

BEPCII - 1 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|---------------------------------------------------------------------|
| BEPC/IHEP | 01/06/2026 - 31/07/2026 | Michela Greco (INFN-TO & UNITO) Giulio Mezzadri (IHEP & INFN-FE) |

| <u>CGEM-IT off detector electronics upgrade</u> | Daily activity, skills required and to be acquired |
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| <p>The CGEM-IT is the new inner detector of the BESIII experiment. A dedicated readout chain has been developed to receive and transmit data collected by the front-end boards.</p> <p>To receive the fast signals (CLOCK, TRIGGER, CHECK, and FULL) from the experiment trigger system, a dedicated FANOUT module has been designed, and after several years of commissioning, it has now been operating for the past year.</p> <p>However, the system requires an upgrade since the FPGA, which is at the base of the FANOUT module operations, is outdated. To ensure the longevity of the experiment and facilitate the production of spare parts, a new FANOUT module based on a more recent FPGA has been implemented, and it is planned to be installed during the summer shutdown.</p> | <p>The student will work with the experts in the preparation, installation, and testing of the new FANOUT modules.</p> <p>They will learn the basis of the operations of the readout chain of a high energy experiment and the fast control systems, and more in general, the systems needed for safe operations of a detector inside a spectrometer.</p> <p>The student will work together with the experts from INFN and IHEP.</p> <p>Simple prior knowledge of electronics and the Python programming language is required.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| No required training | |

CERN - 1-

| Hosting Laboratory | Available period | Contact persons |
|--------------------|--------------------------------|----------------------------------------------|
| CERN | 01/05/2026 – 30/09/2026 | Biagio Di Micco Michela Biglietti |

| <u>Construction of an absolute discriminating variable for the $HH \rightarrow \gamma\gamma bb$ analysis</u> | Daily activity, skills required and to be acquired |
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| <p>The project is intended for a student that will spend the time at CERN to acquire software and analysis skills working on an on-going high profile physics analysis. The one-month activity is dedicated to the analysis of ATLAS data on the $hh \rightarrow b\bar{b}\gamma\gamma$ channel. The ATLAS collaboration will be going to finish the full Run3 data acquisition and a strong effort to provide the full Run3 statistics results will be put in place. One of the main characteristics of the $hh \rightarrow b\bar{b}\gamma\gamma$ analysis is the use of a full data driven technique to extract the signal yield in several analysis categories using a functional fit to the sidebands of the $m\gamma\gamma$ distribution. Both the signal and the background distributions are parameterised with continuous functions that are used to extract the signal yield. In order to have enough data to constraint the background function, the analysis selection needs to be set less powerful than ideal. In the present project a different approach is proposed, trying to build a single, most powerful discriminating variable that contains all the kinematic features of the signal, including the di-gamma system invariant mass. This will not require a large amount of data to constraint the shape of the background but at the same time will rely on the Monte Carlo simulation of the background shape.</p> <p>The work consists of implementing a discriminating variable already developed in previous thesis work and validate the distribution using background enriched samples. Attention will be dedicated to the extrapolation reliability of the background shapes to regions with very low background expected yields using ABCD-like method, working on b-tagged / anti-btagged jets and the $m\gamma\gamma$ and $m\bar{b}b$ sidebands. The final goal is to give an estimate on the systematic related to the background extrapolation and compute the expected signal significance of the new approach.</p> | <p>The project requires expertise with the c++ programming language and the ROOT analysis software. The student needs to have a good knowledge of particle physics at the level of the undergraduate Italian specialistic courses.</p> <p>The student will improve his statistical analysis and data analysis skills by handling large Monte Carlo based samples, implementing likelihood functions and improving data driven background estimation and Monte Carlo corrections.</p> <p>The first two weeks will be dedicated to the study of the available discriminant and get familiarity with the ATLAS analysis software, in particular the framework used inside the $\gamma\gamma bb$ analysis team and checking the kinematic variables and the shape of the discriminant for the signal and the background samples, the third week the work will focus on using data driven techniques to validate the shapes predicted by the Monte Carlo simulation , to compare them with data and to apply data driven corrections.</p> <p>The last week of the project will be focused on evaluating systematics on the background extrapolation and compute the expected signal significance.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 2-

| Hosting Laboratory | Available period | Contact persons |
|--------------------|--------------------------------|-------------------------------------------------|
| CERN | 01/07/2026 – 30/09/2026 | Giovanni De Lellis Richard Jacobsson |

| <u><i>Development of a tool to identify electromagnetic showers in the SND@LHC experiment</i></u> | Daily activity, skills required and to be acquired |
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| <p>The project is part of the SND@LHC experiment at CERN which has observed neutrino interactions at a collider for the first time. The project focuses on developing a software tool for detecting electromagnetic showers produced by electron neutrino interactions in the emulsion films, which are the tracking layers instrumenting the neutrino target region of the apparatus. Using the computational resources and data infrastructure of the experiment available at CERN, the candidate will process a dataset of emulsion images to identify basic electromagnetic shower patterns. The work involves implementing image preprocessing routines, applying simple clustering algorithms, and evaluating the results against reference data.</p> | <p>The candidate will develop and test a prototype software tool for detecting electron neutrino-induced showers in emulsion films. Daily tasks include preprocessing image data, applying clustering algorithms to identify particle tracks, validating results with simulated datasets, and documenting the workflow. Basic programming (Python or C++), image processing knowledge, and familiarity with particle physics concepts are required</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 3-

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|-------------------------------------------------------------|
| CERN | 01/06/2026 – 30/09/2026 | Valentina Mariani (INFN -Perugia) Matteo Presilla (CERN) |

| <u><i>Jet substruction characterization for polarization measurement in VBS events</i></u> | Daily activity, skills required and to be acquired |
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| <p>Vector Boson Scattering (VBS) is one of the most promising processes we can investigate to indirectly search for physics beyond the standard model. Although many measurements have been already performed, a deep characterization especially in terms of polarization components is still missing.</p> <p>In association with the two vector bosons, W or Z, two highly separated jets are also produced. Thus, depending on the final state of the vector bosons, there will be from 2 to 6 jets as signal signatures.</p> <p>The characterization of the jet substructure, especially when boosted topologies are produced, can give important insight in the definition of the polarization states of the vector boson emitted in the scattering.</p> <p>The jet substructure investigation in a hadronic environment as LHC represents a challenge. The application of innovative machine learning techniques is pivotal to reach a good signal identification over background.</p> <p>We propose to exploit different available algorithms, performing optimization for the specific physics case of the VBS process, to maximize the sensitivity to access the polarization components of the interacting vector bosons.</p> | <p>Daily activity: The activity of this project consists in learning the main features of the LHC and of CMS, reviewing the recent CMS tools for jet reconstruction, compare them and optimizing the algorithms for the VBS process.</p> <p>Required skills: knowledge of fundamentals of collider physics, detectors, and c++/python.</p> <p>Skills to be acquired: At the end of the project, he/she will gain knowledge about how reconstruct jet in physics analysis. He/she will gain a good knowledge on machine learning techniques and how to apply them to HEP. He/she will be able to critically understand the details of a data analysis in HEP and how to present physics results to the scientific community and interact with colleagues in an international and diverse environment.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>none</p> | |

