

Helmholtz Call for 2018 CSC Fellowship Applicants

Helmholtz Centre: Forschungszentrum Juelich GmbH – www.fz-juelich.de

Department/Institute: Peter Grünberg Institute, Semiconductor Nanoelectronics (PGI-9)
http://www.fz-juelich.de/pgi/pgi-9/EN/Home/home_node.html

Supervising scientist: Dr. Dan Buca

University for Registration (for those looking for a dissertation): RWTH Aachen

Research Field: Key Technology/ Group IV photonic devices

Position: PhD Student **or** Sandwich PhD Student

Research Area:

Group IV photonics aims at the realization of fully integrated electronic-photonic circuits (EPICs) on a chip. Integration is meant to reduce power consumption, size and cost in high performance optical systems. The photonic components have to be compatible with the Si manufacturing technology, on which the standard microelectronics industry is founded. The alloying of Ge with Sn leads to the formation of a direct bandgap semiconductor for Sn concentration in excess of ~9 at.%, as experimentally proven in our Institute. After that, different cavity configurations such as Fabry-Perot waveguides and resonant microdisk structures based on GeSn alloys featuring Sn concentrations between 8 at.% and 14 at.%, were studied, exhibiting laser emission between 2.0 μm and 2.6 μm . This wavelength range enables possible applications, such as sensing of molecules containing C-H or O-H bonds.

The objective of this project is to fabricate and characterize CMOS integrative light emitters, photodetectors and modulators based on GeSn and SiGeSn alloys. The heterostructures and device design, the high-k passivation and the metallic contacts have to be optimized. The design of the LEDs will be adapted for the fabrication on GeSn based lasers and benchmarked with III-V technology.

All these tasks require extensive process investigations, structural and electrical characterization of heterostructures and the production of test devices (diodes). A fully equipped clean room, various epitaxy and deposition tools as well as numerous analysis methods are available.

The work is done in collaboration with RWTH Aachen University and includes cooperation with University of Leeds, UK for band structure calculations and CEA-LETI, France on material side.

A successful PhD-thesis may be defended at the university RWTH Aachen.

Specific Requirements:

- Excellent knowledge of solid state physics and possibly device physics;
- The ability to work and communicate within a scientific team in fluent English.

Duration of stay: 2 years (Sandwich PhD); 4 years (PhD)

Work Place: Forschungszentrum Juelich, Germany (near Cologne and Aachen)

Earliest Start: September 2018

Language Requirement: Very good knowledge of English language, written and spoken. A German language course will be offered parallel to the project.

Name and Address of the Supervisor: Dr. Dan Buca, Forschungszentrum Juelich, Peter Grünberg Institute (PGI 9), 52425 Juelich, Germany
d.b.buca@fz-juelich.de

Helmholtz Call for 2018 CSC Fellowship Applicants

Helmholtz Centre: Forschungszentrum Jülich GmbH – www.fz-juelich.de

Department/Institute: Institute for Nuclear Physics, Experimental Hadron Structure (IKP-1),

Supervising scientist: Prof. Dr. James Ritman

University for Registration (for those looking for a dissertation): Ruhr-University Bochum

Research Field: Matter

Position: PhD Student ☒ **X** or Sandwich PhD Student ☐ **X**

Research Area:

The Institute for Nuclear Physics at the research centre Juelich participates in the PANDA experiment at the High Energy Storage Ring (HESR) which will be constructed at the GSI in Darmstadt in the upcoming years in the “Facility for Antiproton and Ion Research“ (FAIR). To fulfill the physics goals of PANDA experiment at HESR a luminosity monitor based on measuring elastic scattering in the Coulomb-strong interference region is presented. This system is based on tracking the antiprotons scattered near the beam axis with multiple layers of HV-MAPS detectors. It requires precise differential cross section of antiproton-proton elastic scattering in order to determine the integrated luminosity. On a limit by the lack of existing data in the relevant beam momentum region the KOALA experiment at HESR dedicated to antiproton-proton elastic scattering measurement has been proposed.

The KOALA group is searching for an appropriate candidate to strengthen its team. Depending upon the qualifications of the applicant, a Ph.D. position is available mainly to help performing the measurements of KOALA detectors at COSY and developing the code for detector simulation and data analysis. Verification test, e.g. like $pp \rightarrow pp$ elastic scattering measurement, and the data analysis would be a central part of the candidate's task. The Ph.D. student could either be formally enrolled at a German university, or do this work as a Sandwich Ph.D. student.

A successful PhD-thesis will be defended at Ruhr-University Bochum.

Specific Requirements:

The equivalent of a master degree in the field of nuclear or particle physics is required.
The working language in the institute is English. German courses are available.
The student should have significant experience in programming, preferably with C or C++.
Experience with the CERN software packages GEANT and/or ROOT is desirable.

Duration of stay: 24 months for Sandwich PhD
4 years for PhD

Work Place: Research Center Juelich, Germany (near Cologne)

Earliest Start: September 2018

Language Requirement: English is the working language. A German language course will be offered parallel to the project.

Name and Address of the Supervisor: Forschungszentrum Juelich GmbH, Prof. Dr. J. Ritman,
Institut für Kernphysik, IKP-1, 52428 Juelich, Germany
j.ritman@fz-juelich.de

Helmholtz Call for 2018 CSC Fellowship Applicants

Helmholtz Centre: Forschungszentrum Jülich – www.fz-juelich.de

Department/Institute: Nuclear Physics Institute, Experimental Hadron Structure (IKP-1)
<http://www.fz-juelich.de/ikp/EN/Home/ExperimentelleHadronenstruktur.html>

Supervising scientist: Susan Schadmand, PhD habil., Dr. Daniel Lersch, Prof. Dr. James Ritman

University for Registration (for those looking for a dissertation): Ruhr-University Bochum and University of Wuppertal

Research Field: Hadron Physics

Position: PhD Student or Sandwich PhD Student

Research Area:

We study decays of light mesons with a focus on the intrinsic structure and decay dynamics of hadrons.

