

## HIP SUMMER JOBS IN 2017

INTERNATIONAL OPPORTUNITIES AT CERN AND AT ESRF

Research domain	<b>1. Higgs physics at the LHC</b>
Number of employees	<b>1</b>
Job description	Data analysis in the context of searching for a charged Higgs boson in CMS and/or Collaboration within the LHC Higgs Cross Section Working Group.
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. - 31.8.2017
Contact person	Sami Lehti, supervisor Tel. +358 9 191 50566/+41 22 767 8595 Email: sami.lehti@cern.ch

\*\*\*\*\*

Research domain	<b>2. Jet physics at the LHC</b>
Number of employees	<b>1</b>
Job description	Data analysis of the high energy jets (sprays of particles produced by quarks and gluons) produced in the high energy collisions in CMS experiment. We will use OpenData and high energy collisions at 13 TeV, and investigate possibilities of using Deep Learning for quark and gluon identification.
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. - 31.8.2017 (or as agreed)
Contact person	Katri Lassila-Perini, supervisor      Mikko Voutilainen, supervisor Tel. +41 22 767 9354                      Tel. +358 2 50565 Email: katri.lassila-perini@cern.ch   mikko.voutilainen@cern.ch

\*\*\*\*\*

Research domain	<b>3. Track reconstruction at high luminosity</b>
Number of employees	1
Job description	Reconstruction of charged-particle trajectories (tracks) is a crucial ingredient of the particle reconstruction software at the CMS experiment, both for physics analyses and in online selection (trigger). The summer student will participate to development and tuning of CMS tracking algorithms for best performance at high luminosity reached after the future LHC and CMS upgrades. It is possible to also include more technical tasks for the reconstruction software performance depending on the student's interests.
Preferred student profile	Physics, computer science or engineering student; interest to proactively work in a truly international team of researchers.
Special skills required	C++ and python programming, familiar with linux/UNIX, basic physics knowledge
Training period	1.6. - 31.8.2017 (or as agreed)
Contact person	Matti Kortelainen, supervisor Tel. +41 22 767 1534 Email:matti.kortelainen@cern.ch

\*\*\*\*\*

Research domain	<b>4. Research and development for instrumentation in nuclear physics at ISOLDE</b>
Number of employees	1
Job description	<p><b>Projects (1) Developments at the VITO beam line.</b> The VITO setup is used for polarizing nuclear spins with laser light and then using the polarized nuclei for a versatile research programme in nuclear physics, fundamental interactions, material science and biology: to perform ultrasensitive NMR studies or to look at angular distribution of <math>\beta</math> and <math>\gamma</math> decay. The student will be involved in performing ion-optics calculations and designing new beam line elements. Testing of the planned differential pumping system is also foreseen.</p> <p><b>Project (2): The MINIBALL efficiency at high energies</b> For some experiments, efficiency curves and response functions for the MINIBALL <math>\gamma</math>-ray detectors are needed for <math>\gamma</math>-ray energies up to at least 7.5 MeV. This project will be dedicated to producing high quality detector response functions for the MINIBALL detectors extending up to high <math>\gamma</math>-ray energies. The student will have to combine GEANT4 simulations with experimental calibration spectra.</p>

**Project (3): Software infrastructure at ISOLDE**

This project focuses on the development of software infrastructure at ISOLDE; consolidation, updating and addition of functionalities to the existing programs with a view on developing new ones. Scripts are written in Swing (Java) with JavaFX support.

**Project (4): Data-acquisition at COLLAPS**

The COLLAPS data-acquisition is being upgraded and the measurement and control part for the normal fluorescence detected collinear laser spectroscopy set-up has been implemented. In a next step, this project will focus on the integration of RF-generators and amplifiers in the system, also in order to perform beta-NMR measurements.

