HIP SUMMER JOBS IN 2020

INTERNATIONAL OPPORTUNITIES AT CERN AND AT ESRF

Research domain	**1. Higgs physics at the LHC**
Number of employees	**1**
Job description	Data analysis in the context of searching for a charged Higgs boson in CMS
Preferred student profile	Person interested in experimental particle physics.
Special skills required	Basic knowledge of particle physics, computing skills, familiar with UNIX/linux environment, OO-programming in C++ and python.
Training period	1.6. - 31.8.2020
Contact person	Sami Lehti, supervisor Tel. +358 50 448 5621/+41 22 767 8595 Email: sami.lehti@cern.ch

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Research domain	**2. Jet physics at the LHC**
Number of employees	**1**
Job description	Data analysis of jets (sprays of particles produced by quarks and gluons) produced in the high energy collisions in CMS experiment. We will use Monte Carlo simulations and high energy collision data at 13 TeV to extract high-precision calibrations for light quark, gluon and bottom quark jets. This is a pre-requisite for a precise top quark mass measurement and understanding vacuum stability
Preferred student profile	Physics or applied/engineering physics student; three years or more of studies; interest to proactively work in a truly international team of researchers.
Special skills required	Programming experience, preferably c/c++; familiar with UNIX/linux
Training period	1.6. - 31.8.2020 (or as agreed)
Contact person	Mikko Voutilainen, supervisor Tel. +358 2 941 50565 Email: mikko.voutilainen@cern.ch

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Research domain	**3. Silicon pixel detector characterization**
Number of employees	**1**
Job description	The summer student will characterize detector modules that will be installed to the upgraded CMS pixel detector. In addition, the student participates into developing and fine tuning the test benches in the laboratory, which requires basic knowledge of object oriented programming.
Preferred student profile	Student of engineering physics or electrical engineering
Special skills required	Basic knowledge of object oriented programming (e.g. C++/Java/Python), knowledge of LabVIEW a plus. Interest in experimental physics instrumentation, preferably some courses related to detectors.
Training period	1.6. - 31.8.2020
Contact person	Prof. Panja Luukka, supervisor Tel. +41 75 411 4299 Email: panja luukka@cern.ch

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Research domain	**4. Research and development for instrumentation in nuclear and material physics at ISOLDE**
Number of employees	**1 - 2**
Job description	**Projects 1: EC-SLI_COOLVIEW** Upgrade of the On-line Emission Channelling (EC-SLI) setup. Implementation, tests and commissioning of (a) the new beam profiler, collimator and beam scanner and (b) the new cooling station to perform EC experiments down to 30 K. All the new pieces of equipment will be delivered in early 2020. **Project 2: ISOLDE decay station upgrade** The ISOLDE decay station (IDS) is dedicated to research in the fields of nuclear structure, nuclear engineering and astrophysics. This project is related to work at the new support structure that allows for better accommodation of new detector set-ups and a tape station. **Project 3: MINIBALL electronics upgrade**

The MINIBALL digital electronics upgrade will be finalized in 2020. It is foreseen to be tested with stable ion beams with the SPEDE electron spectrometer prior to its first experimental campaign with radioactive beams. The project also involves mechanical assembly and vacuum tests.

Project 4: Upgrades and offline tests at the VITO beamline
The VITO beamline at the ISOLDE facility at CERN is devoted to laser polarisation and beta-detected NMR studies in fundamental physics, nuclear structure, as well as biology. The student will be involved in hardware upgrades taking place at VITO. To these belong the implementation of an offline ions source, tests of a reionization cell, and measurements with conventional Nuclear Magnetic Resonance. The software upgrades will involve programming in LabView and aim at controlling remotely different elements of the experimental beamline. The student should be a hand-on person ready to learn new things, and already a little familiar with experimental setups or ion sources, vacuum chambers, and vacuum pumps and basic electronics.

Preferred student profile	In general, these project are aimed for third year students with basic courses in physics and interest to work in a laboratory environment with an international team of researchers. Students that like experimental physics, assembling and testing of experimental new equipment at the hardware level are preferred.
Training period	1.6. - 31.8.2020
Contact person	Janne Pakarinen Tel. +358 40 805 4900 Email: janne.pakarinen@jyu.fi The individual projects will be supervised by local researchers within ISOLDE.

