ACCELERATOR AND **M**AGNET **I**NFRASTRUCTURE
FOR **C**OOPERATION AND **I**NNOVATION

http://eu-amici.eu/

Mardi 8 octobre – Mercredi 9 octobre 2019

ATRIUM de CentraleSupélec

(Eiffel Building)

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La construction d'accélérateurs de particules et d'aimants supraconducteurs pour la recherche :

un domaine d'excellence Européen,

des opportunités de stages et thèses pour les étudiants de l'Université de Paris-Saclay

Le projet AMICI a été financé par le programme Horizon 2020 Recherche et Innovation de l'Union Européenne sous la convention de subvention N° 731086

Commissariat à l'énergie atomique et aux énergies alternatives (CEA), France

COBALT-Web (internship)

CONTEXTE

Le DACM (Département des Accélérateurs, de Cryogénie et de Magnétisme) est un département de l'IRFU (Institut de Recherche sur les lois Fondamentales de l'Univers). Dans le cadre des projets de développement d'accélérateurs de particules, les équipes utilisent actuellement l'application COBALT (voir annexe) pour la gestion des projets en mode agile. Différents retours d'expérience indiquent la nécessité d'un upgrade majeur de COBALT.

DESCRIPTION DU BESOIN

Développée en langage Java, l'application COBALT utilise le design pattern MVC et une base de données MYSQL hébergée en interne. Elle est opérationnelle mais souffre des limitations suivantes :

- nécessité d'installation d'un client lourd
- fonctionnalités limitées sur les aspects multi-utilisateurs, multi-projets, administration
- possibilités de personnalisation très limitées

OBJECTIFS DU STAGE

Le travail de stage consiste à réécrire une grande partie du logiciel en utilisant des technologies logicielles plus récentes afin d'en améliorer les fonctionnalités et la pérennité. Plus précisément, il s'agit de :

Faire évoluer l'application vers une architecture « 3-tiers » basée sur :

- un client riche sur navigateur Web basé sur un framework javascript de type Angular.js
- un serveur d'application reprenant tout ou partie des classes Java de l'application actuelle
- un serveur de base de données reprenant tout ou partie du schéma actuel

Adapter le mode multi-utilisateurs aux besoins spécifiques des projets (customisation)
Implémenter des capacités à s'intégrer à la gestion des projets (édition des CR de réunions…)
Améliorer les fonctionnalités du client riche par rapport à l'IHM actuel
Rationaliser la gestion du code et du déploiement en utilisant la plateforme GitLab de l'Irfu.

LE TRAVAIL DE STAGE COMPREND

- la revue du code existant et des fonctions implémentées, l'expression des nouveaux besoins
- la spécification d'une architecture web « responsive » et multi-plateformes (PC, Mac, mobile)
- la spécification des améliorations fonctionnelles et ergonomique par rapport à l'existant
- le développement du client Web et du serveur d'application (avec réutilisation du code serveur)
- le déploiement, comprenant documentation, information et accompagnement des utilisateurs
- la gestion du projet

DURÉE DU STAGE

Environ 6 mois

INTÉRÊT DU STAGE

Contexte de projets innovants, Déroulement du cycle de vie complet d'un projet informatique, Position de chef de projet junior, Accompagnement, Aspects techniques et intégration.

PROFIL ET COMPÉTENCES ATTENDUS

Ecole d'ingénieur informatique – candidat élève en Master 2

Bonne connaissance du langage Java (reprise de l'existant), des bases de données relationnelles et d'au moins un framework d'application Web.

Autonomie et intérêt pour les nouvelles technologies logicielles

CONTACT

Philippe GASTINEL – CEA IRFU – DRF/DACM/Dir
philippe.gastinel@cea.fr – 01.69.08.33.28

Participer aux tests et analyses de l'aimant IRM

Iseult (record du monde : 11,72T & corps entier). (internship)

CONTEXTE

L'aimant a atteint en juillet son champ nominal de 11,72 T, mais il reste encore de nombreux tests à faire pour le transformer en IRM opérationnel : homogénéiser le champ magnétique (0,5 ppm dans une sphère de 22 cm), le stabiliser (à mieux que 0,05 ppm/h), vérifier les interactions avec le gradient et assurer une haute disponibilité (10 ans de fonctionnement en continu).

OBJECTIFS DU STAGE

Le travail consistera principalement à analyser les mesures des tensions afin de comprendre les phénomènes observés : couplage entre les différents circuits, courant de Foucault, glissement par saccade du bobinage sur son support, influence des perturbations extérieures…

La participation aux tests se fera en fonction du planning du projet au sein d'une équipe d'une douzaine de personnes. Si besoin, des tests spécifiques pourront être réalisés pour mieux comprendre un aspect particulier des phénomènes observés.

PROFIL

Ecole d'ingénieur – candidat élève en Master 2

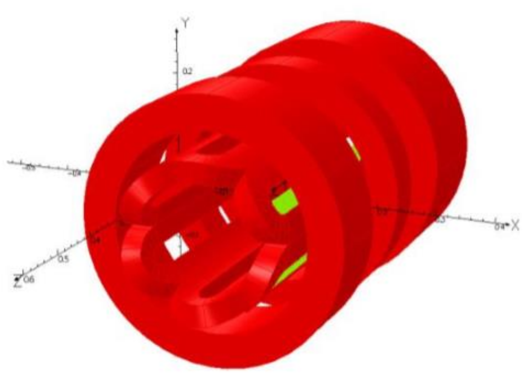
CONTACT

C. Berriaud (CEA Saclay DACM)

Modélisations Multiphysiques d'un électroaimant supraconducteur pour une source d'ions (internship)

DESCRIPTION ET PROBLEMATIQUE

Dans le cadre de la recherche fondamentale en physique nucléaire, des faisceaux d'ions sont étudiés au sein d'accélérateurs. Ces faisceaux d'ions sont produits par une source dite ECR (Electron Cyclotron Resonance). L'un des composants majeurs de ce type de source est un électroaimant. Via le champ magnétique produit, il permet le confinement du plasma d'ions qui une fois extrait de la source produira un faisceau de haute intensité prêt à être exploité par l'accélérateur. Pour permettre la production d'ions lourds, cet aimant doit produire un champ magnétique suffisamment fort (> 2 T) qui ne peut être obtenu par des aimants permanents ou des bobinages en cuivre. Il est donc nécessaire de faire appel à des matériaux supraconducteurs. Leur mise en œuvre requiert une approche multi-physique, associant électromagnétisme, mécanique et thermique. Le but du stage est de modéliser et étudier ce type d'aimant en vue d'une conception préliminaire.



