Licia Mozzina

+39 340 549 0541
Via Strela n.2, Parma
(PR), Italy, 43125

licia.mozzina@cern.ch
GitHub: licia-mozzina

Education

Università di Bologna - Alma Mater Studiorum — November 2025 - Present
PhD program in Physics
Supervisor: Prof. Luigi Guiducci, Co-Supervisor: Dott. Andrea Perrotta

I am a first year PhD student, working for the SND@LHC and CMS experiments at CERN. In SND@LHC, I have taken part in all stages of the upgrade of the muon system with Drift Tubes (MiniDT) detectors: installation, integration, commissioning and software development. I will also contribute to the hardware preparation for the upgrade of the present detector, SND@HL-LHC, that will be entirely based on silicon technologies. In CMS, I have been trained to be the detector expert on-call for the Drift Tubes (DT) system, and I will continue my shifts during 2026 LHC collisions. I am also taking part to the assembly and testing of minicrates for the Phase 2 Upgrade of the DT for HL-LHC.

Università di Bologna - Alma Mater Studiorum — September 2023 - 29th October 2025
Master degree in Physics, Nuclear and Subnuclear Physics curriculum
Final grade: 110/110
Thesis: *Upgrade of the SND@LHC muon detectors with Drift Tubes*
Supervisor: Prof. Luigi Guiducci, Co-Supervisor: Dott. Giulia Paggi

Università di Bologna - Alma Mater Studiorum — September 2020 - 15th September 2023
Bachelor degree in Physics
Final grade: 108/110
Thesis: *Measurement of effective cross section for luminosity measurements at the LHCb experiment using PLUME data*
Supervisor: Dott. Fabio Ferrari, Co-Supervisor: Prof. Angelo Carbone

The Probe for LUminosity MEasurement (PLUME) detector is a luminometer installed at the start of Run 3 in 2022 in the LHCb experiment at the LHC. The knowledge of its cross-section is essential to evaluate the instantaneous luminosity delivered to the LHCb experiment.
The PLUME detector is composed of two layers, each with 24 PMTs. Due to the operational definition of its cross-section, the analysis has exploited the *LogZero* method that computes the specific number of interactions of the beams' bunch crossings. The data needed for the analysis had to be collected during a specific procedure, the *van der Meer scan*, where the two LHC colliding proton beams are displaced in the transversal direction in several steps.
I worked on all the steps needed to perform the analysis. In particular:

- I gathered the data from two CERN databases (TIMBER for beams position and NXCALS for beams populations) and from PLUME Ntuples (ADC values)
- I developed a ROOT data analysis tool that consisted in: selection and time-alignment of data according to the steps of the van der Meer scan; computation of the specific number of interactions for each step; fitting of the resulting values; computation of cross-section with fit results
- I obtained three different measurements for PLUME's effective cross section, each employing a different detector proxy for the computation of the specific number of interactions: particle hits in two projective PMTs and two innovative proxies, a single particle hit in any PMT and the average of ADC values in all PMTs
- I cross-checked the analytic propagation of uncertainties to the final cross-section measurements via a toy Monte Carlo technique
- I presented the results in a meeting of the LHCb Luminosity Working Group (29/06/2023)

The cross-section measurements have been used for PLUME calibration since July 2023. The same data analysis tool has been exploited in order to provide the effective cross-section for the Pb-Pb run in October 2023.

Liceo Classico G. D. Romagnosi (Parma) September 2015 - June 2020
Upper Secondary Education Diploma Classical Lyceum
Final grade: 100/100 cum laude

Additional Experience

Master student abroad **01/03/2025 - 01/07/2025**
Unibo program for the preparation of the master thesis abroad
Upgrade of the SND@LHC muon detectors with Drift Tubes
Supervisor: Prof. Luigi Guiducci, Doct. Wolfgang Funk

During my stay at CERN, I worked in the Scattering and Neutrino Detector (SND@LHC) experiment, as part of the Alma Mater Studiorum - University of Bologna program for the preparation of the master thesis abroad.
The SND@LHC experiment is located at the Large Hadron Collider. The SND@LHC detector can discriminate all neutrino flavors in the unexplored pseudo-rapidity range of $7.2 < \eta < 8.4$, at 480 m from LHC Interaction Point 1. Signal events are neutrino interactions, originated by the neutrino flux from pp collisions at the ATLAS interaction point, with energies between 100 GeV and 1 TeV. For my master thesis, I contributed to the muon system upgrade, based on the installation of two additional Mini Drift Tubes (MiniDT) detectors, miniature versions of CMS Drift Tubes. MiniDT modules provide high resolution x-y position and direction measurements for a more precise track reconstruction, and are expected to allow accurate muon flux measurements and a better discrimination between background and muon neutrino interactions in the SND@LHC target. I participated in all the steps of the upgrade:

- I fixed and tested MiniDT modules;
- I took part in the installation and I was trained to work on detector hardware and to deal with the challenges of operating in an experimental area contiguous to the LHC tunnel;
- I got familiar with SND@LHC electronics and readout system and with the CMS DT Phase 2 upgrade electronics;
- I was involved in the online integration of MiniDTs in the experiment control system;
- I participated to the data taking and to the SND@LHC operations;
- I developed software for the MiniDTs integration in the SND@LHC offline tools, implementing the offline event building of MiniDT data with SND@LHC event data and working on track reconstruction.

Summer Student **29/07/2024 - 27/09/2024**
INFN-CNAF - Sezione di Bologna *Bologna, Italy*
Sviluppo applicazioni di fisica delle alte energie su architetture hardware eterogenee
Supervisor: Dott. Francesco Giacomini

During my period as Summer Student at INFN-CNAF, I have contributed to the development of imaging techniques for scintillation light tracks in RIPTIDE (RecoIl Proton Track Imaging DEtector).
RIPTIDE is an innovative recoil-proton track imaging system designed for fast neutron detection. It captures images of scintillation light produced by neutron-proton (n-p) elastic scattering in a plastic scintillator. The main goal is to reconstruct both the energy and the incoming direction of impinging neutrons from two orthogonal projections of the scattering events.
I participated to several operations in the simulation and analysis of scattering events images:

- Study of the best optical system characteristics in the GEANT4 simulation of the detector;
- Development of a hybrid analysis tool that combines both the Hough transform with statistical moment-based methods to determine track direction and orientation and deep-learning techniques to remove optical aberrations from the tracks;
- Estimation of proton energies from the reconstructed tracks, cross-check validation with Monte Carlo data;
- Accurate reconstruction of neutron energies for single scattering events, as verified with MC data.

The whole process can be easily extended to double scattering events. Since the promising results of the aforementioned techniques, this analysis tool could be generalized and scaled to meet the needs of other experiments that use scintillation light analysis to reconstruct decay topologies.

What Next? Giovani che raccontano il futuro **24/11/2021**
INFN - Sezione di Bologna *Bologna, Italy*
Event for the scientific dissemination of the INFN activities at the Bologna laboratories

Publications

Scintillating light track reconstruction for fast neutron detection based on deep learning techniques
Proceedings of Science
S. Lanzi et al.

International Symposium on Grids and Clouds (ISGC2025)
16 -21 March 2025
Academia Sinica Grid Computing Centre (ASGC), Taipei, Taiwan

Contributions at conferences

111° Italian Physical Society Congress, Palermo, Italy
22 - 26 September 2025

Talk: Upgrade of the muon identification system at the SND@LHC experiment