Prayag Yadav

Name:	Prayag Yadav	**Date of Birth:**	25 April 2001
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Technical Skills

Keywords	Description
Data Science - Python -COFFEA - Dask - NumPy -HTCondor - Matplotlib	Working experience in Python programming and use of modern data analysis tools relating to high energy physics: COFFEA Framework (Columnar Object Framework for Effective Analysis), uproot, awkward array, boost histogram hist, NumPy, Dask, HTCondor, Matplotlib, pandas, SciPy, etc
C++ - ROOT – RDataFrame - pyROOT	Working experience in C++, RDataFrame, ROOT Framework, pyROOT
GNU/Linux - RHEL – Almalinux - Docker - Singularity	Very good experience with the GNU/Linux operating system. Working experience with Debian-based and RHEL-based systems. Worked with docker, singularity, and Jupyterhub
Machine Learning - Neural Networks	Familiar with machine learning and Neural Networks. Know the basics of ANN, RNN, and CNN and their implementation using Keras and TensorFlow. Deployed TensorFlow docker and singularity containers to utilize hardware acceleration through Nvidia GPU in my project lab servers
Web Development -Typescript – NextJS - React	Familiarity with other languages: Fortran, HTML, CSS, JavaScript, Typescript, Bash, and Octave. Experience in Web Development: Made websites using React-based frameworks like NextJS. Hands-on experience with maintaining a web server that hosts PHP-based frameworks like Docuwiki

Education

Integrated Master of Science in Physics

University:	University of Hyderabad, India
Joined:	August 2019
Duration of course:	5 years (2019-2024)
Date of completion:	July 2024
Cumulative GPA:	**8.62**

Intermediate

School:	Mount Carmel Senior Secondary School, Cement Nagar, India
Subjects:	Physics, Maths, Chemistry, Biology, English
Board of Examination:	Central Board of Secondary Education (CBSE)
Duration:	2 years (July 2017 to July 2019)
% of marks obtained:	**92.8%**

Matriculation

School:	Vianney Vidya Mandir, Ghugus, India
Subjects:	Physics, Chemistry, Maths, Biology, English Lit. and Gramm., Home Science
Board of Examination:	Indian Certificate of Secondary Education (ICSE)
Year of Completion:	2017
% of marks obtained:	**89%**

Master's Thesis

Project Title: Background Estimation of Mono-Higgs in $b\bar{b}$ final state using 2018 data of the **CMS** detector at the LHC, CERN

Supervisor: Dr Bhawna Gomber, University of Hyderabad

Description:

- Among the many open questions in physics, the question of Dark Matter is a mysterious one
- In this thesis, I studied the SM background of a specific 'simplified model' of dark matter. The simplified model is a supersymmetric model called the two-Higgs doublet model - a (2HDMa).
- The 2HDMa model introduces a new pseudoscalar 'a', which mediates the interaction between the Dark sector (denoted by χ and $\bar{\chi}$) and the usual standard model particles.
- The signal signature is a high missing transverse momentum and a standard model Higgs, which decays to two bottom quarks. These bottom quarks produce particle jets identified as 'b-jets' using a b-tagging algorithm
- The analysis involved the identification of the signal (large p_T^{miss} + $H \rightarrow b\bar{b}$) from various backgrounds estimated by defining control regions and by Monte-Carlo simulation.
- I used **COFFEA** (Columnar Object Framework for Effective Analysis) as my analysis tool AND collaborated on the ongoing analysis with the CMS – University of Wisconsin group to perform control region studies.
- The two major backgrounds for this analysis are top pairs ($t\bar{t}$) and $Z \rightarrow \nu\bar{\nu}$. These two backgrounds are estimated by estimating four different control regions: single muon, single electron, double muon, and double electron. I have contributed to estimating Top muon and Top electron control region studies.

Internships and other projects

Position: HSF-India Trainee (June 2024 – Present)

Project Title: Building examples for Future Circular Collider (FCC) Analyses using the Columnar Framework for Effective Analysis (COFFEA) framework and developing the Schema class implementation of FCC simulation samples in COFFEA

Mentors: David Lange (Princeton University), Bhawna Gomber (University of Hyderabad)

Description:

- The purpose of this project is to build the necessary schema class for FCC simulation samples in COFFEA and create examples of simple analyses done in COFFEA utilizing FCC simulation samples.
- The schema classes for the NanoAOD data structure are already present in COFFEA. Developing a schema class for FCC samples would enable analyses to be performed in Python and take advantage of parallel processing with less time to insight
- Based on the existing examples of FCC analyses, COFFEA examples of the same are to be built and documented, which will streamline the reproducibility of the results.
- Recent milestone: Successfully developed compatibility for a variant of FCC EDM4HEP data format. (Link)

Position: Intern with CMS group at the University of Hyderabad (20th July 2022 to 4th July 2023)

Mentors: Bhawna Gomber (University of Hyderabad)

Description:

- Before starting my master's project, I interned with the CMS (Compact Muon Solenoid) Group at the University of Hyderabad. I did this in parallel to my coursework classes.
- During this time, I learned the analysis basics in experimental HEP.
- I learned a lot of tools: C++, ROOT, Python, COFFEA, bash scripting, and submitting jobs to Dask and HTCondor schedulers.
- I took up the task of setting up and maintaining the newly bought server for my lab. I learned how to install RHEL-based enterprise Linux on the server, ROOT, and other HEP-relevant software, deployed containerized solutions to HEP analysis like singularity and docker containers, and hosted an internal Jupyterhub server with containerized backends.
- At the physics analysis part, I helped the PhD students estimate Dielectron backgrounds in their analyses using ROOT and C++.

Position: Project Student in experimental nuclear physics (May 2021 to July 2021, Dec 2021 to Jan 2022)

Title: Study of entanglement of photons in para-positronium decay and its implications

Mentors: Prof. Rudrajyoti Palit (Tata Institute of Fundamental Research, Mumbai)

Description:

- I did a reading project on the above-mentioned title. I learned in detail about Gamma-ray spectroscopy and double Compton scattering cross-sections.
- I focused on the use of segmented HPGe detectors to detect the correlation between two entangled photons produced because of a positronium decay ($e^+ + e^-$).
- I learned about the signal processing and data acquisition required for such an analysis. I also learned about CZT detectors and NaI (Tl) gamma spectroscopy.
- At the end of my project, my guide posed a problem. The problem was to find the relative contributions of Compton Scattering and Photoelectric absorption in a full photopeak corresponding to an E=0.511MeV. I solved the problem by creating a simulation in Python from scratch.

Workshops, Conferences, and Volunteering work

Machine Learning Workshop | University of Hyderabad | 26 Oct 2022 to 28 Oct 2022

- Learned the basics of ANN, CNN, and RNN
- Hands-on training in Machine Learning and Neural Networks
- Hands-on experience with Keras and TensorFlow
- Created a simple neural network to separate proton beam halo data from hadron data

ICFAST Conference | University of Hyderabad | 9 Sept 2022 – 12 Sept 2022

- Attended all the talks given by Indian and Japanese professors
- Attended poster sessions by scholars from all over the country

Volunteered for Vigyanotsav | Jan 2020 and Aug 2023

- A science fest hosted by the Junior Science Club, University of Hyderabad
- Demonstrated and explained superconductivity to school students by levitating a High T_c Superconductor over a magnet

Language Proficiency

English: Fluent in reading, writing, speaking, and listening.

Hindi: Native speaker. Fluent in reading, writing, speaking, and listening