

# Mehulkumar Shiroya

## Ph.D. Scholar - Particle Detectors & Simulation

Research & Development of particle detectors for high-energy physics; detector simulation/geometry, data-rate studies, and physics data analysis.

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-  DOB: April 21, 1994
-  Gender: Male
-  Marital Status: Married
-  Nationality: Indian
-  Research Area: Elementary Particle and Nuclear Physics, Detector Physics

## Current Status

### Ph.D.

May 2021 - Present

*Institut für Kernphysik, Goethe Universität Frankfurt, Germany;  
Helmholtz Forschungsakademie Hessen für FAIR (HFHF), Campus Frankfurt*

- ROOT/TGeo-based simulation geometry development for the Silicon Tracking System (STS).
- Comparative studies: Primitive solids vs. Tessellated/CAD-derived geometry (runtime, secondaries, physics impact).
- Tracking-performance evaluation: Efficiency, Acceptance, Momentum resolution.
- Data rate studies in the 4-12 AGeV/c beam-momentum range for readout electronics Front-end-Boards (FEBs) assignment to the detector.
- STS physics simulations including hits reconstruction efficiency (dead-time / electronic threshold dependence), cluster characterization, and  $dE/dx$ .

 [Goethe Universität Frankfurt webpage](#)

## Education

### Get-Involved Programme Fellow

Jan 2020 - Mar 2021

*GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany*

 [GSI webpage](#)

### M.Sc. Physics

Oct 2017 - 2021

*Institute for Nuclear Physics, Goethe University Frankfurt, Germany*

**Master thesis:** Optical Inspection of Micro-Strip Silicon Sensors for the CBM Experiment at FAIR  
(Grade: 1.0)

**Final grade:** 2.1 (out of 5)

 [Goethe Universität Frankfurt webpage](#)

### Integrated Physics

2011 - 2016

*Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India*

CGPA: 8.00 / 10

 [SVNIT webpage](#)

## Technical Skills

- **Programming:** C++, PYTHON; Basic Machine-Learning workflows

- **Tools:** CERN ROOT, GEANT4 (Basic-to-Intermediate Level), L<sup>A</sup>T<sub>E</sub>X

## Communication

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- English; German (B1, TELC); Gujarati; Hindi

## Awards

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- Giersch-Exzellenz-Preis Award (2024), HGS-Hire Graduate School

## Research Experience

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### Master Thesis

#### **Optical Inspection of Micro-Strip Silicon Sensors for the CBM Experiment at FAIR**

*Goethe University Frankfurt, Germany*

A custom-made optical inspection setup was used to scan the surface of microstrips silicon sensors received from Hamamatsu Photonics for their surface quality assurance before they are used in the construction of the Silicon Tracking System(STS) for the CBM experiment at FAIR. As expected, different manufacturing processes and handling could harm the sensors. They might have different defect types, such as, for example, Implant breaks, Double metal, Aluminium open, Aluminium shorts, Passivation open, Dust, etc. These defects could deteriorate the sensor performance if available on the sensor surface in a substantial amount. Therefore, each of the defect types' images was trained using the Convolutional Deep Neural Network (CDNN) to look for defective strips. Based on the number of defective strips found on each of the sensors, a grading scheme was applied to distinguish them in different grades for their placement on the ladders for the STS detector. In addition, we have developed an automated scheme to read the bit-code information from the sensor surface using the OpenCV package and implemented a grading scheme for sensor placement on STS ladders.

### Detector Development (RPC/MRPC)

#### **Fabrication & Performance of Large Resistive Plate Chamber**

*SVNIT, Surat, India; Variable Energy Cyclotron Centre (VECC), Kolkata, India*

Fabricated a single-gap oil-free RPC ( $240\text{ cm} \times 120\text{ cm}$ ) and performed characterization (long-term efficiency, noise rate, time resolution across the module, charge measurement).

#### **Glass-based MRPC development for TOF-PET**

*VECC*

I was actively involved in the development and characterization of two identical five-gap glass-based Multi-gap Resistive Plate Chamber (MRPCs) of the dimension  $18\text{ cm} \times 18\text{ cm}$  for their application in Time-of-Flight Positron Emission Tomography(TOF-PET) imaging technique.

