Helmholtz Graduate School for Energy- und Climate Research
[Helmholtz Interdisciplinary Doctoral Training in Energy and Climate Research]

announces 7 HITEC Doctoral Fellowships
27 November 2012

Call for applications

HITEC (Helmholtz Interdisciplinary Doctoral Training in Energy and Climate) is the graduate school for scientists and engineers who want to earn a Ph.D. in the challenging fields of energy and climate research. HITEC is a joint initiative between Forschungszentrum Jülich (www.fz-juelich.de/portal/EN/AboutUs/Institutes_Facilities/Institutes/InstituteEnergyClimate/_node.html), the RWTH Aachen University, the Ruhr-University Bochum, the University of Cologne, the Heinrich Heine University Düsseldorf, and the University of Wuppertal. As a rule the Ph.D. certificate is awarded by one of the member universities. HITEC is committed to scientific excellence, to an interdisciplinary and international research environment, to an accepting learning environment which embraces diversity, and aims to turn the Ph.D. students into well needed experts for academia and industry.

Its faculty members, scientists and engineers, are leading experts in their fields. HITEC offers a 3-year training programme which accompanies the doctoral thesis: students can select from a variety of HITEC events, including lectures on topics or methods, hands-on training courses in the lab or professional skills training, such as scientific writing or presenting.

HITEC launches a call for applications for 7 doctoral fellowships (HITEC Ph.D. Fellowships). 12 projects, indicated below, are open for application. We are seeking highly qualified and motivated scientists and engineers for doctoral studies in the fields of materials science, atmospheric physics, chemistry, chemistry for nuclear safety research, crystallography, modelling, numerical simulations. The integration in international co-operations requires the ability to cooperate in an international team, thus we expect good skills in the spoken and written English language. HITEC particularly welcomes applications from women. We also welcome applications from disabled persons.

The best 12 applicants (one candidate per project) will be invited to Germany for a week (20-27 April 2013), to join the respective research group in Jülich or at the university. You will receive an email notification about the admission and invitation in the mid of February. The task during this one week is to jointly work on the project idea with faculty members and supervisors and to turn it into an outstanding and convincing HITEC (Ph.D.) Project. On the last day of their stay the candidates present their projects and the outline of their dissertations to the members of the HITEC Advisory Board. Of the 12 pairs (projects / candidates) the seven best pairs (HITEC Projects / HITEC Fellows) will be selected.

▶ You choose one project for application and substantiate your reasons in a personal statement. If in agreement with the specific requirements of the projects you can choose more than one project, but you have to refer to them in each case. For details of the application you need to check the Guidelines for Applicants (page 8 ff)

▶ For application specific questions please contact HITEC Office:
Dr. Bärbel Köster, Managing Director; b.koester@fz-juelich.de

▶ Please package all documents (see Guidelines for Applicants, p. 8 ff) into 1 pdf-file and submit your application electronically until 11 January 2013 to: b.koester@fz-juelich.de
HITEC Projects

HITEC Project # 1: Multi-scale modelling of PS-PVD manufactured gas separation membranes

High efficient oxygen transport membranes for use in power plants and chemical reactors require both a high permeance and a high selectivity of the functional top layer. With a new deposition technique that combines traditional vapour deposition and plasma spraying methods, Plasma spray physical vapour deposition (PS-PVD), thin and yet almost defect-free layers could be applied on porous metal supports which is very difficult to achieve with other methods. A multi-scale simulation shall help to understand the deposition process and to further optimize the layer system. This includes: (1) a molecular dynamics model which especially regards the gas flow occurring during the process to calculate the orientation of the deposited columnar structures and local material density variations (voids) as a function of process parameters, deposition angle, and geometric surface configuration, (2) a finite element or a statistical analysis in order to extend the results to macroscopic surface areas simulating the overall microstructure and the quality of the layer on various substrate topographies and microstructures. Existing and new experimental data shall be compared with the computational results. In order to ensure the technical relevance, boundary conditions such as the permeance of the support shall be included. The analysis can be extended to graded layer systems which are typically used in membrane layer systems.