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. For project (1), the student ideally should have knowledge of the 3D design package Autodesk Inventor and/or the Simion programme and to have some experience in putting together experimental setups: vacuum chambers, pumps, etc. For project (2) experience with semiconductor detectors and simulations would be useful, but not essential. Project (3) is suitable for a computing scientist or someone with a high level of programming in C++/python and Java, respectively. Project (4) would benefit from a student with technical skills and experience in electronics.
Training period	1.6. - 31.8.2017
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.

\*\*\*\*\*

Research domain	<b>5. Exploratory physics with CMS-TOTEM at the LHC</b>
Number of employees	<b>1</b>
Job description	Participate in the physics analysis of the data taken with the CMS-TOTEM experiment at the Large Hadron Collider (LHC). The TOTEM experiment is expanding its physics reach to searches for new phenomena using leading proton detection in proton-proton collisions at LHC together with the CMS experiment. Work will consist of analysis of data or simulations related to these 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++ and/or object oriented programming a big plus. Basic knowledge of statistical methods and data analysis is an advantage.
Training period	1.6. - 31.8.2017 (the dates are flexible)
Contact person	Kenneth Österberg, supervisor Tel. +358 50 5225166 Email: kenneth.osterberg@helsinki.fi

\*\*\*\*\*

Research domain	<b>6. R &amp; D of gas detectors</b>
Number of employees	1
Job description	Hands-on in GEM based detectors and study of their operation capabilities, understanding of the processes: initial ionization, produced by the primary particles, avalanche multiplication and induction of the signals at the anode. Then carry out analysis of the data recorded by using statistical methods. In addition to that, carry out tasks for improvement of electronics devices used for detectors testing.
Preferred student profile	Physics Student – Computer student with interest on physics.
Special skills required	Basic knowledge of interaction of radiation with matter, programming, statistics methods and electronics and very well motivated.
Training period	1.6. - 31.8.2017
Contact person	Francisco García, supervisor Tel. +358 9 1915 1086 Email: <a href="mailto:Francisco.Garcia@helsinki.fi">Francisco.Garcia@helsinki.fi</a>

\*\*\*\*\*

Research domain	<b>7. CLIC module</b>
Number of employees	1
Job description	Position for a mechanical engineering summer trainee is available in the framework of the module development for future particle accelerator Compact Linear Collider (CLIC). ( <a href="http://clic-study.web.cern.ch/">http://clic-study.web.cern.ch/</a> )  CLIC module is a two meter long assembly group containing all of the necessary subsystems for operation the potential future particle accelerator. 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 design update.

The work tasks are including 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	Catia required, Ansys advantage.	
Training period	1.6. - 31.8.2017 (exact dates are negotiable)	
Contact persons	Markus Aicheler, supervisor <a href="mailto:markus.aicheler@cern.ch">markus.aicheler@cern.ch</a> Tel. + 41 22 766 2182	Jukka Väinölä, supervisor <a href="mailto:jukka.vainola@cern.ch">jukka.vainola@cern.ch</a> Tel. +41 22 766 2174

\*\*\*\*\*

Research domain	<b>8. Experimental particle physics in ALICE</b>	
Number of employees	1	
Job description	<p>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 ultrarelativistic center of mass energy regime at the LHC.</p> <p>The selected candidate will participate into the data analysis in our group. We study the properties of the quark-gluon plasma (QGP), created in these collisions, through the modifications it induces to di-hadron or jet correlations. Second main branch of the analysis is to study flow fluctuations in the expanding QGP to better constrain the transport properties of the plasma and also the initial conditions of the collision.</p>	
Preferred student profile	<p>Physics student who has studied basic particle physics and is interested in data-analysis. For more information see <a href="https://trac.cc.jyu.fi/projects/alice/wiki/Jan">https://trac.cc.jyu.fi/projects/alice/wiki/Jan</a> and the “Ultra-relativistic Heavy Ion Physics” course.</p>	

Special skills required: Programming skills (C/C++) and basic knowledge of unix-like OS help significantly in getting into work.