Vue 3D des bobines au sein d'un aimant ECR

DESCRIPTION GROUPE/LABO/ENCADREMENT

Le stage se déroulera au sein du DACM au CEA Paris-Saclay. Le DACM est spécialisé dans la conception et la réalisation d'électro-aimants supraconducteurs ainsi que la maîtrise de la cryogénie associée. Il participe à de nombreux projets, par exemple pour la physique des particules ou pour l'imagerie médicale.

TRAVAIL PROPOSE

Le stage se déroulera en plusieurs étapes:

1. Dans un premier temps, prendre en main les concepts : modèles Eléments Finis magnétique (EF) 2D et 3D, modèle EF mécanique 2D, principes de la précontrainte dans les électro-aimants supraconducteurs, principe de protection des électro-aimants supraconducteurs. Il est à noter que des modèles de ce type d'électro-aimants seront disponibles à l'arrivée du/de la stagiaire afin de faciliter la prise en main de la problématique.

2. Etudes paramétriques des différentes grandeurs dimensionnant l'électroaimant.

3. Etudes multiphysiques faisant intervenir les différents aspects de l'aimant supraconducteur et les couplages associés : champ magnétique produit, mécanique (2D) de la structure, étude électrothermique pour la protection de l'aimant.

Selon le déroulement du stage, une prise en main de la modélisation mécanique 3D pourra être envisagée.

FORMATION ET COMPETENCES REQUISES

Le projet s'inscrit idéalement dans le cadre d'une fin d'études niveau Master ou Ingénieur, avec une formation en génie mécanique et en modélisation. Le/la candidat/e saura faire preuve d' : - Une bonne compréhension de la mécanique des structures. - Un intérêt pour la modélisation numérique - Une envie d'apprendre et de contribuer au domaine de la supraconductivité appliquée

ENCADRANTS

Hélène Felice: helene.felice@cea.fr Etienne Rochepault : etienne.rochepault@cea.fr

REMUNERATION PREVUE

900-1300 € net/mois en fonction de l'école/université

DATES

6 mois à partir de Mars au plus tôt.

Comportement de Structures Mécaniques à Températures Cryogéniques pour les Futurs Aimants d'Accélérateurs (internship)

DESCRIPTION ET PROBLEMATIQUE

Afin de développer les accélérateurs de particules du futur tels que le HiLumi - Large Hadron Collider (HL-LHC) et le Future Circular Collider (FCC), des électro-aimants à très haut champ (15-16T) sont nécessaires. Ces aimants sont constitués de bobines supraconductrices et nécessitent une structure mécanique pour compenser les efforts magnétiques considérables exercés sur les supraconducteurs. La structure est utilisée pour appliquer une précontrainte à température ambiante, puis l'aimant est refroidi à 1.9 K pour atteindre l'état supraconducteur, enfin les bobines sont alimentées en courant pour générer le champ magnétique. Différents tests ont été réalisés sur des aimants prototypes, instrumentés avec des jauges de déformation. En revanche plusieurs phénomènes (non linéarités, hystérésis, transferts partiels de précontrainte…) demandent d'être étudiés plus en détails. Le CEA dispose d'une structure mécanique réduite qui permet de faire varier les paramètres de manière flexible et rapide. Le but du stage est de reproduire les phénomènes observés dans les structures d'aimants, afin de les étudier en détail et comprendre les phénomènes.

Structure mécanique réduite « Subscale Dipole »

DESCRIPTION GROUPE/LABO/ENCADREMENT

Le stage se déroulera au sein du DACM au CEA Paris-Saclay. Le DACM est spécialisé dans la conception et la réalisation d'électro-aimants supraconducteurs ainsi que la maîtrise de la cryogénie associée. Il participe à de nombreux projets, par exemple pour la physique des particules ou pour l'imagerie médicale.

TRAVAIL PROPOSE

Le stage se déroulera en plusieurs étapes:

1. Dans un premier temps, prendre en main les concepts : mesures par jauge de déformation, modèles Eléments Finis (EF) 3D, principes de la précontrainte par la méthode « bladders and keys ».

2. Des cycles de charge-décharge à l'ambiante seront effectués, dans un premier temps sur un matériau connu (aluminium par exemple), puis sur une bobine supraconductrice. Ces expériences serviront à identifier les phénomènes imputables à la structure et ceux imputables aux bobines.

3. Des cycles thermiques à température cryogénique seront appliqués, afin d'étudier les différents phénomènes mises en jeu lors du refroidissement et du réchauffement. En particulier on s'attachera à identifier les pertes de précontrainte lors du cycle thermique.

4. Une partie modélisation EF 3D, se basant sur des modèles existants, qui permet d'une part de faire varier les paramètres, et d'autre part de corréler les analyses avec les données issues de jauges de déformation.

European Organization for Nuclear Research, France/Switzerland

Doctoral Student Programme at CERN

Company Description

At CERN, the European Organization for Nuclear Research, physicists and engineers are probing the fundamental structure of the universe. Using the world's largest and most complex scientific instruments, they study the basic constituents of matter - fundamental particles that are made to collide together at close to the speed of light. The process gives physicists clues about how particles interact, and provides insights into the fundamental laws of nature. Find out more on home.cern.

Diversity has been an integral part of CERN's mission since its foundation and is an established value of the Organization.

Job Description

Imagine getting involved in work that is changing the world and imagine doing it before you've left university.

Imagine working in an international environment and having a great quality of life.

Put all these ingredients together to make this imagination a reality.

Take part in CERN's Doctoral Student Programme!

This is a chance to work on your thesis while spending up to 36 months at the forefront of science. Whether you've already chosen a subject or are still making your decision, if your specialism is Applied Physics, Engineering or Computing, this is an invitation to further your knowledge in a truly unique organization. In fact, it's an invitation to get involved in world-famous experiments of unprecedented scale and scope. An invitation to join an environment like nowhere else on Earth.

You will have the opportunity to work in a diversity of fields at the cutting edge of technology: applied physics, IT, mathematics, electricity, electronics, mechanical or civil engineering, instrumentation for accelerators and particle physics experiments, materials science, radiation protection, safety and environmental protection, science communication, surveying, ultra-high vacuum are but a few of the examples of the many domains in which successful applicants will learn and contribute their knowledge.

The following link provides examples of Doctoral student projects (http://careers.cern/doct-projects) with numbers to identify them. If any of these are of specific interest for you, you will be asked to provide their corresponding number during the application process. Please note this is not mandatory nor a guarantee that these projects will be the ones for which you are selected: you may be selected on another project that matches your profile.