CERN - 4 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|--------------------------------|-------------------------------------------------------------------------------|
| CERN | 01/06/2026 – 30/10/2026 | Alessandro Lapertosa (INFN-CT) - Antonio Vagnerini (NEBRASKA/CERN) |

| <u><i>Machine Learning models for data quality of the CMS Pixel detector</i></u> | Daily activity, skills required and to be acquired |
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| <p>Tracks are an essential component of any physics analysis. The tracking system of the CMS experiment is made up of thousands of silicon modules. Because of the aging of the detector, and all other possible incidents that may happen during operations, there is the need for constant monitoring of the detector components, in order to guarantee the best data quality in terms of tracking and vertexing.</p> <p>The CMS Tracker Data Quality Monitoring group has developed tools to check the quality of the recorded data, with the aim of spotting potential detector issues and certify the data as good for usage in physics analyses.</p> <p>To support the work of the human shifters and to further increase the efficacy of the process, machine learning models are being used to identify detector anomalies.</p> | <p>The student will contribute to the development (both in terms of training and evaluation) of unsupervised machine learning models to be applied on Pixel detector data from Run 3. Moreover, the student will learn the structure and operation of the CMS Pixel detector and the CMS Data Quality process.</p> <p>Skills required (desirable): basic coding with python notebooks</p> <p>Skills to be acquired: pixel detector structure, operation and data acquisition, machine learning basics (data preparation, training, inference), data analysis and plotting tools</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| No training required | |

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| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|-----------------------------------------------------|
| CERN | 01/05/2026 – 30/11/2026 | Carlo Schiavi – Andrea Coccaro, Martino Tanasini |

| Harmonisation of hadronic final state reconstruction for the ATLAS experiment and its application to di-Higgs searches | Daily activity, skills required and to be acquired |
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| <p>The research project aims at integrating the candidate into the study of reconstruction and identification of hadronic final states with emphasis on performance studies of newly established transformer-based algorithms for the identification of jets stemming from beauty quarks, charm quarks or tau leptons decaying hadronically. The candidate will focus on characterising the performance of the state-of-the-art algorithm developed within the ATLAS collaboration with emphasis on maximising the selection efficiency for jets from both beauty quarks and tau leptons while preserving the orthogonality of the selection. Emphasis will also be given in assessing the impact on a flagship di-Higgs search analysis</p> | <p>The daily activities will include both discussions with experts based at CERN and in-person sessions for understanding the flow and the technical tools currently in use in a large particle-physics experiment. The project will be carried out mainly autonomously by the candidate, with regular discussions and feedback from the supervisors and other colleagues collaborating on the same project line. Presentations at relevant working group meetings are also possible and will be encouraged. The project will require a basic understanding of programming in C++ and Python. Knowledge of basic machine learning algorithms would be an advantage, though it is not a strict requirement.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
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CERN - 6 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|--------------------------------|-------------------------------------------------|
| CERN | 01/06/2026 – 30/09/2026 | Enrico Robutti Valentina Avati |

| <u>Basic studies on the performance of the silicon pixel tracker of the CMS Precision Proton Spectrometer</u> | Daily activity, skills required and to be acquired |
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| <p>The CMS Precision Proton Spectrometer (PPS) reconstructs protons escaping intact from proton-proton interactions in the Large Hadron Collider (LHC) at CERN. It is located in the LHC tunnel about 200 m from the interaction point of the CMS experiment, on both sides. It has been collecting data since 2016, and its data is used for several published searches for rare Standard Model processes or signatures of New Physics. For the LHC Run3 (2022-2026), PPS detectors have been upgraded. The new setup has collected data in 2022, 2023 and 2025 and will continue in 2026. This project consists in contributing to the basic evaluations of the performance of the silicon pixel tracker of PPS and its evolution during the data taking period.</p> | <p>The student will learn the basics of the physics investigated at the LHC and of the CMS experiment, with particular focus on the processes studied by PPS and the operating principles of its tracking detectors. The task will involve participating in monitoring the detector's performance through the standard tools available, and to data taking shifts (depending on the actual LHC schedule). Some familiarity with the Linux operating system environment is required. Basic programming skills in C++ and/or python may be occasionally useful.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 7 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/04/2026 – 30/10/2026 | Andrea Massironi Dave Barney |

| <u><i>Exploiting current CMS detector to its limits</i></u> | Daily activity, skills required and to be acquired |
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| <p>With the current accumulated data of LHC in CMS, almost 10% of the total integrated luminosity that the High-Luminosity LHC will collect, the full exploitation of the detectors currently installed in CMS could profit from new ideas and new use, also for dedicated and specialized new searches.</p> <p>We propose the test of the timing performance of the current preshower detector of CMS, that could bring new potential to physics searches and improvements in final state particle reconstruction, for example for pileup suppression or late signal tagging. Tests with the current data collected will be developed, in order to assess the current performance, possible improvements, and eventually application of these new data in CMS.</p> | <p>Required skills: basic coding, c++, python</p> <p>Skills acquired: coding, working in a big collaboration, learn how to present results</p> <p>Daily activity: development of the CMS software code to test new features in the current CMS detector. Calibrate the preshower for timing reconstruction, and use this additional information in object reconstruction or dedicated analysis signature.</p> <p>The results will be then presented in working meeting and general CMS meetings</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 8 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 15/06/2026 – 02/08/2026 | Francesca Dordei Marianna Fontana |