Training period 1.6. - 31.8. 2017

Contact person

Jan Rak, supervisor  
Tel. +358 50 428 0812  
Email: janrak@bnl.go

Sami Räsänen, supervisor  
Tel. +358 50 355 7082  
Email: [sami.s.rasanen@jyu.fi](mailto:sami.s.rasanen@jyu.fi)

DongJo Kim, supervisor  
Tel. +358 50 313 7868  
Email: djkim@bnl.gov

\*\*\*\*\*

Research domain **9. High Energy Physics ALICE**

Number of employees 1

Job description 3 different possible project profiles, which can be customized, combined and tailored according to interests and skills:

**Physics analysis + phenomenology**

Special studies on Quantum Chromodynamics (QCD), especially in high energy diffractive proton-proton collisions. Get hands on with real LHC data and advanced Monte Carlo simulations.

**Mathematical analysis algorithms**

Pattern recognition with matrix factorization and mathematical optimization techniques applied, for example, on new particle resonance searches. Novel approaches are favored!

**Detector simulation / instrumentation**

Detector simulation for forward physics at the LHC, and possibly instrumentation electronics work.

Preferred student profile Physics and/or computational science student with a solid interest in particle physics.

Special skills required C/C++ programming

Training period 1.6. - 31.8.2017

Contact person Risto Orava, supervisor  
Tel. +358 50 301 7361, +41 22 767 4696  
Email: risto.orava@helsinki.fi

Mikael Mieskolainen, supervisor  
Tel. +358 40 8338 946  
Email: mikael.mieskolainen@cern.ch

\*\*\*\*\*

Research domain	<b>10. Green HEP Computing</b>	
Number of employees	2	
Job description	<p>Green computing and data analysis research at HIP focuses on improving energy efficiency of HEP computing in cloud clusters by analyzing and developing software and hardware solutions.</p> <p>The summer trainee will focus on developing and testing energy optimisation tools and methods for particle physics computing in Linux environment.</p>	
Student profile	<p>Computer science or related field. It is desirable that more than a half of studies is carried out. A team player, proactive and eager to learn new skills. For advanced students it may be possible to continue the summer project for MSc thesis.</p>	
Skills required	<p>At least basic knowledge on programming and experience on working with Linux operating system.</p>	
Training period	<p>A flexible three month period between 1.5. - 30.10.2017.</p>	
Contact person	<p>Supervisors; Tapio Niemi Tel. +41 22 767 6179 Email: <a href="mailto:tapio.niemi@cern.ch">tapio.niemi@cern.ch</a></p>	<p>Jukka K. Nurminen Tel. +358 50 4836 442 <a href="mailto:jukka.k.nurminen@aalto.fi">jukka.k.nurminen@aalto.fi</a></p>

\*\*\*\*\*

Research domain	<b>11. Engineering (Mechanical, Materials, Aeronautical)</b>	
Number of employees	1	
Job description	<p>Mechanical engineering R&amp;D on a novel particle tracking system for the future upgrade of the CMS experiment (<a href="http://cms.web.cern.ch/">http://cms.web.cern.ch/</a>). The trainee will work in a multi-disciplinary team designing, manufacturing and testing prototypes of an ultra-light-weight tracker, based on silicon strip and pixel sensors. The mechanics of this tracker is planned to consist of carbon-fibre polymer-matrix and metal-matrix composites, carbon foams, light metals, high-performance adhesives, and to use two-phase CO<sub>2</sub> cooling. Depending on the trainee's profile and interests the tasks may consist of 3D design work, FE-analysis, market studies, prototype manufacturing, instrumentation and/or testing.</p>	
Preferred student profile	<p>Technical University engineering student (Machine Design, Engineering Materials, Mechanics of Materials, Aeronautical, Applied Thermodynamics, Mechatronics, Instrumentation). The</p>	

tasks will be chosen and tuned following the study background and interests of the trainee.