Students specialising in theoretical or experimental particle physics are not eligible to apply for this programme.

Qualifications

In order to qualify for a place on the programme you will need to meet the following requirements:

- You are a national of a CERN Member or Associate Member State (home.cern/about/member-states).
- You have started or are about to start a doctoral programme in a university.

- Your work envisaged at CERN is all or part of the thesis work required to obtain your PhD. The award of the degree remains the responsibility of your university. Academic arrangements will be discussed between your university thesis supervisor and your CERN supervisor.
- You have a good knowledge of English OR French.

Additional Information

CERN would very much like to benefit from your expertise, commitment and passion.

In return, CERN will provide you with:

- A contract of association for 6 months initially, renewable up to 3 years.
- The total period (up to 36 months) may be spread over a maximum duration of four consecutive years to allow you to spend time at your university (for periods of up to 12 months, granted as unpaid special leave).
- An allowance of 3704 Swiss Francs per month (net of tax).
- A travel allowance.
- Depending on your personal circumstances, a supplement if you are married and/or have children.
- Coverage by CERN's comprehensive Health Insurance scheme (the contribution will be automatically deducted from your allowance).
- 2,5 days of paid leave per month.

Please note that CERN cannot contribute to any cost related to your University nor will CERN reimburse tuition fees.

This is how you can apply:

You will need the following documents, **clearly labelled** (e.g. "CV", "Motivation letter", "Academic transcript", etc.) **and in PDF format** to complete your application:

- A CV.
- A copy of your most recent academic transcript giving an overview of your marks (if you download it from your university portal please make sure there is no protection so that we can open it).
- A reference letter from your University Professor is mandatory. Should you have a letter of reference from a previous internship you may add this as a second reference.
- You can upload these letters at the time of application if you have them to hand. You will also be provided with a link as soon as you have submitted your application to forward to your referees to upload their letters confidentially.
- Note: this must be done before the closing date.

Make sure you have all the documents needed to hand as you start your application, as once it is submitted, you will not be able to upload any documents or edit your application further.

Your application along with all supporting documents should reach us no later than 21 October 2019. Please note that your application may also be shared during the process with a panel of national experts for evaluation purposes. Ultimately, it will be reviewed by a panel of CERN experts who will meet in December 2019.

Fellowship Opportunities at CERN

Take part in the Fellowship Programme

What could be a better boost for your career than a work experience in one of the largest scientific experiments in the world at the cutting edge of technology, to develop your technical skills, knowledge and expertise?

If you're a recent graduate from **university or a technical institute**, you're no doubt looking for the chance to make your mark. Here it is: you could spend up to three years working right at the forefront of scientific research. As a Fellow, you could join us for research work in particle physics or take part in advanced development work in a broad range of applied science, engineering and technical fields. Whichever route you take, it will be an extraordinary experience. An experience like nowhere else on Earth.

Categories of Fellowships

CERN offers different categories of fellowship in line with different levels of education and experience. Browse the following categories to find the one that best matches your profile. Take part by applying for a:

- Junior Fellowship, for nationals of Member or Associate Member States with a BSc or MSc degree and no more than 4 years' experience after completing your highest diploma,
- Senior Fellowship, if you have a PhD or at least four years' experience post-MSc (or equivalent diploma which gives access to doctoral programmes), and a maximum of 10 years' experience.
- Senior Research (Theoretical & Experimental) Fellowship, for researchers in the fields of theoretical and experimental physics holding a PhD and up to ten years' experience in your field.
- Post Career Break Fellowship, if you have the profile of either a Junior or Senior Fellow and have been on a career break for personal reasons (for example for family or caring responsibilities, health issues) for at least two years.

How does it work?

Calls for applications open twice per year, for a period of several months closing respectively in March and in September. All applications for Fellowships are reviewed by the Associates and Fellows Committee made up of a panel of CERN experts who meet usually in May and November, to finalise the selection process. Please note that Senior Research Theoretical physicists are only selected at the November committee.

We wish you all the best for your application for this enriching programme!

CERN also participates in Marie Skłodowska-Curie Actions which fund individual fellowships for candidates of any nationality. All open opportunities will be listed below along with the standard Fellowship programmes.

Deutsches Elektronen-Synchrotron, Germany

For our location in Hamburg we are seeking:

PhD Student Positions in Accelerator R&D

DESY

DESY is one of the world's leading research centres for photon science, particle and astroparticle physics as well as accelerator physics. More than 2400 employees work at our two locations Hamburg and Zeuthen in science, technology and administration.

Accelerator Research and Development (ARD) is a core mission of the lab. By further developing and inventing technologies for improving existing accelerator facilities and for constructing new ones, the ARD group gathers indeed accelerator building expertise to stay at the leading edge of accelerator science.

The position

Doctoral students are invited to take an active role in one of the following research topics at DESYs Accelerator R&D:

- Improvements of existing accelerator flagship facilities, e.g. upgrades to DESYs synchrotron radiation facilities, seeding of free-electron lasers, atto- and femto-second electron and photon beams
- Super-conducting RF technology for future accelerators and its implementation in FLASH, the European XFEL and other modern high power accelerators
- Compact accelerator technology with high accelerating fields, e.g. plasma accelerators, dielectric structures, beam or laser drivers for accelerators, cost-efficient technologies
- New accelerator facilities for R&D, photon science and particle physics, e.g. future free-electron lasers (XFEL upgrades, PETRA IV), the SINBAD facility at DESY, future colliders (e.g. FCC at CERN)

Requirements

- Doctoral students in the fields of physics or engineering may stay enrolled in their home university or enroll at the University of Hamburg or the Technical University Hamburg-Harburg (acceptance criteria must be met)

DESY-Doctoral programme is awarded for a duration of at least 3 years.

Do not hesitate to contact us at DESY Accelerator R&D to get additional information on the current research activities. Further information is available here: http://ard.desy.de/e206405.

Please arrange for two letters of reference.
Salary and benefits are commensurate with those of public service organizations in Germany. Classification is based upon qualifications and assigned duties. Handicapped persons will be given preference to other equally qualified applicants. DESY operates flexible work schemes. DESY is an equal opportunity, affirmative action employer and encourages applications from women. Vacant positions at DESY are in general open to part-time-work. During each application procedure DESY will assess whether the post can be filled with part-time employees.

We are looking forward to your application via our application system:

Internship at DESY

DESY offers at both research locations in Hamburg and Zeuthen the possibility to carry out internships of several weeks in the fields of research, information technology (IT), mechanics, electrical engineering, electronics and administration.

Questionnaire internship proactive applications (482KB)

Internship proactive application

How do I apply?