| <u>Measurement of the oscillation parameter $\Delta\Gamma_d$ using Run3 LHCb data</u> | Daily activity, skills required and to be acquired |
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| <p>Decays of neutral B mesons provide an important probe of the Standard Model (SM), in particular through the measurement of the so-called decay-width difference, $\Delta\Gamma_d$, in the $B^0 - \bar{B}^0$ meson system. In the SM this parameter is expected to be extremely small, making it a powerful null test: any deviation from the prediction would be a clear sign of physics beyond the SM.</p> <p>The excellent vertexing, tracking and particle-identification capabilities of the LHCb experiment make it ideally suited to study neutral B decays such as $B^0 \rightarrow J/\psi K^*$ and $B^0 \rightarrow J/\psi K_S^0$ with high precision using Run-3 data. These channels, reconstructed through dimuon J/ψ decays and well-identified kaon and pion final states, provide clean signatures for yield extraction and time-dependent studies relevant for $\Delta\Gamma_d$.</p> <p>In this project, the student will reconstruct and select $B^0 \rightarrow J/\psi K^*$ and $B^0 \rightarrow J/\psi K_S^0$ candidates using Run-3 pp-collision data, perform invariant-mass fits to measure their yields, and carry out basic studies needed for the determination of $\Delta\Gamma_d$ exploiting available code from Run 2 analyses. The results will be used to validate the performance of the newly collected datasets and will pave the way for the most precise determination of $\Delta\Gamma_d$ at LHCb.</p> | <p>Daily activity: The main activities of the project consist in learning the key features of the LHC and of the LHCb experiment, becoming familiar with the LHCb tools used to access and process Run-3 datasets, and developing the software needed to select $B^0 \rightarrow J/\psi K^*$ and $B^0 \rightarrow J/\psi K_S^0$ candidates in pp-collision data. The student will also perform invariant-mass fits using ROOT and RooFit to extract the signal yields.</p> <p>Required skills: Basic knowledge of particle-physics fundamentals and detector principles, as well as familiarity with Linux environments and command-line operations.</p> <p>Skills to be acquired: The student will acquire proficiency in the LHCb software environment and gain experience with machine-learning techniques applied to HEP. They will develop a critical understanding of the main steps of a data analysis. The project will also enhance their ability to present physics results effectively and to work both independently and within an international, collaborative research environment.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| Basic training to access the CERN site. | |

CERN - 9 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/05/2026 – 30/11/2026 | Martino Borsato Renato Quagliani |

| <u><i>Future Circular Collider sensitivity to rare B meson decays</i></u> | Daily activity, skills required and to be acquired |
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| <p>The Future Circular Collider (FCC) is a proposed 100-km accelerator complex at CERN, with the electron–positron stage (FCC-ee) designed to deliver extremely clean collisions and record-breaking statistics. FCC-ee would produce an enormous number of b-quarks, making it an ideal environment for precision flavour physics.</p> <p>Rare B-meson decays occurring through loop-level processes are especially powerful probes of physics beyond the Standard Model. Despite the broad physics studies already performed for FCC-ee, the sensitivity to some rare B decays has not yet been explored in detail. This project aims to provide first estimates of how well FCC-ee could measure some of these key processes. The student will generate and analyse simulated datasets corresponding to what a detector at FCC-ee would record. Using the fast-simulation framework Delphes, they will configure and run detector simulations for both signal and background processes, then analyse the resulting events with Python-based CERN tools to extract the relevant observables and estimate the achievable sensitivity. Working alongside experts in flavour physics and FCC studies, the student will gain insight into the full workflow of a modern particle-physics analysis—from detector modelling to statistical interpretation. The outcome will be a first assessment of the potential of FCC-ee to study rare B decays with its large, clean data sample anticipated for the 2040s.</p> | <p>The daily work alongside researchers based at CERN and the University of Milano-Bicocca will involve learning to use Delphes to simulate FCC-ee collisions, configuring the IDEA detector model, generating samples of B-meson decays, and analysing the resulting events using Python-based CERN software tools. The student will become familiar with flavour-physics observables, Monte Carlo simulation workflows, and statistical methods for extracting sensitivities to rare processes. A basic knowledge of Python is required; familiarity with Linux and C++ is helpful but not essential. Over the course of the project, the student will acquire practical experience with particle-physics simulation tools, hands-on data analysis skills, and an understanding of how large future collider experiments are designed to address key questions in fundamental physics.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |

CERN - 10 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/05/2026 – 30/11/2026 | Marta Calvi Sara Celani |

| <u>Tagging the B flavour at LHCb in Run3</u> | Daily activity, skills required and to be acquired |
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| <p>The LHCb detector is a forward spectrometer at the LHC, designed for high-precision studies of beauty- and charm-hadron decays. A central goal of its physics programme is the measurement of time-dependent CP violation in B-hadron decays. A key element in these analyses is flavour tagging, <i>i.e.</i> the determination of a neutral B meson's initial flavour at production. Because these mesons naturally oscillate between particle and antiparticle states, their flavour cannot be directly inferred from the decay products and must instead be deduced from other particles in the event using dedicated algorithms. The more demanding conditions of Run3, with higher luminosity and increased event multiplicity, call for more powerful tagging algorithms than those used in Run 2. This makes flavour tagging an ideal playground for advanced machine-learning techniques, aimed at maximising tagging efficiency, reducing mistag probabilities, in order to enhance the sensitivity of LHCb's key measurements. This project focuses on developing and optimising state-of-the-art ML-driven flavour-tagging algorithms for Run 3, assessing their performance on benchmark decay channels, and comparing them with the established Run2 algorithms to quantify improvements and remaining limitations.</p> | <p>The student will actively collaborate with the team developing Run3 flavour-tagging algorithms at LHCb, taking part in discussions on physics strategies, algorithm design, and performance evaluation. Daily tasks will involve coding in Python and analysing data with the ROOT framework, so a basic familiarity with these tools, as well as with the principles of particle detectors, is expected. Through this experience, the selected candidate will learn how LHCb, and more generally, a modern high-energy physics detector, operates, and will interact with experts from around the world. The student will also develop essential skills in teamwork, data analysis, and the application of machine-learning techniques to complex particle physics problems, gaining firsthand experience of the challenges and methodologies of contemporary experimental research.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
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CERN - 11 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/03/2026 – 31/09/2026 | Mauro Dinardo and Styliani Orfanelli |

| Data acquisition software and test system development for the CMS Phase 2 Inner Tracker | Daily activity, skills required and to be acquired |
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| <p>The High-Luminosity LHC (HL-LHC) is an upgrade of the CERN LHC expected to operate for 10 years starting in 2030. It will run at a nominal center-of-mass energy of 14 TeV with a 25 ns bunch-crossing period. In the ultimate performance scenario, the peak instantaneous luminosity will reach $7.5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ with an average of up to 200 overlapping pp collisions per bunch crossing. This will enable the CMS experiment to collect an integrated luminosity of up to 3000 fb^{-1} over its lifetime. The increased luminosity will greatly expand the physics potential of the LHC, allowing precision studies of the Standard Model and searches for rare beyond Standard Model processes. To this extent, CMS has carried out an upgrade program of its subdetectors, in particular, the vertex detector was re-designed to cope with the extreme radiation fluence expected at HL-LHC. The new silicon pixel sensors and readout chip are now in the production phase. At CERN a "System Test" stand is being set up to perform tests of the whole readout chain which includes the readout chips mounted on modules (i.e. multiple readout chips), together with ad-hoc current driven, rad-hard, power supplies, and a rad-hard optical readout. The successful candidate is required to assemble several complete readout chains, and develop software routines within the experiment Data Acquisition framework, to conduct comprehensive testing to identify potential weaknesses (including power supply noise and power performances). This testing is essential for validating critical aspects of the entire readout chain.</p> | <p>The project proposal is set in the experimental particle physics field. It consists of laboratory activities that involve the preparation of the experimental apparatus, the development of calibration routines, the acquisition of the relevant measurements, and ultimately the critical analysis of the collected data. More specifically the successful candidate must have a basic understanding of the C++ programming language, and the ROOT data analysis package. Experience with the Linux operating system, even though it's not required, would be extremely beneficial. The candidate will acquire knowledge on cutting-edge readout systems, and vertex detectors.</p> |
| <p>Any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
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CERN - 12 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/05/2026 – 30/09/2026 | Maurizio Martinelli Nathan Jurik |