#### **Bakelite MRPC development**

*VECC*

A six-gap bakelite MRPC with electrode thickness  $500\text{ }\mu\text{m}$  and a gas gap between each electrode of  $250\text{ }\mu\text{m}$  was fabricated, as it is much easier to handle compared to glass MRPCs, and a test of the detector was done with cosmic rays.

## **Detector Simulation**

### **Geant4 MRPC simulation study**

*Project work*

I have done a small project work on learning the Geant4 simulation package. We implemented the MRPCs of the dimension 18 cm × 18 cm with electrode thickness 500  $\mu\text{m}$  and 250  $\mu\text{m}$  gas-gap. We introduced the converter using different materials to investigate the detector's photon efficiency.

## **Summer Internship**

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### **Raman spectroscopy for material characterization**

**Jun – Jul 2013**

*Inter University Accelerator Centre (IUAC), New Delhi, India*

Trained on Raman spectroscopy and characterized silicon thin films (crystalline, porous, amorphous).

## **Summer Schools**

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### **EURIZON Detector School**

**17 – 28 Jul 2023**

*Universität Wuppertal, Germany*

### **OCAL: Accelerators, Lasers and Related Science & Technologies**

**May – Jul 2015**

*Raja Ramanna Centre for Advanced Technology, Indore, India*

Lectures and hands-on experiments on beam dynamics/optics, laser technology, and accelerator stability studies.

## **Presentations**

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### **Oral Presentations / Talks**

- **Comparison of simulation geometry based on ROOT primitive solids and tessellated solids** - DPG 2025, Universität zu Köln, Germany.
- **Studies of detector data rates and hit multiplicity for the STS of the CBM experiment** - DPG 2024, Justus-Liebig-Universität Gießen, Germany.
- **A new concept for the geometry of the Silicon Tracking System in the CBM experiment** - DPG 2023, TU Dresden, Germany.
- **Study of the material budget and data rates for the STS detector system of the CBM experiment** - DPG 2022, Universität Mainz, Germany.

### **Poster Presentations**

- **Data rates in the Silicon Tracking System of the CBM experiment: Comparison of simulations with beamtime data** — Quark Matter 2025, Goethe University Frankfurt, Germany.
- **Experiences from the CBM collaboration: CAD to ROOT conversion for detector geometries** - CHEP 2024, AGH University, Krakow, Poland.
- **Study of the material budget and data rates for the STS detector system of the CBM experiment** - Quark Matter 2022, Krakow, Poland.
- **Development of MRPCs for PET imaging** - Seth Anandram Jaipuriya College, Kolkata, India.
- **Towards TOF-PET imaging using five-gap glass MRPCs** - Seth Anandram Jaipuriya College, Kolkata, India.

# Conferences & Workshops

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## In-person

- DPG Spring Meeting 2025 - Universität Köln
- DPG Spring Meeting 2024 - Justus-Liebig-Universität Gießen
- DPG Spring Meeting 2023 - TU Dresden
- National Workshop on Particle Radiation: Effects and Application (2016) - Kolkata, India
- Thin Films & Vacuum Technology training (2013) - SVNIT, Surat, India
- PCB workshop (2013) - SVNIT, Surat, India
- 5<sup>th</sup> Science Conclave/Inspire Internship Program (2012) - IIIT Allahabad, India

## Online / Virtual

- HGS-Hire Soft-skill course I (Germany), Apr 26-28, 2022
- Quark Matter 2022 (Krakow, Poland), Apr 4-10, 2022
- DPG 2022 (Mainz, Germany), Mar 28-Apr 1, 2022
- Weak Interactions and Neutrinos 2021 (University of Minnesota, USA), Jun 7-12, 2021
- Strangeness in Quark Matter 2021 (BNL, USA), May 17-22, 2021
- Joint GlueX-EIC-PANDA Machine Learning Workshop, Sep 2020
- Neutrino 2020 (Fermilab, USA), Jun 22-Jul 2, 2020

## Leadership

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- Coordinator, Training & Placement Section, Department of Physics, SVNIT Surat (2015-2016)

## References

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### Prof. Dr. Alberica Toia

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Goethe Universität Frankfurt  
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### Dr. Christian Schmidt

Head of STS working group and Detector Lab (DTL)  
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### Dr. Volker Friese

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### Dr. Johann Heuser

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