Interested person can apply for the advertised internships via the online portal. If the desired area or group does not have an online advertisement at the moment, please send us your application documents with details of the desired area or group to praktikanten@desy.de and we will check individually whether an internship is currently possible.
As internships are limited and supervision must be provided for the desired period, applications should be submitted at least 6 months (earliest 8 months) before the start of the internship.

Required application documents and information for a proactive application

Letter of motivation stating the kind of internship and any existing knowledge or skills

- **Computer skills**
- **Knowledge of the operating systems OSX, Linux or Windows**
  Knowledge of foreign languages
- **Other special skills or knowledge**

Specification of the desired period
Indication of the field of interest (max. 3):

- **Astrophysics (only in Zeuthen)**
- **Electrical Engineering**
- **Industrial Mechanics**
- **Mechatronics**
- **Technical Product Designer**
- **Business Internship**
- **Electronics Development**
- **IT/Computing**
- **Physics**
- **Vacuum Technology**
- **Construction Mechanics**
- **Electronics Production**
- **Library/Documentation**
- **Precision Mechanics**

Name of a person at DESY with whom an agreement may have been made about an internship at DESY
Curriculum Vitae
Students: matriculation certificate
Compulsory internships: School requirements or the university regulations for a compulsory internship
Current certificate
Questionnaire internship proactive applications **(necessary)**

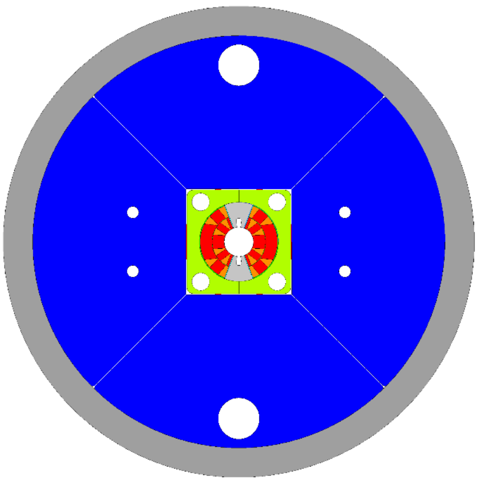
You can find our current internship advertisements here: www.desy.de/career/job_offers
DESY would like to significantly increase the participation of women in the scientific-technical field and therefore requests girls to apply for the positions to be filled.
We look forward to receiving your application via our application portal:
www.desy.de/onlineapplication

Istituto Nazionale di Fisica Nucleare (INFN), Italy

Quench and protection of high field superconducting magnets for future accelerators (PhD thesis)

Description and issue

Due to the high stored energy, the superconducting dipolar magnets of future high-energy hadronic accelerators (such as the 100 TeV Future Circular Collider) present critical aspects both in relation to the achievement of the required magnetic field (B = 16T) and in relation to the protection systems in the case of transition of the magnet to the normal state (a phenomenon called *quench*). The student is asked to carry out a study of the Quench problems of a model of the 16 T dipoles in development phase.



A cross section of the model under development in INFN. The core of the magnet is a Nb_3Sn coil placed at the centre).

Group/Lab/Supervision

The thesis work will be carried out in the Genova laboratory of the Italian Institute for Nuclear Physics. The development of the model is done in collaboration with CERN, The Quench aspect will be also cover the protection aspects.

Proposed work

This activity involves a basic study of magnet protection methods based on numerical computations, especially a new system being studied at CERN based on the effects of variable-rate dissipation in superconducting cables. This system, called CLIQ (Coupling Losses Induced Quench) is proving to be very promising and will probably be the only way to protect the magnets of the future accelerator. The standard method based on quench heaters shall be studied as well. The chosen protection system shall be constructed and integrated into the magnet.

Required training and competences

For accessing the PhD in Applied Superconductivity (a part of the PhD in Physics of Genova University) a master degree in Physics or Engineering is required.

Acquired competences

In the three years of the PhD activities the student will acquire competences in the design of superconducting magnets. And the use of Finite Element codes (ANSYS™, COMSOL™)

Collaborations/partnership

The development of the model of is done in a framework of collaboration with CERN. The INFN groups involved in this activity are the Genova and Milano sections of INFN.

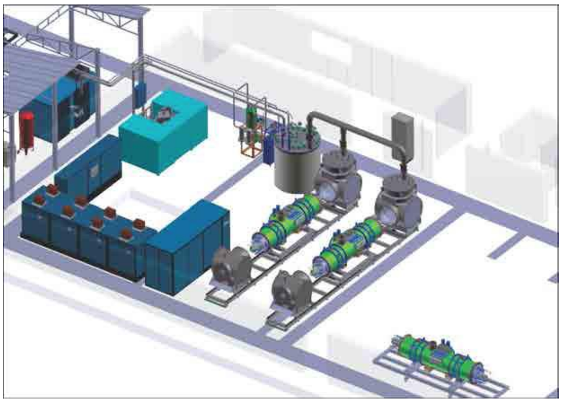
Contacts

P.Fabbricatore pasquale.fabbricatore@ge.infn.it
S.Farinon
stefania.farinon@ge.infn.it

Cryogenic tests of superconducting magnets (PhD thesis)

Description and issue

Development and implementation of the Management & Control System of a test line for superconducting accelerator magnets.



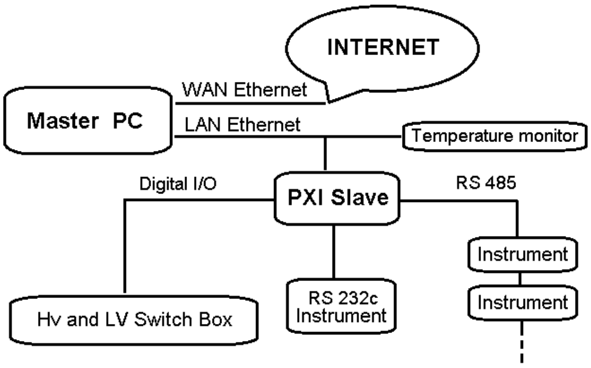
Test station for superconducting magnet under development at the Salerno University under INFN responsibility.

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Implementing in collaboration with a dedicated company of the necessary test steps in the M&CS for recording, analyses and reporting of the cryogenic tests of the superconducting quadrupole modules of the SIS100 synchrotron for FAIR accelerator complex.



Data acquisition and control management

Required training and competences

General physics, cryogenic basic understanding, good LabView programming, electrical and electronic skills.