| <u><i>CPV and Mixing in $D^0 \rightarrow K^0, K^+K^-$ decays</i></u> | Daily activity, skills required and to be acquired |
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| <p>The LHCb detector is a forward spectrometer at the LHC designed to precisely measure the properties of B- and D-meson decays. For Run 3, it has undergone a major upgrade to extend its physics reach, including the integration of a fully software-based trigger for event selection. This upgrade significantly improves the kinematic acceptance as a function of the particle decay time, which is crucial for analyses that measure neutral-meson mixing and CP-violation parameters.</p> <p>Among such analyses, the decay $D^0 \rightarrow K^0, K^+K^-$ is particularly promising. It enables the determination of the observables using two complementary approaches:</p> <ol style="list-style-type: none"> 1. The bin-flip method, which exploits the ratio of suppressed to favored decays in the Dalitz plot as a function of decay time. 2. A time-dependent study of the S- and P-wave components near the $\phi \rightarrow K^+K^-$ resonance. <p>The successful candidate will analyze the data recorded by LHCb in Run 3 (2024–2025) and assess the sensitivity of these decays to mixing and CP-violating observables. This will involve estimating signal yields, studying the decay's phase-space acceptance as a function of time, and comparing the results to detailed simulations.</p> | <p>The student will actively collaborate with the team studying $D^0 \rightarrow K^0, \pi^+\pi^-$ decays at LHCb and will be the first to analyse $D^0 \rightarrow K^0, K^+K^-$ decays in Run 3. The software and tools developed by the analysis team will be shared and adapted by the student to the decay channel of interest.</p> <p>Daily tasks will involve coding in Python and analysing data using the ROOT framework, so basic familiarity with these tools—as well as with the principles of particle detectors—is required. Throughout the project, the student will report their progress and findings to the analysis team.</p> <p>By the end of the project, the student will have developed essential skills in data analysis, communication, and teamwork. They will also gain valuable physics insight into the structure of multi-body decays and how detector acceptance can introduce significant biases if not properly modelled.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |

CERN - 13 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 06/07/2026 – 05/08/2026 | Cristiano Tarricone (R. Bellan) Antonio Vagnerini |

| <u><i>Introduction to CMS Data Quality Monitoring and First Run-3 Studies of the Triboson ZZγ Production</i></u> | Daily activity, skills required and to be acquired |
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| <p>The project introduces the student to the CMS Data Quality Monitoring (DQM) workflow and to its ongoing integration of Machine-Learning-based anomaly-detection tools. The student will contribute to the commissioning and testing of these ML tools within the online and offline DQM environment, gaining insight into automated data-quality assessment and detector-performance validation. Building on this operational experience, the student will work on the first Run-3 extension of the CMS analysis targeting ZZγ triboson production. The familiarity acquired through DQM with detector behavior, reconstruction issues and data-processing workflows will directly support the adaptation of the existing Run-2 ZZγ framework for the Run-3 analysis, including validation of physics objects, early event selection and preliminary background identification. The project thus combines hands-on detector-operations training with initial physics-analysis development, providing a coherent view of how high-quality data are ensured and subsequently used in pioneering Run-3 analyses.</p> | <p>Daily Activity: Training and supervised practice with CMS DQM tools; contribution to offline data-quality certification; validation of ML-based data certification; adaptation of the VZγ Run-2 framework to Run-3 nanoAOD data; basic validation of leptons, photons and jets; early event-selection tests and study of the background modeling.</p> <p>Skills Required: Basic particle physics; familiarity with Linux; introductory Python/C++ programming; interest in data analysis and collaborative work. Skills to Be Acquired: Operational understanding of CMS DQM (online/offline); use of CMSSW and nanoAOD workflows; practical experience with detector-performance checks and data-quality procedures; introductory experience with ML tools for anomaly detection; improved technical, organizational and reporting skills within a large collaboration.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| The student will complete all mandatory CERN training for general computing environment usage. | |

CERN - 14 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/05/2026 – 30/10/2026 | Stefano Argirò Giacomo Cucciati |

| <u><i>Upgraded readout electronics and DAQ of the CMS Electromagnetic Calorimeter</i></u> | Daily activity, skills required and to be acquired |
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| <p>Starting from 2030 LHC will enter the High-Luminosity phase, in which the detectors will be challenged by the increased interaction rate. The CMS Electromagnetic Calorimeter (ECAL) will be equipped with a completely revised electronic readout to cope with the new running environment. INFN designed and produced an ASIC chip to sample the signal at high frequency and manage its transmission, which will equip the Very Front-End boards.</p> <p>An international team at CERN is following the production and test of the new electronics, and, at the same time, developing new data acquisition software and tools that will allow the test, commissioning and operation of the ECAL. A complete detector module is expected to be tested with an electron beam in Fall 2026.</p> | <p>The successful candidate will take part in the testing and integration of the upgraded electronics. This will extend to laboratory setup for test and qualification of the electronics boards, storage and analysis of the test data, assembly of a test module of the calorimeter and participation in test-beam data taking. The candidate will familiarize with lab instrumentation, data acquisition and analysis. Some knowledge of python will be an advantage.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 15 -

| Hosting Laboratory | Available period | Contact persons |
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| CERN | 01/06/2026 – 31/10/2026 | Filippo Errico (INFN Roma, Sapienza) Claudio Quaranta (CERN) |