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Research domain	**5. New physics searches with CMS/TOTEM at the LHC**
Number of employees	**1**
Job description	A novel way to search for new physics phenomena is by detecting intact protons scattered only very little in the proton-proton collision and combine their information with a measurement of the central system with the central part of the CMS experiment. The task would be to participate in the physics analysis of the data taken with the CMS experiment at the Large Hadron Collider (LHC) and combine it with a leading proton measurement either by CMS or TOTEM. The work will consist of analysis of data and/or simulations related to such searches for new phenomena.

Preferred student profile	Physics (or physics interested computer science) student eager to learn new things.
Special skills required	Basic programming skills are necessary, knowledge of C++, ROOT and/or data analysis frameworks is a big plus. Basic knowledge of statistical methods and data analysis is an advantage.
Training period	1.6. - 31.8.2020 (the dates are flexible)
Contact persons	Laurent Forthomme, supervisor Tel. +41 22 7674696 Email: laurent.forthomme@cern.ch Kenneth Österberg, supervisor Tel. +358 50 5225166 Email: kenneth.osterberg@helsinki.fi

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Research domain	**6. R & D of gas detectors**
Number of employees	**1**
Job description	Generic development and testing of Micro Pattern gaseous detectors. Hands-on in detectors and carry out studies of components, including laboratory tests. A core task during this year will be dedicated the implementation of an automatic calibration procedure of the Time to Digital convertors (TDC) for VMM3 ASIC, which includes installation and maintenance of a its Data Acquisition System (DAQ).
Preferred student profile	Physics Student – with interest in electronics, programming and material sciences.
Special skills required	Basic knowledge of interaction of radiation with matter, programming C++, statistics methods and electronics and very well motivated.
Training period	1.6. - 31.8.2020
Contact person	Francisco García, supervisor Tel. +358 50 5599570 Email: Francisco.Garcia@helsinki.fi

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Research domain	**7. CLIC module**
Number of employees	**1**

Job description	Position for a mechanical engineering summer trainee is available in the framework of the conceptual module design for future particle accelerator Compact Linear Collider (CLIC) located at CERN, Geneva, Switzerland. (http:/clic-study.web.cern.ch/) CLIC module is a two meter long assembly group containing all of the necessary subsystems for the potential future particle accelerator still in conceptual design phase. The best possible integration for the accelerating structure into the CLIC module, together with its connection to every sub-system needs to be guaranteed for proper functioning. The student will participate to R&D tasks of CLIC module and its subsystems conceptual design update. The work tasks are including drafting and design work of adjustable high precision systems, manufacturing optimisation or analysing the behaviour of such systems by the means of thermo-mechanical measurements and simulation. The exact job description will be adjusted to the interests and competences of the student.
Preferred student profile	Mechanical engineering (preferably 2 years or more). The student should be interested in challenging multidisciplinary product development.
Special skills required	3D CAD skills required, thermal/structural analysis skills advantage. (CATIA and ANSYS are used at CERN)
Training period	1.6. - 31.8.2020 (exact dates are negotiable)
Contact persons	Markus Aicheler, supervisor markus.aicheler@cern.ch Tel. + 41 22 766 2182

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Research domain	**8. Experimental particle physics in ALICE I**
Number of employees	**1**
Job description	We offer a summer trainee position within the ALICE experiment where the main goal is to study the deconfined QCD matter produced in lead-lead collisions in the ultra-relativistic energy regime at the LHC. The selected candidate will participate in the data analysis in our group. We study the transport properties of the quark-gluon plasma (QGP), created in these collisions, trough flow fluctuation analysis. This analysis resembles harmonic analysis of cosmic

	microwave background, the early universe sound harmonics. Second main branch of the analysis in our group is to study how jets are modified in heavy ion environment. For example, the soft QCD radiation emitted by the high-energy parton can be modified while it traverses the QGP.
Preferred student profile	Physics student who has studied basic particle physics and is interested in data-analysis.
Special skills required:	Programming skills (C/C++) and basic knowledge of Unix-like OS help in getting into work. Prior experience in using the ROOT data analysis framework is appreciated but not required.
Training period	1.6. - 31.8.2020
Contact person	Sami Räsänen, supervisor Tel. +358 50 355 7082 Email: sami.s.rasanen@jyu.fi DongJo Kim, supervisor Tel. +358 50 3137868 Email: djkim@cern.ch