Acquired competences

Control system for general testing of superconducting elements in cryogenic environments

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

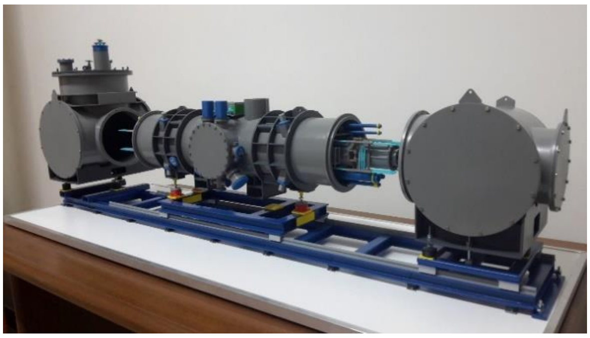
Contact

U.Gambardella
umberto.gambardella@sa.infn.it
A. Saggese
saggese@unisa.it

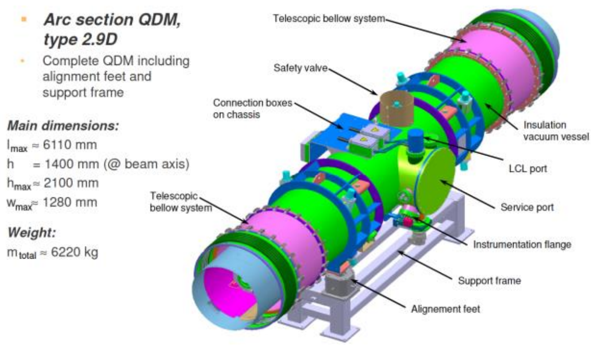
Leak tests in cryogenic equipment (PhD thesis)

Description and issue

Leak test for cryogenic accelerator magnets: techniques and methodologies from room temperature to the cryogenic environment



A cryogenic equipment (a quadrupole module of FAIR SIS100 synchrotron) to be tested at INFN Salerno.



A quadrupole module of SIS100 synchrotron

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Develop and realize suitable systems for checking the isolation vacuum and beam pipe vacuum in superconducting accelerator modules.

Leak detector and RGA at INFN Salerno

Required training and competences

General physics, cryogenic basic understanding, knowledge of vacuum technology,

RGA analyses, leak test with He.

Acquired competences

Vacuum leak check, RGA analyses, UHV techology

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

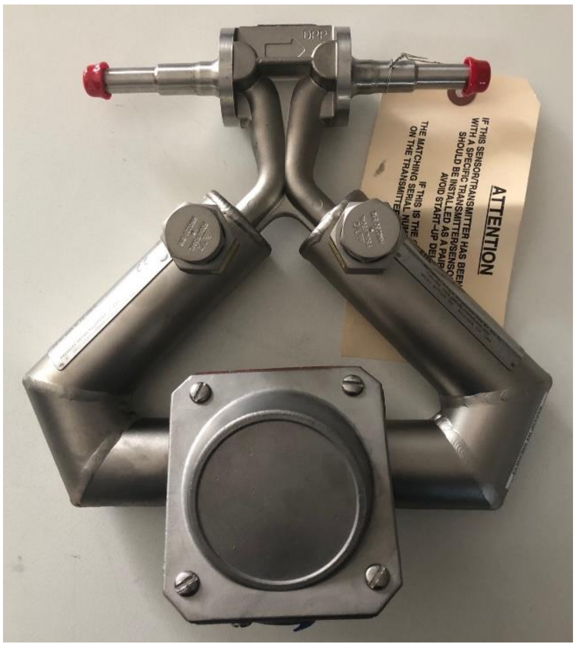
Contact

U.Gambardella umberto.gambardella@sa.infn.it
D. D'Agostino
ddagostino@sa.infn.it

Fluid dynamics measurement at cryogenic temperatures (PhD thesis)

Description and issue

Measurement of cold flow: methods and issues. The facility in Salerno for testing of superconducting magnets is equipped with Coriolis mass flow meter in order measure the He flow in the process lines. The use of this equipment shall be implemented in the tests of the quadrupole module of SIS100 synchrotron.



A Coriolis mass flow meter to be used in the fluid dynamics measurements

Group/Lab/Supervision

Superconductivity Group @ INFN Salerno.

Proposed work

Test among different cold flow measurement techniques in supercritical He cooling pipes. The aim is to measure the supercritical He mass flow in the quadruple modules under test at INFN Salerno and develop methods for obtaining information about the cryogenic thermal loads.

The WEKA mass flow meter to be used in the fluid dynamics measurements

Required training and competences

General physics, Thermodynamics, Cryogenic basic understanding.

Acquired competences

Thermodynamics of cryogenic gas, heat load measurements at cryogenic temperatures

Collaborations/partnership

INFN is performing this activity in collaboration with GSI (Darmstadt).

Contact

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The Institute of Nuclear Physics Polish Academy of Science (IFJ PAN), Poland

International PhD Studies at the Institute of Nuclear Physics PAN

Within PhD studies we conduct postgraduate education leading to obtaining PhD in physics. We cooperate with International PhD Studies at the Institute of Physics Polish Academy of Sciences in Warsaw as well as with foreign institutions educating PhD students, such as: Joint Institute for Nuclear Research in Dubna, Czech Technical University in Prague, Belarusian State University in Minsk, Bilkent University in Ankara, and Pierre-and-Marie-Curie University in Paris.

During the 26-year activity we promoted to PhD in physics around 120 young scientists. The candidate to International PhD Studies can be each person who possesses master's diploma in the field of physics or related, who is interested in scientific work and declares active participation in research conducted at the Institute.

The recruitment for PhD Studies is held annually at the time announced on the Institute's website. PhD students can be awarded scholarships paid from the assets of the institutions in which the scientific supervisor is affiliated.

The above-mentioned information is included also in the International PhD Studies poster.

In December 2013 the Institute of Nuclear Physics Polish Academy of Sciences was recognized the most pro-doctoral institute of Polish Academy of Sciences.

In the years 2005-2007 fifteen of the International PhD students and one research assistant were beneficiaries of the European Social Fund, from which the assets financing the project "European Social Fund for members of International PhD Studies at the Institute of Nuclear Physics Polish Academy of Sciences in Krakow", realized within measure 2.6 of the Integrated Regional Operational Programme, were raised.