| <u>Characterization of BTL Timing Performance from Test-Beam Measurements</u> | Daily activity, skills required and to be acquired |
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| <p>The MIP Timing Detector (MTD) is a major upgrade of the CMS experiment, designed to provide precise time information for charged particles during HL-LHC operations. Within the MTD, the Barrel Timing Layer (BTL)—using LYSO:Ce crystals read out by Silicon Photomultipliers (SiPMs)—is currently in the construction and commissioning phase at CERN. The proposed summer-student project will focus on the performance validation of BTL modules through the analysis of recent and upcoming test-beam datasets. In the most recent one, conducted at CERN in September 2025, two BTL modules were exposed to a 180 GeV charged pion beam and aligned with a Micro Channel Plate (MCP) used as an external time reference. The MCP provides a precise external reference that enables a full characterization of the modules and a detailed study of amplitude-walk corrections, including tests of new correction strategies. Using two BTL modules together with the MCP also allows an independent determination of the time resolution from the particle time-of-flight. The student will contribute to the estimation of the BTL time resolution under realistic operating conditions by analyzing particle time-of-flight measurements using the BTL modules and the MCP.</p> | <p>A student working on test-beam data would contribute to extracting physics and performance metrics from these datasets, developing correction algorithms, and comparing results across modules and readout configurations. Examples of relevant data-analysis tasks include:</p> <ol style="list-style-type: none"> 1) Reconstructing timing resolution using left–right SiPM differences and studying its dependence on operating voltage and thresholds. 2) Analyzing modules with low light yield or asymmetries to quantify how non-ideal conditions affect performance. 3) Implementing amplitude-walk and slope-based timing corrections using TOFHIR multi-threshold information and time references. 4) Studying energy-sharing events across multiple crystals and evaluating combined timing reconstruction strategies. <p>A student on this project will gain practical experience in detector data analysis, learning how to reconstruct signals, extract precise timing, and validate performance using large test-beam datasets. Along the way, they will also become familiar with the operation of the BTL/MTD readout chain. The project requires basic programming skills (Python or C++), familiarity with data and general understanding of particle detectors.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
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CERN - 16 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------------|----------------------------------------------------------------------|
| CERN | 1/06/2026 – 31/10/2026 | Riccardo Paramatti (Sapienza, INFN) Mattia Campana (CERN) |

| <u>Characterisation of the CMS ECAL performances with data collected in a barrel supermodule test-beam</u> | Daily activity, skills required and to be acquired |
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| <p>The ECAL upgrade for the HL-LHC introduces new radiation-tolerant front-end electronics and a readout system designed to ensure stable energy and timing performance in the high-luminosity environment. This summer student project focuses on analyzing ECAL test-beam data collected with a spare supermodule equipped with the upgraded electronics. In the latest campaign at CERN (October 2025), the module was exposed to high-energy electron and pion beams, with a Micro-Channel Plate (MCP) detector providing an external time reference. A second test-beam run is scheduled for June 2026 to expand the dataset. The student will analyze these data to assess key performance indicators of the upgraded ECAL. He/she will first reconstruct pulse shapes and extract amplitudes and timing from the digitized waveforms, forming the basis for later studies. Building on this, the student will evaluate energy linearity across beam energies, extract energy resolution from reconstructed spectra, and determine timing resolution using the MCP. He/she will also study how the timing response varies with the particle impact position. Through this work, the student will contribute to evaluating the upgraded ECAL under realistic test-beam conditions while gaining hands-on experience in calorimeter signal reconstruction and data analysis.</p> | <p>A student working on ECAL test-beam data will help extract key performance metrics from the supermodule with upgraded electronics. The main analysis tasks include:</p> <ol style="list-style-type: none"> 1. Studying crystal-to-crystal variations and energy linearity across the available beam energies. 2. Determining the energy resolution by fitting reconstructed spectra to extract the stochastic, noise, and constant terms. 3. Evaluating the ECAL timing resolution using the MCP as an external reference, with particular attention to its dependence on signal amplitude. <p>Through this work, the student will gain hands-on experience in calorimeter data analysis, including pulse-shape reconstruction, extraction of precise energy and timing information, and study of the timing dependence on particle impact position. The project also offers opportunities to develop communication and presentation skills within the CMS ECAL community. Basic programming skills (Python or C++), familiarity with ROOT, and a general understanding of particle-detector instrumentation are required.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
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CERN - 17 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|------------------------------------------------------------------|
| CERN | 01/06/2026 – 31/10/2026 | Livia Soffi (INFN Roma, Sapienza) Raffaella Tramontano (CERN) |

| <u><i>Energy Regression and Calibration of Soft Electrons in CMS</i></u> | Daily activity, skills required and to be acquired |
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| <p>Open questions in the Standard Model motivate searches for new exotic particles. Among these, many scenarios predict light, narrow resonances that decay to charged leptons. The specific case of reconstructing electrons in this regime is more challenging compared to muons and previous searches at collider experiments: electrons with low transverse momentum produce shallow electromagnetic showers and are strongly affected by bremsstrahlung and conversions in upstream material; moreover, standard triggers, reconstruction, and energy calibrations were historically optimized for higher energy leptons. However, in the dielectron channel, the few-GeV mass range is newly accessible at the CMS experiment thanks to a dedicated data stream called double-electron Parking. In this project, the student will optimize the electron energy reconstruction at low energies by (i) training a dedicated energy regression for sub-50 GeV electrons and (ii) deriving granular energy scale corrections from $J/\psi \rightarrow e^+e^-$ decays in the 2024 CMS Parking datasets. The procedure will improve the agreement between data and simulation and will stabilize the electromagnetic calorimeter response versus transverse momentum and time, for both calorimeter-only and combined (calorimeter+track) energies.</p> | <p>The student will be involved in the full analysis workflow required to improve the reconstruction of low-energy electrons in the CMS experiment. Daily activities will include identifying low-energy dielectron candidates, and organizing the inputs needed for training a dedicated energy regression for sub-50 GeV electrons. As the project progresses, the student will work on reconstructing $J/\psi \rightarrow e^+e^-$ decays in data, extracting peak positions, and deriving fine-grained energy scale corrections as a function of transverse momentum, detector region, and time. A significant part of the work will involve comparing data and simulation, validating the performance of the new regression and corrections, and producing monitoring plots and quantitative performance metrics.</p> <p>To carry out these activities, the student should already be familiar with basic programming—particularly Python—have some exposure to data analysis tools such as ROOT, and possess a general understanding of particle physics and statistical or machine-learning concepts. By the end of the project, the student will have developed concrete experience with electron reconstruction, gained hands-on expertise with energy regression models and detector calibration.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
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CERN - 18 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|-------------------------------|
| CERN | 01/06/2026 – 01/11/2026 | Giulia Manca Patrick Robbe |