Training period 3 months, 1.6. - 31.8.2017 (exact dates can be adjusted)

Contact person Antti Onnela, supervisor  
Tel. +41 75 411 0673  
Email: antti.onnela@cern.ch

\*\*\*\*\*

Research domain **12. Technology Programme, Academia-Industry Collaboration**

The Technology Programme is one of the major research programs of Helsinki Institute of Physics (HIP). Our focus areas are Green big data and computing, Accelerator technologies, Medical imaging technologies, Radiation detection technologies as well as Academic and Industrial collaboration.

Number of employees **1 - 2**

Job description Enhancing Helsinki Institute of Physics collaborative R&D&I activities at CERN, in particular with Knowledge Transfer Group and Idea Square teams.

Analysing CERN knowledge and technology transfer platforms' functioning mechanisms and the related (business) ecosystems.

Contacting project engineers of different nationalities and potential partners in European Industry.

Mapping R&D opportunities at CERN and in the near region.

Preparing funding possibilities for R&D projects (EU industry-academia, Tekes etc.) and creating project proposals.

Surveying Horizon 2020, The Finnish Funding Agency for Innovation and Academy of Finland funding opportunities.

Preferred student profile Independent and hard-working, commercially oriented technical MSc student. Interested in creating applied R&D projects and business ventures in international setting, involving academic and industrial partners. Initial knowledge of Finnish industry, R&D&I funding instruments and (EU) industry-academia programmes is desirable. Good synthesizing 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. - 31.8.2017 (some flexibility on dates possible)



Contact person Saku Mäkinen, PhD. Director of Technology Programme HIP/CERN,  
Professor of Industrial Management,  
Tampere University of Technology  
Tel. +358 40 544 1088  
Email: saku.makinen (at) tut.fi

Pietari Kauttu  
HIP/CERN  
pietari.kauttu (at) cern.ch  
Tel. +41 76 487 10 57

\*\*\*\*\*

Research domain **13. Open data in teaching and education**

Number of employees **1**

Job description The CMS experiment at the LHC at CERN has released high-level particle physics data for public use. Tools are being developed to make possible the use of these data in high-school and undergraduate education. We are looking for an enthusiastic student to generate ideas for teaching methods based on these open data and/or 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 user interfaces for an already defined learning target.

Preferred student profile Physics or IT student with interest in teaching and education

Special skills required Familiarity with and/or interest in online teaching

Training period: 1.6.-31.8.2017 (or as agreed)

Contact person Kati Lassila-Perini, supervisor  
Tel. +41 22 767 9354  
Email: [kati.lassila-perini@cern.ch](mailto:kati.lassila-perini@cern.ch)

\*\*\*\*\*

Research domain **14. Research at the synchrotron light source ESRF  
([www.esrf.eu](http://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 the fuel cell catalysts degrade? - Fundamental in-situ studies of platinum single crystal model catalysts degradation processes. The student will participate on the experiments at ESRF and will participate in the analysis of the acquired data.

**Project (2):** Surface X-ray diffraction in transmission geometry - new tool for operando and in-situ surface science. The student will be involved in experiments where hard X-rays and microfluidic electrochemical cells are used to probe transient structures on the oxide surfaces during the Oxygen Evolution Reactions, the key reaction in hydrogen production. Part of the project is the analysis of the obtained data.

**Project (3):** 3D tomography of running fuel cell. In this project the student will be involved in commissioning of the low temperature fuel cell (PEMFC) which special design allows X-ray tomography. The final goal is to make a 3D tomography of the running fuel cell in order to obtain critical data about the processes leading to the premature failure of the cell. This is a perfect project for a student who likes “hands-on” science.

## 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. - 31.8.2017

## Contact person

Simo Huotari, supervisor  
 Tel. +358 2941 50638  
 Email: [simo.huotari@helsinki.fi](mailto:simo.huotari@helsinki.fi)  
 The individual projects will be supervised by local researchers at ESRF.