Proposed topics of PhD theses are available at:
https://www.ifj.edu.pl/msd/en/index.php?menu=topics

Contact:

Centre national de la recherche scientifique (CNRS), France

Development and realization of the optical Fabry-Perot resonator for the Gamma Factory Proof of Principle Experiment (PhD Thesis)

The ultimate aim of the Gamma Factory project is to create and exploit particle beams with unprecedented intensity, purity, energy range, and plug-power efficiency. A primary beam of γ-rays is proposed to be generated by storing atomic beams of partially stripped ions in the LHC ring(s) and by exciting their atomic degrees of freedom by laser beams. Secondary beams of polarized charged leptons, neutrinos, neutrons and radioactive ions would be produced in collisions of the high-intensity γ-ray beams with external targets. These primary and secondary beams could open new perspectives for the High Energy Physics community and new cross-disciplinary research domains (for instance electroweak measurements with atoms, high intensity low emittance muon sources for future colliders) at CERN by re-using its existing accelerator infrastructure in unconventional but innovative way.

Nowadays, high intensity sources of photons in the MeV range exploit the Compton backscattering process. However these sources are, so far, providing up to several 10^10 photons/seconds. The idea underlying the Gamma Factory concept consist in exploiting the much larger cross section of atomic transitions and exploit the relativistic boost of the photons absorbed and emitted in the atomic reference frame. This requires acceleration at high energies of partially stripped ions with appropriate choices of atomic element, beam energy and number of electrons kept in the atomic orbitals to allow their excitation with conventional laser wavelength. Laser-beam excitation of atomic transitions is a popular tool of atomic, molecular and optical physics used for fundamental measurements, involving sometimes cooled atomic beams. In the Gamma Factory project, we will adapt these technics also in order to deliver low emittance, low energy spread atomic beams for various applications.

The first critical milestone towards the realization of this long term and ambitious program is the realization of such a high intensity photon source at the CERN SPS. It will allow to demonstrate the long term potential of the project on an experimental ground and that the requested laser systems can be integrated in the harsh environment of hadronic machines under operation at CERN. One of the goals of the experiment is also to demonstrate that the atomic beams can also be efficiently cooled, as expected from simulations. The main tool to construct and operate for this Proof of Principle consist of a laser system resonantly enhanced in a Fabry-Perot cavity that is under the responsibility of the LAL group. The PhD candidate will participate in the design of the optical cavity and laser system, will commission and evaluate the performances of the optical system at LAL, prior its installation in the CERN SPS. Finally, the candidate will take a predominant part in the data taking and operation of the system in the CERN SPS. She/he will participate in the data analysis and optimization of the experiment. The candidate may also take an active part on the evaluation of the performance of the Gamma Factory scheme for its potential in the LHC, by quantitatively estimating the impact of one of its applications.

Further reading: http://cds.cern.ch/record/2690736/files/SPSC-I-253.pdf

Contacts:

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- Fabian ZOMER, zomer@lal.in2p3.fr

Development of the high intensity positron sources for the future colliders (Master internship)

Positron sources are critical components of the future linear or circular collider projects (ILC, CLIC. FCC). This is essentially due to the very high beam intensity required to achieve a high luminosity. In a conventional positron source, positrons are produced by high energy electrons hitting a target, where the low-momentum population is captured and accelerated in the positron capture section until the energy needed. In the conventional positron-generation scheme, a possible scheme to increase the positron intensity is to increase the incident electron intensity and energy. However, the allowable heat load as well as the thermo-mechanical stresses in the target severely limit the beam power of the incident electrons. Therefore, a two-stage process for producing the positrons can be employed in order to overcome the above mentioned constraints. The first stage is a generation of gamma rays. In the second stage the electron and gamma ray beams are separated and the latter is sent to the target, where the gamma rays are converted into e-/e+ pairs. In this framework, recent investigations led to a concept of hybrid schemebased on a relatively new kind of positron source using the intense photon production by high energy (some GeV) electrons channeled along a crystal axis (i.e. channeling radiation).
Several experiments at CERN and KEK, including a proof-of-principle experiment in Orsay, have been performed to study the performance of the hybrid positron source and at present this technology has been also exploited at the KEKB facility in Japan. Further investigations concerning the heat dissipation and thermo-mechanical stresses in the targets are mandatory to ensure a performant reliability of this source. Moreover, a new option of the target-converter can be also considered implying the use of a granular target made of small spheres. Such converter can provide better heat dissipation associated with the ratio surface/volume of the spheres and better resistance to thermal shocks. The complete optimization of the positron production requires not only the maximization of the total positron yield, but also an innovative study of thermal e effects in the targets, especially its dynamical behaviour limiting the performance of the positron source.

The candidate is expected to join the positron source group of Laboratoire de l'Accélérateur Linéaire LAL (Orsay, France). This group has a longstanding expertise in positron sources acquired through numerous studies and realizations that concerned fixed target experiments with positrons, positron sources for storage rings (ACO, DCI and SuperACO), and studies for e+e- circular (LEP, SuperB) and linear colliders (CLIC, ILC). This project will be performed in close collaboration with KEK (Tsukuba, Japan), where the world's highest intensity positron source currently in operation is of great importance giving the opportunity to work on the full simulation and optimization of the working positron source and gain the operational experience.

Contact: Iryna Chaikovska, chaikovs@lal.in2p3.fr

Sujet de Thèse : Compatibilité ultra vide de composants obtenus par impression 3D métallique pour accélérateurs de particules : pression dynamique, désorption stimulée, production de particules secondaires et étude des effets collectifs

Ces dernières années, la Fabrication Additive (FA) est devenue un procédé de fabrication incontournable qui révolutionne les processus de conception et de fabrication d'éléments mécaniques. Elle atteint actuellement une maturité qui lui permet d'être utilisée de manière rentable et fonctionnelle par les industriels. La FA est définie comme un procédé de mise en forme d'une pièce par ajout de matière, à l'opposé de la mise en forme traditionnelle par enlèvement de matière (usinage). La FA permet notamment de fabriquer des formes très complexes, irréalisables avec les procédés conventionnels. En fonction des pièces, la FA peut permettre une réduction importante des coûts et des délais de fabrication. Dans le domaine de la fabrication des grands accélérateurs de particules (par exemple le futur collisionneur FCC au CERN) la possibilité d'introduire des composants issus de la FA est activement étudiée.
Toutefois, avant d'introduire des éléments issus de fabrication additive métallique dans un accélérateur de particules, il est tout d'abord indispensable de vérifier s'ils sont compatibles avec l'ultra vide (10^{-7} à 10^{-10} mbar) qui règne dans les lignes de faisceaux. Par ailleurs, un certain nombre de phénomènes secondaires parasites en condition de service (désorption stimulée, production de particules secondaires conduisant à des effets collectifs indésirables) peuvent limiter les performances des accélérateurs. La FA produit notamment des pièces avec une forte rugosité. Dans le cadre de cette thèse, il s'agira notamment d'étudier l'impact de l'état de surface d'acier inox 316L obtenu par FA sur le comportement sous vide d'une part, et sur les propriétés (taux d'émission d'électrons secondaires, désorption stimulée électronique et ionique) lors d'interactions avec des particules (électrons et ions) d'autres part. On s'intéressera également à l'influence de la chimie de surface sur les processus de conditionnement par bombardement électronique.