| <u><i>Bottomonium studies in different collision systems at LHCb</i></u> | Daily activity, skills required and to be acquired |
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| <p>This project focuses on studying the production of bottomonium (Υ) states in different collision environments recorded by the LHCb experiment at CERN. Bottomonium mesons, bound states of a bottom quark and its antiquark ($b\bar{b}$), provide a sensitive probe of the strong interaction and the behavior of quantum chromodynamics (QCD) in both vacuum and nuclear matter. By comparing the yields, cross-sections, and production ratios of the $\Upsilon(1S)$, $\Upsilon(2S)$, and $\Upsilon(3S)$ states across proton–proton (pp), proton–lead (pPb), and potentially lead–lead (PbPb) or fixed-target (p–gas) collisions, it is possible to disentangle the effects of cold nuclear matter and final-state suppression phenomena such as quark–gluon plasma formation, which would be a first time for LHCb. The work will combine hands-on data analysis within the LHCb software environment (ROOT, DaVinci, and Python tools) with a theoretical interpretation grounded in modern QCD models. The end goal is to produce corrected yields, cross-section ratios, and, where possible, a nuclear modification factor R_{pPb}, providing insight into how the bottomonium family behaves in different collision systems. The results will be a preliminary study part of a more extensive work which will be benchmarked against existing LHCb publications and other LHC experiments (ALICE, CMS, ATLAS).</p> | <p>Activity: The student will work within the LHCb IFT physics group under the supervision of an experienced physicist. Daily tasks will include: 1) Accessing and processing LHCb datasets using the experiment’s computing framework (DaVinci, Ganga, Dirac). 2) Selecting and reconstructing $\Upsilon \rightarrow \mu^+\mu^-$ candidates from pp and pPb collisions. 3) Performing invariant-mass fits using ROOT and RooFit to extract signal yields for $\Upsilon(1S)$, $\Upsilon(2S)$, and $\Upsilon(3S)$. Skills required: 1) Basic understanding of particle physics and the Standard Model (introductory courses). 2) Familiarity with Linux environments and command-line operations. 3) Working knowledge of programming in Python and/or C++. 4) Some experience with ROOT (data analysis, histogramming, and fitting) is desirable but not essential. 5) Motivation to learn and ability to work both independently and as part of a team. Skills acquired: 1) Practical experience with real data from a large-scale particle physics experiment. 2) Proficiency in the LHCb software environment 3) Understanding of signal extraction, efficiency corrections, and systematic uncertainty evaluation 4) Familiarity with quarkonium production</p> |
| Any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| <p>The student might do to the LHCb control room but he/she will not need a special training for that.</p> | |

CERN - 19 -

| Hosting Laboratory | Available period | Contact person(s) |
|--------------------|--------------------------------|-----------------------------------------|
| CERN | 01/06/2026 – 30/09/2026 | Mauro Iodice – Michela Biglietti |

| Resistive Micromegas optimised for Muon Systems at FCC | Daily activity, skills required and to be acquired |
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| <p>Resistive Micromegas have become an established technology for operation in high-energy physics experiments (e.g. ATLAS) and have recently evolved to withstand the very harsh, high-rate environments foreseen for future detectors. Building on the high-rate performance achieved in our R&D programme, we are now pursuing a parallel line of development targeting low- and medium-rate applications for the muon systems of FCC-ee. This effort focuses on a novel readout architecture designed to maintain high spatial resolution while significantly reducing the number of readout channels. It is based on the capacitive-sharing readout concept, implemented through a multilayer PCB where charge spreading is achieved via capacitive coupling between stacked pad layers. Small pads facing the amplification region distribute the induced charge to larger, staggered pads on the underlying layers, ultimately leading to the final readout pads. Despite the large size of the readout electrodes, this mechanism enables excellent spatial resolution through charge-weighted centroid reconstruction.</p> <p>We plan to perform a comprehensive characterisation of recently built Micromegas detectors with the capacitive-sharing readout, using radioactive sources (e.g. ^{55}Fe) and an X-ray gun available at the GDD Lab at CERN. Subject to beam-time availability at the SPS test-beam facility, we may also evaluate their performance with particle beams.</p> | <p>The student will work in one of the leading laboratories worldwide for Micro-Pattern Gaseous Detectors. He/she will actively contribute to the measurement programme, participating in detector characterisation, data taking, and data analysis.</p> <p>The activities will include tests and characterisation of the prototypes in the lab using ^{55}Fe and X-rays, and possibly participation in a test-beam campaign. The student will learn all stages of the experimental workflow: detector setup, data acquisition and analysis. Knowledge of C++ and ROOT is advantageous but not required.</p> <p>The student will gain hands-on experience with:</p> <ul style="list-style-type: none"> • Micromegas detectors • High-voltage and gas systems • Readout electronics and DAQ • Particle-physics data-analysis tools |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.)</p> | |
| <p>The work will take place in the Gaseous Detector Development Lab at CERN, which is a Supervised Radiation area. The student is supposed to use test radioactive sources, and is required to both carry a dosimeter and have successfully completed the Radiation Protection - Supervised Area course on CERN's learning hub</p> | |

CERN - 20 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|--------------------------------------------------------|
| CERN | 01/06/2026 – 30/11/2026 | Silvia Resconi (INFN-Milano) Federica Piazza (CERN) |

| Performance of Neural Network-based Missing Transverse Momentum Algorithm | Daily activity, skills required and to be acquired |
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| <p>Among the final states produced in pp collisions at the LHC, some contain invisible particles that give rise to an imbalance in the transverse momentum known as Missing Transverse Momentum (MET). A precise reconstruction of MET is crucial not only for SM measurements but also for searches for new physics. The work consists in the development of a new Neural-Network-based MET reconstruction algorithm. The study may explore different levels of input information, including standard reconstructed objects, jet and soft-term constituents (inner-detector tracks and calorimeter deposits), and, where feasible, truth information for individual hard objects. The main task will be to validate the predicted MET from the new NN approach against current algorithms (TST, METNET), evaluating the performance in various ATLAS Run-3 physics processes, both with genuine MET (e.g. $W \rightarrow \ell\nu$) and without it (e.g. $Z \rightarrow \ell\ell$). The performance will be assessed in terms of resolution, scale, tails, and data–MC agreement. The goal of the project is to improve the stability and accuracy of MET for ATLAS analyses sensitive to invisible particles and BSM signatures.</p> | <p>Useful skills:</p> <ul style="list-style-type: none">• Experience with ROOT, Python and C++• Basic knowledge of MET reconstruction in ATLAS.• Interest in machine-learning applications in high-energy physics. <p>Daily activity:</p> <ul style="list-style-type: none">• Familiarize with the NN-MET framework and datasets, use METPerformance package to produce resolution, scale, tails, and data–MC agreement plots, generate these for NN-MET, compare with other ATLAS MET variants, and document results, under the guidance of MET experts. |

CERN - 21 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|-----------------------------------|
| CERN | 01/06/2026 – 31/07/2026 | Ruggero Turra Lorenzo Pezzotti |

| <u><i>Study of the performance of a Dual Readout calorimeter on electrons and pions beams</i></u> | Daily activity, skills required and to be acquired |
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| <p>The project aims to study the performance of a prototype of dual readout calorimeter to a beam of high-energy electrons and pions at the SPS-H8 line. The dual-readout method is based on the use of two different types of signals, which provide complementary information about the showers developing in the calorimeter. The technique makes it possible to avoid/eliminate many of the problems that have traditionally strongly limited the performance of hadron calorimeters. In addition, the possibility to sample the showers with high granularity will provide additional capabilities such as the possibility to exploit particle flow algorithms in general purpose colliders detectors. A module of high-granularity, dual-readout calorimeter has been assembled within the HiDRa project using steel capillary tubes as absorber and scintillating/cherenkov fibers as active material. The transverse size of the HiDRa prototype is optimized to guarantee a full containment of the showers produced by high energy pions. The module performance will be measured on SPS pions and electrons beams in summer 2026. With the expected dataset it will be possible to fully characterize the response to hadrons setting a fundamental milestone in the development of the dual readout calorimetry. This project is incardinated in the CERN future accelerator strategy as a dual readout calorimeter is foreseen in one of the detector concepts being developed for FCC-ee.</p> | <p>The project will focus on the analysis of the data collected during the 2026 SPS test beam. The student will work on the prompt reconstruction and calibration of the calorimeter signals, the extraction of the performance, in particular the energy resolution, and the comparison of the measured response to a simulation.</p> <p>For this project, we expect students with a strong interest in experimental particle physics and data analysis. Through this project, the student will have the unique opportunity to work on the data from a fully functional, cutting-edge real detector prototype, contributing to the development of the FCC-ee project.</p> <p>The exact time will be determined once the SPS-H8 line schedule will be available.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| | |