The intrinsic structure is investigated by transition form factors. They are measured via decays with dileptons in the final state. If measured with sufficient precision, the form factors will have significant impact on current issues of physics beyond the standard model. They are observed via decays with dileptons in the final state.

The dynamics of the decays is studied via radiative and hadronic decays of eta and eta' mesons and addresses the influence of the box anomaly and the light quark mass ratios. The utilized method is a Dalitz plot analysis.

We analyze data from two experiments, the WASA detector that was operated at COSY-Jülich and the CLAS detector at Jefferson Laboratory (USA) with has recently been upgraded and is presently in the commissioning phase. In addition, existing CLAS data sets are available for the data analysis.

We have positions available for the data analysis of light meson decays using existing or upcoming data.

Specific Requirements:

master's degree in a related subject
programming in C++ and/or java
familiarity with GEANT simulations and event generation is useful
team work
work in an international collaboration

Duration of stay: 24 months for sandwich PhD; 4 years for PhD

Work Place: Forschungszentrum Jülich, Germany (near Cologne)

Earliest Start: September 2018

Language Requirement: Very good knowledge of English language, written and spoken. A German language course will be offered parallel to the project.

Name and Address of the Supervisor: Dr. Susan Schadmand, Forschungszentrum Jülich, Nuclear Physics Institute (IKP-1), 52425 Jülich, Germany;
s.schadmand@fz-juelich.de

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<http://www.fz-juelich.de/ikp/EN/Home/ExperimentelleHadronenstruktur.html>

Supervising scientist: PhD habil. Susan Schadmand, Prof. Dr. J. Ritman

University for Registration (for those looking for a dissertation): Ruhr-University Bochum

Research Field: Hadron Physics

Position: PhD Student or Sandwich PhD Student

Research Area:

The Wide Angle Shower Apparatus WASA was operated at the COSY proton and deuteron accelerator in Jülich. The physics goals in the field of hadron physics contribute to answering fundamental questions concerning the strong interaction. The approach is the study of symmetries and their violation, spectroscopy, form factors, and hadron-hadron interactions.

The experimental campaign at COSY in Jülich has recently been concluded. The central part of the detector system, containing charged-particle tracking devices, a superconducting solenoidal magnet, and an electromagnetic calorimeter consisting of 1012 sodium-doped CsI scintillating crystals, is being moved to GSI Darmstadt. It will be complementing the Fragment Separator (FRS) in upcoming experiments on hadron physics.

The experimental approach requires the usage, maintenance, and improvement of the experiment from detector components, via trigger and readout electronics, to the data analysis and simulation calculations, and finally the physics interpretation of the results. The combined setup is operated by an international collaboration which offers the experience of team work and participation in the experiment beam times at GSI. Doctoral thesis topics are available which will deal with the interpretation of the data with an analysis based on C++ and ROOT software.

Specific Requirements:

master's degree in a related subject
programming in C++ , GEANT simulations and event generation
basic knowledge of detectors, readout and data acquisition, event processing is useful
team work and work in an international collaboration

Duration of stay: 24 months for sandwich PhD; 4 years for PhD

Work Place: Forschungszentrum Jülich, Germany (near Cologne)

Earliest Start: September 2018

Language Requirement: Very good knowledge of English language, written and spoken. A German language course will be offered parallel to the project.

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s.schadmand@fz-juelich.de

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Supervising scientist: Prof. Dr. Qing-Tai Zhao

University for Registration (for those looking for a dissertation): RWTH Aachen

Research Field: Key Technology/ Nanoelectronics

Position: PhD Student or Sandwich PhD Student

Research Area:

Power consumption is the grand challenge in semiconductor industry. For MOSFETs the reduction of the supply voltage V_{dd} is hindered by the physical thermal limit of the subthreshold swing $SS = m \times 60\text{mV/dec} \geq 60\text{mV/dec}$ at 300K. On the base of thermal emission, the dominating transport mechanism of a MOSFET, $SS < 60\text{mV/dec}$ at 300K can only be achieved when the body factor $m < 1$. This can be done by integration of a ferroelectric capacitor to the device, forming a negative capacitance FET (NCFET).

In this project we will investigate NCFET with HfO_2 based ferroelectric materials. The ferroelectric layers will be deposited by ALD. NCFETs with planar and nanowire geometries will be studied to achieve $SS < 60\text{mV/dec}$ at room temperature.

All these tasks require extensive process investigations, structural and electrical characterization of nanowires and the production of test structures and transistors. A fully equipped clean room with process technologies down to $< 10\text{nm}$, various epitaxy and deposition tools as well as numerous analysis methods are available at the Research Centre Juelich.

A successful PhD-thesis may be defended at the university RWTH Aachen.

Specific Requirements:

- Excellent knowledge of solid state physics and possibly device physics;
- The ability to work and communicate within a scientific team in fluent English.

Duration of stay: 2 years (Sandwich PhD); 4 years (PhD)

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Name and Address of the Supervisor: Dr. Qing-Tai Zhao, Forschungszentrum Juelich, Peter Grünberg Institute (PGI 9), 52425 Juelich, Germany
q.zhao@fz-juelich.de