot}10^{17}$ 1 MeV n_{eq} cm^{-2}

M. Addison[1], A. Bellora[2,3], F. Borgato[4,5], D. Brundu[6,7], A. Cardini[6], G. M. Cossu[6], G. F. Dalla Betta[4,5], L. La Delfa[8], A. Lai[6], A. Lampis[6]*, A. Loi[6], M. M. Obertino[2,3], S. Vecchi[10] and M. Verdoglia[8,5]

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The 3D trench silicon pixel sensors developed by the *TimeSPOT* collaboration have demonstrated exceptional performance, even after exposure to extreme radiation fluences up to $1{\cdot}10^{17}$ 1MeVn_{eq}/cm^2. This study assesses the radiation tolerance of these sensors using minimum ionizing particles during a beam test campaign. The results indicate that while radiation damage reduces charge collection efficiency and overall detection efficiency, these losses can be mitigated to levels comparable to non-irradiated sensors by increasing the reverse bias voltage. Charge multiplication was observed and characterised for the first time in 3D trench sensors, revealing a distinct operating regime post-irradiation achievable at bias voltages close to 300 V. Additionally, the timing performance of irradiated sensors remains comparable to their non-irradiated counterparts, underscoring their resilience to radiation damage. Currently, 3D trench silicon detectors are among the fastest and most radiation-hard pixel sensors available for vertex detectors in high-energy physics colliders. These findings highlight the potential of these sensors for new 4D tracking systems of future experiments at the Future Circular Hadron Collider (FCC-hh), advancing the capabilities of radiation-hard sensor technology.

KEYWORDS

particle tracking detectors, solid-state detectors, timing detectors, 4D tracking, radiation hardness, high time resolution, high luminosity, FCC-hh

1 Introduction

Tracking particles at extremely high fluences is one of the primary challenges for future hadronic collider experiments. To cope with the $O(10)$ increase in instantaneous luminosity at the High Luminosity Large Hadron Collider (HL-LHC) compared to the current LHC, several innovative detector solutions have been proposed. Among these, 3D trench silicon pixel sensors have emerged as a promising candidate due to their excellent spatial and temporal resolution, along with their radiation hardness, which was already proven up to fluences of 2.5·10^{16}1MeVn_{eq}/cm^2 [1]. These sensors are particularly well-suited for high-occupancy tracking detectors operating close to

THANK YOU !!!

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