FNAL - 1 -

| Hosting Laboratory | Available period | Contact persons |
|-------------------------|-------------------------|------------------------------------|
| FNAL (Batavia, IL, USA) | 01/06/2026 – 30/09/2026 | Massimo Casarsa Luciano Ristori |

| <u>A space-time tracking algorithm for high-occupancy events at a 10 TeV muon collider</u> | Daily activity, skills required and to be acquired |
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| <p>A muon collider represents a highly appealing option as a future collider to explore the energy frontier after the high-luminosity phase of the LHC, enabling a broad physics program that includes direct and indirect searches for new physics, precise Standard Model measurements in an unexplored energy regime, and significant advancements in the Higgs sector.</p> <p>Due to the unstable nature of muons, a muon collider detector is expected to operate under unprecedented background conditions. The fulfillment of the muon collider's physics potential crucially depends on the detector's capability to efficiently and accurately reconstruct the products of the $\mu^+\mu^-$ collisions. In particular, the reconstruction of charged particle trajectories (tracks) will be one of the most challenging tasks due to the huge number of spurious hits in the tracker from the background and the overwhelming number of hit combinations to be processed.</p> <p>A novel track-finding algorithm, loosely inspired by the Hough transform concept (<u>M. Casarsa, S. Jindariani, L. Ristori, 2025 JINST 20 P04030</u>), is under development to cope with the severe background levels. Notably, this algorithm includes the time of arrival of each hit as an additional coordinate, and its execution time is proportional to the total number of hits to be processed.</p> | <p><u>Daily activity:</u> The student will participate in the activities of the Physics & Detector Group of the Muon Collider International Collaboration. He/she will contribute to the characterization and performance studies of a novel pattern-recognition algorithm based on a multi-dimensional extension of the Hough transform.</p> <p><u>Required skills:</u> Basic knowledge of the Linux operating system and C++ programming basics.</p> <p><u>Skills to be acquired:</u> Collaborative work in the international high-energy physics environment; understanding of track finding concepts in particle physics experiments; enhanced skills in C++ programming, Monte Carlo simulations, and data analysis with the ROOT package.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). | |
| None | |

KEK - 1 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|------------------------------------|
| KEK (Tsukuba) | 01/06/2026 - 30/09/2026 | Laura Zani Marcela Garcia (KEK) |

| <u>Study of neural network based online selections for tau studies at Belle II</u> | Daily activity, skills required and to be acquired |
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| <p>Leptons are powerful tools for searching for new physics beyond the Standard Model. Particularly, tau leptons offer an ideal testbed since they are the only lepton heavy enough to decay into hadrons, allowing for precision tests of the Standard Model, through the measurement of several fundamental parameters. Belle II experiment at the electron-positron asymmetric energy collider SuperKEKB will collect the largest data set of more than ten billion tau pairs at the end of its data taking. However, tau event selection and reconstruction is challenging. Tau leptons decay before being detected into final states including neutrinos, and they need to be reconstructed from the stable particles produced in their decays.</p> <p>A new machine-learning based algorithm for online selection of tau pairs events have been developed at Belle II experiment. Testing the performance of the newly developed triggers and the agreement in the selected samples between data and simulation is crucial to achieve measurement at a precision below fraction of percent. The grant activity will concentrate on the characterization of the new algorithm using the new data sets acquired in 2025, aiming to spot possible systematic effects in physics measurements.</p> | <p>A basic knowledge of python, root and C++ is very useful, but can also be acquired during the project. Basic principles of interaction of particles with matter should be known and will be applied during the grant activity. Reference groups are available to train the interested student, before going to KEK, to the basic usage of Belle II software.</p> <p>Work at KEK will consist mainly in software activity: running the scripts on reconstructed data to measure the efficiency of trigger selection on simulation and actual data. Analysis work to optimize the trigger performance is also possible.</p> <p>The project will be closely supervised by Dr. Marcela Garcia, a senior post-doc researcher based at KEK, who is a tau physics expert. Dr. Garcia will be in touch daily with the student.</p> |
| any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.). NONE | |
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KEK - 2 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|-------------------------|---------------------------------|
| KEK | 01/03/2026 – 01/10/2026 | Diego Tonelli Kodai Matsuoka |

| <u><i>GasPM photodetector beam-test for the Belle II upgrade</i></u> | Daily activity, skills required and to be acquired |
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| <p>The student will contribute to the design, installation, execution, and data analysis of a beam test - with 5-GeV electrons from the KEK Photon Factory - of the “GasPM” photodetector proposed for the Belle II upgrade. The Belle II experiment at the SuperKEKB e^+e^- collider pursues precision studies of the weak interactions of quarks and τ leptons to push the Standard Model boundaries. Precision calls for large samples, obtained by colliding high-current beams in nm-sized regions. The resulting beam-induced backgrounds pose a challenge: photons from beam interactions with the residual gas or infrastructure spoil the clustering and energy resolution of the Belle II crystal EM calorimeter; this degrades photon and neutrino reconstruction, which is key for several important results that are unique to Belle II. Success in mitigating these backgrounds would therefore enable Belle II’s full potential. A promising approach is the GasPM, a novel, affordable photodetector based on coupling a CsI or LaB6 photocathode with an RPC. A GasPM array covering the inner calorimeter surface would veto, with 20-ps time resolution, out-of-collision-time photons thus strongly reducing beam backgrounds. Previous cosmic, laser, LED and beam tests demonstrated the design time resolution. Current focus is on understanding photon feedback (secondary signals from UV photons from gas de-excitation). The student will be a primary contributor to a beam test planned in mid 2026 to achieve this goal.</p> | <p>Expected project timeframe:</p> <ul style="list-style-type: none"> • Week 1: getting acquainted with the team (1 MSc student, 1 postdoc, 1 staff) and the equipment. Initial tests of the GasPM and its readout digitizer, trigger scintillators, reference RPC, SiPM matrix for suppressing multiple electrons, and acquisition PC. • Week 2: contribution to a preparatory step such as calibrating the digitizer or optimizing the SiPM suppression algorithm. • Week 3: apparatus set up, beam-test execution (3 days), and first look at data. • Week 4: data analysis and documentation. <p>No specific skills are required. The student will learn the (i) basic principles of photodetector physics (ii) operations rudiments for several standard detectors and lab instruments (iii) elementary concepts of statistical data analysis and usage of associated software tools.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>Work in radiation-controlled areas.</p> | |