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Research domain	**9. Experimental particle physics in ALICE II**
Number of employees	**1 - 2**
Job description	We offer a summer trainee position within the ALICE experiment. ALICE studies the properties of matter at extreme temperatures. Such conditions are similar to those present shortly after the Big Bang and nowadays occur routinely during ultra-relativistic heavy-ion collisions at CERN. The accelerator complex and all LHC experiments, including ALICE, entered the Long Shutdown 2, a 2-year period of extensive upgrades. After the upgrade, ALICE aims at recording almost two orders of magnitude more collision events than during all previous runs combined. This requires significant improvements in detector hardware, readout electronics and data analysis software. Our group leads the Fast Interaction Trigger project. This detector will be used in ALICE for triggering, luminosity monitoring, event time and vertex position determination, and reconstruction of event parameters related to collision geometry – multiplicity, centrality and event plane. Depending on individual skills and interests the selected candidate will be able to participate in the following FIT-related tasks: • development of detector control system (C++) • development of online and offline data reconstruction and simulation software (C++) • data analysis

- testing and characterization of FIT detector components
- commissioning of FIT detector within ALICE

The student will work closely with a member of our group, present at CERN during the training period.

Preferred student profile	Physics/IT student who has studied basic particle physics and is interested in data analysis and detector control systems.
Special skills required	Programming skills (C/C++) and basic knowledge of Unix-like OS help in getting into work. Other experience in hardware or embedded systems programming (FPGA, microcontroller) would be an additional asset
Training period	1.6. - 31.8. 2020
Contact person	Maciej Slupecki –maciej.slupecki@cern.ch Wladyslaw Trzaska – wladyslaw.h.trzaska@jyu.fi

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Research domain	**10. Mechanical engineering (Design, Materials, Production)**
Number of employees	1
Job description	Mechanical engineering R&D on a particle tracking system for the upgrade of the CMS experiment, https://cms.cern/news/new-paradigms-cms-phase-2-upgrades. That new tracker will comprise state-of-the-art composite materials, light metals, plastics and two-phase CO_2 cooling. The trainee will work in a multi-disciplinary team in the CERN EP-DT group, https://ep-dep.web.cern.ch/organisation/dt. Depending on the trainee's profile and interests, the tasks may consist of CAD design, structural/thermal (FE) analysis, manufacturing process design and/or conducting measurements on prototypes. *Note:* There may be further job opportunities (including Thesis work) in this project.
Preferred student profile	Technical University engineering student (Engineering Design, Engineering Materials, Production Engineering, Aeronautics, Applied Thermodynamics, Mechatronics, Instrumentation, etc.). The tasks will be chosen and tuned following the study background and interests of the trainee.

Training period	1.6. - 31.8.2020 (exact dates can be adjusted)
Contact person	Antti Onnela, supervisor, CERN EP-DT Tel. +41 75 411 0673 Email: antti.onnela@cern.ch

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Research domain	**11. Technology Programme, Academia-Industry Collaboration** The Technology Programme aims at integrating the projects that have significant technology development, transfer and pre-commercialization activities of HIP in the same programme. The Technology Programme consists of 3 thematic areas: systems, materials and technology.
Number of employees	**1 - 2**
Job description	Enhancing Helsinki Institute of Physics collaborative R&D&I activities at CERN, in particular with Idea Square team. Analysing CERN knowledge and technology transfer platforms' functioning mechanisms and the related innovation ecosystems. Mapping R&D&I landscape around CERN and its collaborations. Analysing Societal Impact of large scientific research infrastructures like cost-benefit analysis and life cycle assessment and industrialisation. Participating in various roles in research projects at CERN.
Preferred student profile	Independent and hard-working, commercially oriented technical MSc student. Interested in creating and participating in international R&D&I projects and business ventures, involving academic and industrial partners. Good synthetizing and documentation skills in English are particularly needed.
Special skills required	Good written/spoken communication skills in English, knowledge of other languages, in particular French, an asset. On the wish list, experience in preparing project documentation and analytical mind-set. Good knowledge of MS-office tools required.
Training period	1.6. - 31.8.2020 (some flexibility on dates possible)
Contact person	Saku Mäkinen, PhD. Professor of Industrial Management, Tampere University

