# Agni Keyoor Purani

**Date of Birth**: July 31, 2002
**Gender**: Male
**Nationality**: Indian
**Interests**: Particle Physics Phenomenology, Collider Physics and Experimental Analysis

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## EDUCATION

**Indian Institute of Technology Kharagpur** — West Bengal, India
Bachelor (Honours) and Master in Physics (Minor in Mathematics), CGPA: 9.51/10.00 — 2019–2024(Expected)

- **Thesis topic:** Composite Higgs Models (under Prof. Tirtha Sankar Ray)
- Various possibilities of form factors and need for such models.
- Using well-motivated form factors and developing an effective field theory
- Finding signatures that can be found in present and future collider experiments.

**Central Board of Secondary Education** — India
Devagiri CMI Public School, All India Senior School Certificate Examination (Class 12), Score: 96% — 2019

**Central Board of Secondary Education** — India
Devagiri CMI Public School, All India Secondary School Examination (Class 10), CGPA: 10.00/10.00 — 2017

## RESEARCH INTERNSHIPS

**Particle Identification using CNN on NA62 Calorimeter** (2023)
Conducted under the guidance of Prof. Douglas Bryman at TRIUMF, Canada, facilitated by Mitacs GRI 2023.

- Applied Convolutional Neural Networks (CNNs using PyTorch) to NA62 Calorimeter for signal separation.
- Consistently distinguished suppressed $K^+$ to $\pi^+ \bar{\nu} \nu$ decay from $\mu$ background.
- Analyzed photomultiplier data for Ring Imaging Cherenkov detector for signal enhancement.
- Participated in TRIUMF Science Week 2023 and GRIDS School 2023, assisting with muon detector supervision.

**Symmetry Methods in Physics** (2020-2023)
Finite Groups and semi-simple Lie algebras under Prof. Ananda Dasgupta, IISER Kolkata, through the NIUS program.

- Used finite group theory for physics problems (Molecular vibrations, selection rules).
- Determined structure constants of semi-simple Lie Groups based on root systems or Cartan Matrix.
- Automated and developed a Python package for finding all roots, drawing Dynkin diagrams, and finding structure constants using the SymPy library.
- Explored Spontaneous Symmetry Breaking through Group Theory and Measure Theory.

**Reconstruction of low pT taus** (2022)
With Prof. Elisabetta Gallo and Dr. Andrea Cardini at DESY (CMS group), Hamburg, via the DAAD WISE 2022 program.

- Suggested and contributed to techniques for reconstructing low pT taus from $b$ decays.
- Utilized CERN's ROOT for data analysis, particularly focusing on 3-prong decays of $B$ mesons to $J/\psi$.
- Applied Boosted Decision Trees (BDTs) with class balance weights to discern signal from background.

**Design Study of Scintillating Crystals as Electromagnetic Detectors using GEANT4** (2021)
Utilized GEANT4 to study scintillating crystals under Prof. Kajari Mazumdar at TIFR Mumbai.

- The dimensions and material of a scintillating crystal were analyzed with respect to the energy deposited in it.
- Higher energy deposition percentage is favorable, but the crystal size cannot be too big due to the effort required to make them.
- Some techniques were discussed on how to detect particles by cleverly using the discrete size of crystals.

## Course Projects / Term Papers

- **Short and Long time prediction of stocks using MC Methods (2023)**, Stochastic Process course (MA41017)  [link]
- **On the radiation by charged objects in a gravitational field (2021)**, Classical Mechanics 2 course (PH31007)  [link]
- **Theoretical Understanding Of Kármán Vortex Street (2021)**, Fluid Mechanics course (PH20101)  [link]
- **Modified Linear Tangent Guidance (2020)**, Classical Mechanics course (PH20001)  [link]

## Skills

- **Programming Languages:** FORTRAN 90, C, C++ (STL, OpenCV, Geant4), ROOT CERN, Octave, HTML, CSS, Arduino, LaTeX, Python (OpenCV, pandas, NumPy, SciPy, scikit-learn, flask, Matplotlib, Qiskit, PyTorch, ml-flow), OpenMPI (C++ and FORTRAN), Bash scripting, ROS, Mathematica.
- **Applications and Tools:** MATLAB Simulink, SolidWorks, LTSpice, ROS, SQL, HTcondor, Slurm scheduler, CalcHEP.

## Certifications

- **Qiskit Global Summer School**, IBM Quantum                                                          August 2020
- **Deep Learning Specialization**, deeplearnig.ai, Coursera                                             August 2020

## Languages

- **English:** Excellent proficiency
- **Hindi:** High proficiency
- **Gujarati:** Moderate proficiency
- **German:** A2-level proficiency
- **French:** A1-level proficiency

## Scholarships and Academic Awards

- Prof. J. C. Ghosh Memorial Prize for the highest CGPA in my class.                                    December 2023
- Mitacs GRI 2023 program, Mitacs, Canada                                                               2023
- WISE 2022 program, German Academic Exchange Service (DAAD)                                            2022
- Inspire Scholarship for Higher Education (SHE), Dept. of Science & Technology, Govt. of India         2019–Current
- NIUS Physics Fellowship, HBCSE (TIFR), India                                                          2020–2022
- JEE Advanced, National Rank 5877 (among about 173,000 registered)                                     2019
- JEE Main, National Rank 3020 (among about 1.15 MN. registered)                                        2019

## Important Extracurricular Activities

- Software Team Member, Aerial Robotics Kharagpur, IIT Kharagpur)                                       2020–Current
  *Used deep learning, computer vision, and filters to achieve special tasks with the Drones. I was also involved in web design.*
- Kerbal Space Program eSports contest, PSI(T), IISER Thiruvananthapuram)                               Febuary 2022
  ***Awarded second prize*** *(team of 2) to land on Duna (Mars equivalent) planet for minimal cost (VF 3762) and time (69 days).*
- Student Mentor, Student Mentorship program, Student Welfare Group, IIT Kharagpur                      2021–2022
  *Guided and solved academic and other related issues faced by three junior students from the physics department on campus.*
- Programming and Data Structures Doubt Sessions, Student Welfare Group, IIT Kharagpur                  2020–2021
  *Designed quizzes and took certain lectures for freshers who had been exposed to programming for the first time.*
- Nexus Competition held during Kshitij (Annual Technomanagement fest of IIT Kharagpur)                 2020
  ***Awarded first prize*** *for making a bot that recognizes shapes, colors, and barcodes and makes decisions accordingly.*
- Inter Hall Ad Design Competition, IIT Kharagpur                                                       2019–2020
  ***Awarded Second prize*** *for creating a movement for saving the environment where I worked on the presentation.*
- Volunteer & Unit Leader at National Service Scheme                                                    2019–2021
  *Led a unit of 34 volunteers and was nominated for the best volunteer award in the unit for the camp in December 2019.*
- PowerPoint Presentation Competition, Sahodaya, Kerala, India                                          2017–2018
  ***Awarded First Prize*** *at the District level. Tasked to create a presentation in one hour and present it on the material provided.*