Début thèse : Septembre 2020

Personnes à contacter :

- Gael Sattonnay (LAL), sattonnay@lal.in2p3.fr
- Bruno Mercier (LAL), mercier@lal.in2p3.fr
- Stéphane Jenzer (LAL), jenzer@lal.in2p3.fr

Participation to the commisionning of the THOMX accelerator

(Master/ Student internship)

The Linear Accelerator Laboratory (LAL) at Université Paris-Sud will start a new particle accelerator in 2019. This accelerator will be an X-ray source based on collisions between electrons and photos (Compton scattering). During the commissioning phase we will check that each sub-system of the accelerator is working as expected and how it impacts the particle beam. The work will involve interaction with the accelerator hardware so the candidate students must be interested in experimental physics. Most of the tests will use the remote control system and data acquisition system so the candidate must be ready to do some computer programming.

No knowledge of the French language is required but some basic words will be taught during the internship to work with non English-speaking staff.

Restrictions: Students with peacemakers will not be allowed to enter the accelerator enclosure due to the presence of strong magnetic fields.

Contact: Nicolas Delerue (LAL), delerue@lal.in2p3.fr

Sujet de Thèse : Étude et optimisation des systèmes bas niveau RF pour l'asservissement et le contrôle des cavités accélératrices supraconductrices

Dans la thématique de recherche sur les accélérateurs de particules, les cavités accélératrices et les systèmes d'asservissements en amplitude, phase et fréquence demandent une R&D poussée et constante de par les exigences de performances des accélérateurs toujours plus importantes. En effet, les cavités fonctionnent à très basses température (entre 4 et 2K) avec des champs électromagnétiques générés en leur sein de plusieurs MV/m. Elles sont donc soumises à des perturbations de type mécanique comme les vibrations dues au pompage sous vide, des variations de pression sur leurs parois dues à la régulation de la pression du bain d'Hélium (Microphonies) ou aux variation du champ électromagnétique (Force de Lorentz). A cela s'ajoute les perturbations liées au faisceau de particule (Beam loading). Tous ces aspects impactent le champ accélérateur en amplitude et phase ainsi que la fréquence de résonnance de la cavité nécessitant un système d'asservissement dit Low Level Radio Frequency system (LLRF). Bien que la conception des cavités tienne compte dans une certaine mesure de ces perturbations, il n'en est pas moins vrai que la majeure partie des solutions reposent sur le système d'asservissement. Dans le passé, il s'agissait de systèmes analogiques ou hybrides. Aujourd'hui, ils sont principalement numériques, programmables et connectés avec des fréquences de fonctionnement de plus en plus élevées, des composants plus compacts, rendant la conception plus complexe que par le passé. Les solutions pouvant être mises en œuvre sont nombreuses, fonction du type de cavité utilisée, de la fréquence de fonctionnement de l'accélérateur, de la dynamique de fonctionnement etc. Il est donc primordial d'être capable développer des outils de simulation qui permettent de déterminer les solutions à mettre en œuvre en tenant compte du matériel et du code utilisé. Cela passe par des outils de simulation logiciels tels que Matlab/simulink couplés avec les outils de programmation du composant programmable afin de tenir compte des limitations numériques, et le développement de simulateur matériel du comportement de la cavité permettant la validation du système LLRF développé. L'utilisation de l'ensemble pour des applications de type « deep learning » est aussi envisageable.

Un autre aspect concerne l'optimisation du code implémenté dans le FPGA en termes de fonctions nécessaires à notre application mais aussi en termes d'utilisation de fonctions propriétaires (IP cores), généralement liées à la marque et au modèle du composant les rendant difficilement portables et difficile à dimensionner. Une autre complexité réside dans la précision et plus particulièrement dans le format utilisé : entier, virgule fixe ou virgule flottante, impactant les ressources utilisées. La programmation dite haut niveau (HLS) de l'application « LLRF » constitue une solution à explorer.

Enfin, le frontal Radio Fréquence (électronique de conditionnement) est de plus en plus compact mais pas moins complexe. En cause, la dynamique, le niveau de bruit en amplitude et phase sans oublier la linéarité, imposées par la stabilité du champ accélérateur nécessaire allant de 0.5% et 0,5° pour des linacs comme SPIRAL2 à des valeurs de 0.01% et 0.01° pour des synchrotrons. La maitrise et l'optimisation de ce frontal RF implique l'utilisation des outils de conception 3D, thermique, électromagnétique à la fois pour la conception sur circuit imprimé mais aussi pour les simulations combinées citées plus haut.

Contexte :

L'Institut de Physique Nucléaire d'Orsay comprend environ 330 personnes. La Division Accélérateurs (DA) de cet Institut regroupe environ 80 techniciens et ingénieurs.
Sa mission est de contribuer aux grands projets relatifs aux accélérateurs du futur. Elle contribue en particulier à la conception d'accélérateurs linéaires supraconducteurs de forte puissance destinés aux programmes européens de la prochaine décennie dans les domaines de la physique nucléaire, la physique des particules, la physique appliquée et l'énergie (retraitement des déchets nucléaires).
Pour ces développements, l'Institut dispose d'une plateforme technologique (SupraTech) de classe internationale qui comporte les équipements lourds spécifiques (liquéfacteur d'hélium, salle blanche, halls cryogéniques expérimentaux…) nécessaires à la préparation et la conduite des expériences sur ces systèmes accélérateurs.

Contact : Christophe Joly : joly@ipno.in2p3.fr

Paul Scherrer Institut (PSI), Germany

The **Paul Scherrer Institute PSI** is the largest research institute for natural and engineering sciences within Switzerland. We perform cutting-edge research in the fields of matter and materials, energy and environment and human health. By performing fundamental and applied research, we work on sustainable solutions for major challenges facing society, science and economy. PSI is committed to the training of future generations. Therefore about one quarter of our staff are post-docs, post-graduates or apprentices. Altogether PSI employs 2100 people.