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Email: saku.makinen (at) tuni.fi

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Research domain	**12. Open data in education**
Number of employees	**1 - 2**
Job description	The CMS experiment at the LHC at CERN has released high-level particle physics data for public use. These data are in use in high schools and in undergraduate education through easy-to-use online programming platforms such as jupyter notebooks. We are looking for enthusiastic students with teaching background/interest to generate ideas for teaching content based on these open data and to develop them further. Depending on the applicant profile, the task can consist either of defining a learning context and goal matching the Finnish high-school programme, or developing tools and material for undergraduate education.
Preferred student profile	Physics teacher student with interest in open data, or physics or IT student with interest in teaching and education.
Special skills required	Interest in open data and in data analysis
Training period:	1.6.-31.8.2020 (or as agreed)
Contact person	Kati Lassila-Perini, supervisor Tel. +41 22 767 9354 Email: kati.lassila-perini@cern.ch

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Research domain	**13. Research at the synchrotron light source ESRF (www.esrf.eu)**
Number of employees	**1**
Job description	**These projects will be done at the European Synchrotron Radiation Facility in Grenoble, France.** ESRF is a highly sophisticated accelerator facility that produces high-energy x-rays with extremely high brilliance. The x-rays are used for studies in different fields in physics and materials science. Within the following projects the student will participate in the development of the new high-energy beamline for x-ray scattering and imaging, ID31 (http://bit.ly/2gxpC87). The scientific aim of the beamline is to study heterogeneous devices such as fuel cells,

organic solar cells, rechargeable batteries, catalytic materials, etc. The beamline uses hard x-ray synchrotron methods for studying both real devices under operating conditions and idealized model systems under precisely controlled environments.

Project (1): How does wood burn without oxygen?
Analysis of a set of wood pyrolysis experiments where various wood samples were heated to high temperature in the absence of oxygen. Use of advanced X-ray diffraction analysis techniques (Pair Distribution Function, Rietveld analysis) to determine the key structural transformation in the process. This project falls into the field of environmental science.

Project (2): Determination of Lithiation processes of battery electrodes (Li-ion batteries).
Data analysis of previous experiments on Si electrodes for next-generation Li-ion batteries. Students will learn the modern approaches for characterization of materials used for energy generation and storage

Project (3): pyBIB - software tool for data visualization and analysis.
The student will develop a python graphical software package for data visualization and analysis. The main building blocks will be taken from silx which is a custom library at ESRF. The student is expected to have a basic knowledge of python and will collaborate strongly with the data analysis unit.

Project (4): X-ray transparent lithium ion batteries
The student will test and commission new lithium ion battery designs compatible with X-ray diffraction and imaging. The student will assemble batteries, participate in synchroton X-ray experiments, and analyze the battery performance.

Project (5): Operando Characterization of Distorted Nanocatalysts for Clean Energy Production and Storage.
The student will take part in operando X-ray measurements of new generation electrocatalysts operating in a hydrogen fuel cell device. Student will be involved in both practical experimental work and data analysis.

Preferred student profile

In general, these project are aimed for third year students with basic courses in physics and interest to work in a laboratory environment with an international team of researchers.
The student should ideally have some experience in putting together basic experimental setups and handling of experimental data with tools such as Python numlib, Matlab, or Octave.

Training period

1.6. - 31.8.2020 (or as agreed)

Contact person

Simo Huotari, supervisor

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The individual projects will be supervised by local researchers at ESRF.