<u>Curriculum Vitae</u>

Name:	Prayag Yadav	**Date of Birth:**	25 April 2001
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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 mysterious.
- 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 which are identified as 'b-jets' using a b-tagging algorithm.
- The analysis involves the identification of the signal (large $p_T^{miss} + H \to b\bar{b}$) from various backgrounds which are estimated by defining control regions and by Monte-Carlo simulation.
- I use the **COFFEA framework** (Columnar Object Framework for Effective Analysis) as my analysis tool.
- The analysis is originally going on at the University of Wisconsin, Madison. I collaborate with the Wisconsin group to perform control region studies.
- The two major backgrounds for this analysis are top pairs ($t\bar{t}$) and $Z \to \nu\bar{\nu}$. 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

- *Internship with CMS group at the University of Hyderabad*
  Supervisor: Dr Bhawna Gomber
  Duration: 20th July 2022 to 4th July 2023
    - 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 learnt the basics of an analysis in experimental HEP.
    - I learnt a lot of tools: **C++, ROOT, CMSSW, Python, COFFEA**, bash scripting and submitting jobs to Dask and HTCondor schedulers.
    - I took up the job of setting up and maintaining the newly bought server for my lab. I learnt how to install RHEL-based enterprise Linux on the server, installed 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 of things, I helped the PhD students with an estimation of Dielectron backgrounds in their analyses using ROOT and C++.
- *Project in experimental nuclear physics*
  Title: 'Study of entanglement of photons in para-positronium decay and its implications'
  Supervisor: Prof. Rudrajyoti Palit
  Duration: (May 2021 to July 2021) and (Dec 2021 to Jan 2022)
    - I did a reading project on the above-mentioned title. I learnt 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 learnt about the signal processing and data acquisition required for such an analysis. I also learnt 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.

Education

- *Integrated Master of Science in Physics*
  University: University of Hyderabad, India
  Joined: August 2019
  Duration of course: 5 years (2019-2024)
  Expected date of completion: July 2024 (Currently in the 10th semester, which is the last semester)
  Cumulative GPA: **8.64** (of the last 9 semesters)
- *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)
  Percentage of marks obtained: **92.8%**
- *Matriculation*
  School: Vianney Vidya Mandir, Ghugus, India
  Subjects: Physics, Chemistry, Maths, Biology, English literature and grammar, Home Science
  Board of Examination: Indian Certificate of Secondary Education (ICSE)
  Year of Completion: 2017
  Percentage of marks obtained: **89%**.

Technical Skills

- 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.
- Working experience in **C++, ROOT** Framework, pyROOT and **CMSSW**.
- Very good experience with the GNU/**Linux** operating system. Working experience with Debian-based and **RHEL**-based systems. Worked with docker, **singularity** and Jupyterhub.
- 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 utilise hardware acceleration through Nvidia GPU in my project lab servers.
- 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 which hosts PHP-based frameworks like **docuwiki**.

Workshops, Conferences and Volunteering work

- *Machine Learning Workshop | University of Hyderabad*
  Date: 26 Oct 2022 to 28 Oct 2022
    - Learnt 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*
  Date: 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*
  Date: 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.