

ARNAB LAHA

CONTACT Indian Institute of Science Education and Research laha.arnab@students.iiserpune.ac.in
Department of Physics [Website](#) [Github](#)
Main Building, A365 Skype : laha.arnab
Pune, Maharashtra 411008 Phone : (+91) 8910000516

EDUCATION **Indian Institute of Science Education and Research (IISER)**, Pune, Maharashtra, India
Ph.D. Candidate in Physics, AUGUST 2018-
Thesis : Search for Vector-like leptons in proton-proton collisions at $\sqrt{s} = 13$ TeV with the CMS detector
Advisor : Dr. Sourabh Dube

University of Hyderabad, Hyderabad, India
Master of Science in Physics, JULY 2018
Thesis : Phenomenology of real singlet scalar dark matter

Presidency University, Kolkata, India
Bachelor of Science in Physics, JULY 2016
B.Sc. project : Dynamics of a neutral particle near a charged black hole

POSITIONS **CMS Exotica b-tagging contact**
Reviewing the usage of heavy flavor tagging in the CMS EXOTICA analyses and helping analyzers with the implementation of b-tagging tools if required in liaison with CMS b-tagging object group (reviewed more than 40 analyses).

RESEARCH PROJECTS **Search for Vector-like leptons in 1L2J and 2LSS final states at CMS**
Devising a search targeting low mass vector-like leptons in 1L2J and 2L same sign(SS) final states using full Run 2 dataset at $\sqrt{s} = 13$ TeV with the CMS detector. Fusion of cut-based strategy with Machine Learning(ML) techniques to improve the analysis sensitivity at low mass (electroweak scale).

Phase 2 tracker geometry implementation in CMS Fast Simulation
Implementation of the phase 2 tracker geometry and phase 2 tracking in CMS Fast Simulation package for High Luminosity-LHC upgrade to facilitate the faster production of Monte Carlo(MC) events generation at HL-LHC.

Latent space representation of multidimensional data
Investigating the hidden patterns in multidimensional data using PCA, UMAP, and Autoencoder in the context of lepton classification using **CERN Open Data**. Developing tools using these techniques for classification tasks for statistically limited and asymmetric datasets.

Lepton tagger
Developing and benchmarking the performance of ML-based techniques to classify leptons based on their source in simulation and data. Application of the tagger to reduce the fake lepton contamination in searches using multiple leptons or same-sign leptons.

Reinterpreting ATLAS 8 TeV multilepton search in the context of VLL
Constraining the vector-like electron, muon, and tau models using ATLAS 8 TeV multilepton search. Also reinterpretation of a model with quintuplet fermions where Leptoquark and VLL appear together in the context of muon g-2 anomaly.

SELECTED PUBLICATIONS

- Inclusive nonresonant multilepton probes of new phenomena at $\sqrt{s} = 13$ TeV. The CMS Collaboration, [Phys.Rev. D 105, 112007 \(2022\)](#).

- Review of searches for vector-like quarks, vector-like leptons, and heavy neutral leptons in proton-proton collisions at $\sqrt{s} = 13$ TeV at the CMS experiment. The CMS Collaboration, [arXiv:2405.17605](https://arxiv.org/abs/2405.17605), [CMS-EXO-23-006](#)
- Search for dilepton resonances from decays of (pseudo)scalar bosons produced in association with a massive vector boson or top quark anti-top quark pair at $\sqrt{s} = 13$ TeV. The CMS Collaboration, [CMS-PAS-EXO-21-018](#)
- See the full publication list in [INSPIRE HEP](#)

MENTORING EXPERIENCE

- Chitrakshee Yede (HSF-India Project) : Generative adversarial network with a dimensionality reduction twist
- Aparna Jayaraj (Master's Thesis) : Simulating collision events using Generative Adversarial Network and Variational Autoencoder (2023) → PhD student at the University of Glasgow
- Chitrakshee Yede (Master's Thesis) : Constraining the vector-like tau model at $\sqrt{s} = 8$ TeV(2023) → PhD student at the University of Hamburg
- Parijat Banerjee (Master's Thesis) : Identification of low-pt taus (2024) → PhD student at the Rutgers University
- Soumya Sarkar (Master's Thesis) : Identifying merge electrons (2024) → PhD student at the University of Duke
- **B.Sc. Thesis** : Parth Thakkar (2020), Maerpreet Arora (2020), Chitrakshee Yede (2021), Ekta Thakur (2022)
- **Summer project** : Trupti Raut (2021), Soorya Narayan (2022)

TEACHING ASSISTANTSHIP

Machine Learning and its physics application(PH6232) [github]	SPRING 2023
Lectures on Feynman diagrams (EHEP Mini-Course)	JULY 2022
World of Physics : Quantum Mechanics(PHY 202)	SPRING 2020
Physics lab instructor in INSPIRE Camp held at IISER Pune	JAN 2020
BSMS second year experimental lab(PHY 221)	FALL 2019
BSMS first year experimental lab(PHY 121)	SPRING 2019

HONORS AND AWARDS

- **CSIR NET JRF** (Aug 2018 - July 2023)
- **DST INSPIRE FELLOW**
- **CSIR NET Dec 2017** : AIR 150, **JEST 2018** : AIR 40, **GATE 2018** : AIR 680, **IIT-JAM 2017** : AIR 23, Rank 13 in Madhyamik Exam WBBSE (2011), 90.4% in 10+2 WBCHSE (2013)
- M.Sc. gold medal (cgpa : 9.16/10)

SKILLS

Programming :	FORTRAN, PYTHON, C++
Operating Systems :	LINUX
Data Analysis :	ROOT, PANDAS, NUMPY, MATPLOTLIB, SCIKIT-LEARN, KERAS AND TENSORFLOW
Writing software :	L ^A T _E X
Markup Language :	HTML(basic), MARKDOWN
HEP tools :	MADGRAPH, PYTHIA, DELPHES, CMS SOFTWARE

TALKS, WORKSHOPS AND OUTREACH

- ML4HEP, Machine Learning School at ICTS, Bangalore -AUG-SEP 2023
- Presented the search for vector-like lepton in India-CMS Meeting at IISc, Bangalore -AUG 2023

On unsupervised and generative Machine Learning in HEP at RIDE22, Innovation Conclave MIT World Peace University, Pune, India (outreach)-SEP 2022

Learning features of multidimensional data using latent space representation”, NARIPHY, IISER Bhopal, India - AUG 2022

Classifying leptons using neural network, India-CMS meeting([Talk](#))-JAN 2022

Attended 16th [CERN-Fermilab HCP](#) Summer School-SEP 2021

Phase 2 tracker in Fast Simulation at CMS, DAE-BRNS HEP symposium, Niser, India.-([poster](#))-DEC 2020

Collider search for dark matter, Comprehensive seminar for PhD enrollment at IISER Pune-SEP 2019 : Dark matter hunt, 2nd Physics Students' symposium (CADENCE) at UOH, Hyderabad, India-MAY 2018