Laboratori Nazionali Frascati - 1 -

| Hosting Laboratory | Available period | Contact persons |
|----------------------------------|-------------------------|-----------------|
| Laboratori Nazionali di Frascati | 01/02/2026 - 31/12/2026 | Davide Piccolo |

| <u>Characterization of RPC and RCC particle detectors with ecological gas mixtures</u> | Daily activity, skills required and to be acquired |
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| <p>We propose a research project aimed at investigating the performance of Resistive Plate Chambers (RPC) and Resistive Cylindrical Chambers (RCC) using ecological gas mixtures with cosmic rays. RPCs are widely utilized detectors in high-energy physics and in LHC experiments at CERN. They consist of a gas volume sandwiched between two planar electrodes, across which a strong electric field (approximately 50 kV/cm) is applied. When a charged particle passes through the RPC, it ionizes the gas molecules, producing electrons. Under the influence of the electric field, these electrons undergo multiplication, generating an electrical signal that can be measured. The best performance of this device is obtained by using fluorinate gases that are greenhouse gases. The project focuses on the study of alternative ecological mixtures to operate the RPCs and to study the performance of the RCC that is a new detector recently introduced as an extension of the planar RPCs to the cylindrical geometry. This new device aims to address some of the challenges associated with RPCs and represents an intriguing alternative that requires systematic investigation. The objective of this project is to study the performance of RCCs and to compare the results with those obtained from planar RPCs, as well as with outcomes from simulation programs.</p> | <p>The student will: conduct daily measurement campaigns by varying the operational parameters of the detectors (RPC and RCC), analyze the collected data and compare the results with outcomes from simulation studies.</p> <p>Required skills are: Laboratory work aptitude and systematic approach to conducting experiments and recording results. Basic experience in using software tools. At the end of the project the student will enhance his laboratory skills through hands-on experience with detection technologies and basic experience in data analysis tools such as ROOT and c++, including Monte Carlo simulations.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>No special training is required. The activities will be done in laboratory without use of radioactive sources.</p> | |

Laboratori Nazionali Frascati - 2 -

| Hosting Laboratory | Available period | Contact persons |
|--------------------|--------------------------------|------------------------------------------------|
| LNF (Frascati) | 01/05/2026 – 30/06/2026 | Danilo Domenici Antonio Di Domenico |

| <u>KLOE-to-SAND for DUNE experiment</u> | Daily activity, skills required and to be acquired |
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| <p>KLOE-to-SAND for DUNE experiment</p> <p>Refurbishment and test of the <i>KLOE</i> Electromagnetic Calorimeter to be used in the new detector called <i>SAND</i> (System for on-Axis Neutrino Detection) which will be part of the Near Detector complex of the <i>DUNE</i> (Deep Underground Neutrino Experiment) project.</p> | <p>The restoring and test of the barrel and end-cap modules of the electromagnetic calorimeter used in the <i>KLOE</i> experiment is performed using cosmic rays. The cosmic muon trigger is provided by means of the time coincidence between a couple of plastic scintillator bars moveable along the module length. The test on the calorimeter response to throughgoing muons must cover all cells of each module (120 for the barrel modules), each one read by a couple of photomultipliers (one for each edge), thus corresponding to a couple of read-out electronics.</p> <p>This operation implies, as a first step, the preliminary preparation and proper checks of the module under test. Then, the systematic daily acquisition of cosmic muon data samples follows, for different positions of the trigger telescope along the module.</p> <p>The requirements for this activity include a basic ability of using simple mechanical tools and standard electronics boards, just like to run Data Acquisition System simple commands.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>The needed skills can be easily acquired by means of a brief training stage just before or at the beginning of the activity period.</p> <p>No special safety procedures are required.</p> | |

Paul Scherrer Institute (PSI) - 1 -

| Hosting Laboratory | Available period | Contact persons |
|-------------------------|-------------------------|------------------------------------------------------|
| Paul Scherrer Institute | 01/05/2026 – 30/11/2026 | Giovanni Gallucci (INFN – Pisa) Angela Papa (PSI) |

| <u>Commissioning of the MEG-II detectors for run 2026</u> | Daily activity, skills required and to be acquired |
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| <p>The MEGII experiment is searching for the lepton flavor violating decay $\mu \rightarrow e\gamma$ with unprecedented sensitivity. Several detector and calibration procedures will be commissioned for the run 2026. The candidate will be involved in Pisa group activities related to detector commissioning, trigger and data acquisition electronics configuration and simple data analysis.</p> | <p>The candidate will have the opportunity to participate in the various phases of commissioning under the supervision of experts responsible for calibrations and detectors. A basic experience in C++ programming language could be useful.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>Radiation-controlled area.</p> <p>Use of calibration radioactive sources.</p> | |

Paul Scherrer Institute (PSI) - 2 -

| Hosting Laboratory | Available period | Contact persons |
|-------------------------|-------------------------|------------------------------------------------------|
| Paul Scherrer Institute | 01/05/2026 – 30/11/2026 | Giovanni Gallucci (INFN – Pisa) Angela Papa (PSI) |

| MuEDM positron tracker detector development for run2026 | Daily activity, skills required and to be acquired |
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| <p>The Electrical Dipole Momentum (EDM) of fundamental particles are intimately connected to the violation of time invariance T and the combined symmetry of charge and parity CP. The MuEDM experiment, using for the first time worldwide the innovative frozen spin technique, aims to measure the muon EDM with heightened sensitivity studying the asymmetry up/down of the positron from the muon decay. The muon beam of Paul Scherrer Institute (PSI) will enter in a uniform magnetic field region, and the muons will be trapped inside the region. The positron from decay will be measured by a dedicated scintillating fibers detector coupled with silicon photomultipliers (SiPMs) and read by CAEN FERS electronics. The candidate will be involved in Pisa group activities related to test of fibers, SiPMs and readout electronics, construction, assembly and integration of positron tracker, simple analysis.</p> | <p>The candidate will have the opportunity to participate in testing, construction and assembling of a new detector under the supervision of experts. A basic experience in C++ programming language could be useful.</p> |
| <p>any required training and/or safety procedures (work in cryogenic environments, radiation-controlled areas, use of radioactive sources, work at height, etc.).</p> | |
| <p>Radiation-controlled area.</p> <p>Use of calibration radioactive sources.</p> | |