FPGA Development Group

Electronic Engineer

FPGA Developer

Your tasks

The FPGA Development group participates in design and development of measurement and control systems for particle accelerators. Your tasks will be:

- Working out concept for firmware and software implemented in system on chip (SoC) for various accelerator subsystems
- Development, verification, and commissioning of applications based on Xilinx FPGA
- Debugging, tests and characterization of digital hardware including A/D and D/A converters
- Close collaboration with software engineers, hardware providers and project leaders
- Support for running systems and other FPGA developers

Your profile

- University degree in electronics
- Experience in programming, simulation and implementation of FPGA projects using VHDL
- Extensive experience in using FPGA development tools such as Xilinx Vivado, ISE / EDK and ModelSim
- Good knowledge of digital signal processing and control theory
- Experience in programming with C / C++, Python and Matlab
- Good knowledge of German and English
- Knowledge of hardware standards and bus systems, such as MicroTCA, VME and CPCI-S
- Knowledge of FreeRTOS or other real-time operating systems would be an asset

We offer

Our institution is based on an interdisciplinary, innovative and dynamic collaboration. You will profit from a systematic training on the job, in addition to personal development possibilities and our pronounced vocational training culture. If you wish to optimally combine work and family life or other personal interests, we are able to support you with our modern employment conditions and the on-site infrastructure.

For further information please contact Dr Waldemar Koprek, phone +41 56 310 37 65.

Please submit your application online for the position as an Electronic Engineer (index no. 8221-00).

Paul Scherrer Institut, Human Resources Management, Melanie Rapisarda-Bellwald, 5232 Villigen PSI, Switzerland.
Apply online now (link is external)

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Radiation Transport and Multiphysics Group

Physicist or Nuclear Engineer

Your tasks

You will perform advanced Monte-Carlo particle transport simulations with MCNP 6 and/or MCNPX 2.7.0 needed for the operation of PSIs High Intensity Proton Accelerator Facility (HIPA), the spallation neutron sources SINQ and UCN at PSI as well as for current and future development and upgrade projects such as SwissFEL and SLS 2.0. Typical examples of these tasks include optimization of the performance of a target station within given constraints, designing shielding using variance reduction methods, calculation of dose rate maps of extended geometries that have to be composed from technical drawings or similar. Other tasks are requested by the Swiss authorities, e.g. for the disposal of radioactive waste, and reports have to be handed in. For these tasks, in-house developed state-of-the-art systems, programs, tools and patches for MCNP(X) source code already exist that you will tailor for the needs of our applications and migrate to higher versions of MCNP. At internal and international expert meetings you will present your results.

Apply online now(link is external)

Your profile

You are a nuclear engineer or Nuclear/Particle Physicist, with a PhD, well experienced in advanced radiation transport calculations using MCNP(X) and eligible for the MCNP(X) source code license, and having a good understanding of the nuclear physics behind. You have skills in coding of challenging calculational models with demanding geometries, profound knowledge of variance reduction techniques and programming. Fortran, C on parallel CPU's, Python and Perl are of advantage. Moreover you are able to work self-reliant and time efficient in small expert groups as well as in international and multidisciplinary teams towards solving given tasks. It is expected that you are a well-balanced person, communicative, innovative and open-minded for new ideas. You have a good command in written and spoken English; ideally you are also able to speek and write German.

We offer

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For further information please contact PD Dr Daniela Kiselev, phone +41 56 310 30 37.

Please submit your application online (including list of publications and addresses of referees) for the position as a Physicist or Nuclear Engineer (index no. 8142-00).

Paul Scherrer Institut Human Resources Management, Melanie Rapisarda-Bellwald, 5232 Villigen PSI, Switzerland

The **Paul Scherrer Institute PSI** is the largest research institute for natural and engineering sciences within Switzerland. We perform cutting-edge research in the fields of matter and materials, energy and environment and human health. By performing fundamental and applied research, we work on sustainable solutions for major challenges facing society, science and economy. PSI is committed to the training of future generations. Therefore about one quarter of our staff are post-docs, post-graduates or apprentices. Altogether PSI employs 2100 people.

Low Level Tools und Controls Core Group

Embedded Software Engineer

Control system and embedded development

Your tasks

Development, test and implementation of timing and event, BSDAQ and/or other control system software for the SLS 2.0 Project. This includes (but is not limited to) development and maintenance of device and EPICS drivers, EPICS DB, client software, interfaces, tools, GUIs and similar

Development and integration of timing and event system on all sub-platforms included in the PSI NPP (Next Processing Platform), for example on Compact PCI Serial, Zynq Ultrascale SOC/SOM and similar

Support for section and department for the development of event-synchronous transfer and storing of data from various sources (EPICS IOCs and other sources) for the SLS 2.0, based on DAQ (BSDAQ) system used in SwissFEL

Further development and maintenace of Linux, Windows, VxWorks and other kernel and EPICS drivers, tools, DBs and GUIs on all supported platforms and operating systems (Linux, Windows, VxWorks…)

Creation and maintenance of software and other documentation

Your profile

- Higher degree in informatics, electronics, electrotechnics, physics, mathematics or in a similar domain
- Excellent knowledge of C and C++, Device Driver and Kernel-level development, development for soft and hard real-time systems and development for resource-constrained systems
- Extensive experience with development for embedded platforms, various operating systems (Linux, VxWorks, Windows,…) and CPUs (Intel family, ARM Family, PowerPC family, etc.)
- Experience with development of drivers and tools that communicate directly with hardware
- Extensive experience with cross-platform development and build tools on Linux/Unix
- Fluent in English, knowledge of German is a plus
- Team player with excellent communication skills
- Knowledge of large research facilities and especially particle accelerators and related control systems, such as EPICS, is a plus
- Knowledge and experience in development for PREEMPT-RT based Linux kernels is a plus
- Knowledge of FPGA and FPGA/related develpoment (VHDL) is a plus
- Expert knowledge and experience in Linux Kernel and file system builds, creation and maintenance of Linux BSPs is a plus
- Expert knowledge and experience in low level Windows development (device drivers and similar low level software) is a plus
- Experience with development for other operating systems, such as VxWorks, FreeRTOS, etc. is a plus

We offer

Our institution is based on an interdisciplinary, innovative and dynamic collaboration. You will profit from a systematic training on the job, in addition to personal development possibilities and our pronounced vocational training culture. If you wish to optimally combine work and family life or other personal interests, we are able to support you with our modern employment conditions and the on-site infrastructure.

This is a fixed-term position. The employment contract will (initially) be limited to 3 years.

For further information please contact Dragutin Maier-Manojlovic, phone +41 56 310 40 23.

Please submit your application online for the position as an Embedded Software Ingenieur (index no. 8211-01).

Paul Scherrer Institut, Human Resources Management, Melanie Rapisarda-Bellwald, 5232 Villigen PSI, Switzerland

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