<table>
<thead>
<tr>
<th>Location of the HITEC Fellow:</th>
<th>Forschungszentrum Jülich, Institute of Energy and Climate Research, Microstructure and Properties (IEK-1; Director (acting) Dr. Hans-Peter Buchkremer; Doctoral advisor Prof. Dr. Robert Vaßen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners of the HITEC Project:</td>
<td>Ruhruniversität Bochum (RUB), Interdisciplinary Centre for Advanced Materials Simulation (ICAMS), Prof. Dr. Alexander Hartmeier</td>
</tr>
<tr>
<td>Specific requirements</td>
<td>Master in Materials Science, Physics, Chemistry, or Mechanical Engineering; Interest in application-oriented theory/numerics</td>
</tr>
<tr>
<td>For project specific questions please contact</td>
<td>Dr. Robert Mücke, FZ Jülich, IEK-1, <a href="mailto:r.muecke@fz-juelich.de">r.muecke@fz-juelich.de</a></td>
</tr>
</tbody>
</table>

HITEC Project # 2: Investigation of the early stages of precipitation and ageing mechanisms of Laves Phase strengthened ferritic steels by high resolution transmission electron microscopy

Together with ThyssenKruppVDM, FZ Jülich, IEK-2, developed heat resisting ferritic steels that provide potential for increasing mechanical strength of high chromium ferritic steels up to temperatures of 850°C by fine intermetallic Laves phase particles. However just roughly investigated up to now, detailed knowledge of the early-stages of nucleation and growth of the Laves phase is essential for further alloy and thermomechanical pre-treatment optimization. Especially there is a lack of understanding of the interaction of compositional issues (nucleation agents, impurities) and varying dislocation density (caused by differing thermomechanical pre-treatment) on microstructure formation and hence high temperature mechanical performance. Therefore, in-depth analytical transmission electron microscopy (TEM) of trial and commercial melts of the 22 wt.-% chromium steel grade Crofer 22 H in solution annealed and pre-deformed (and subsequently precipitation annealed) state will be carried out to especially address precipitate-dislocation interactions during nucleation, growth and deformation at high temperature. Geometry, spatial distribution and chemical composition of the nanoscaled precipitates will be analyzed by sophisticated methods like focused ion beam tomography and transmission electron microscopy. The project combines high-end materials research and development of high resolution TEM methodology. The work will be performed in the framework of an established collaboration between FZ Jülich, Germany and AGH Technical University, Poland and profits from the broad international network of IEK-2 (e.g. National Institute of Materials Science (J), Oak Ridge National Labs (USA), European Creep Collaborative Committee) in the development of advanced ferrites.

| Location of the HITEC Fellow: | Forschungszentrum Jülich, Institute of Energy and Climate Research, Microstructure and Properties (IEK-2; Director Prof. Dr.-Ing. Lorenz Singheiser) |
**Partners of the HITEC Project:**

<table>
<thead>
<tr>
<th>University</th>
<th>Contact</th>
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<tbody>
<tr>
<td>AGH Technical University Krakow, Poland (Prof. A. Czyrska-Filemonowicz)</td>
<td>Prof. Dr.-Ing. Tilmann Beck, FZ Jülich, IEK-2. <a href="mailto:t.beck@fz-juelich.de">t.beck@fz-juelich.de</a> Dr.-Ing. Bernd Kuhn, FZ Jülich, IEK-2, <a href="mailto:b.kuhn@fz-juelich.de">b.kuhn@fz-juelich.de</a></td>
</tr>
</tbody>
</table>

**Specific requirements**

- Master in Materials Science and Engineering; Experience in high temperature alloys and electron microscopy

**For project specific questions please contact**

- Prof. Dr.-Ing. Tilmann Beck, FZ Jülich, IEK-2, t.beck@fz-juelich.de
- Dr.-Ing. Bernd Kuhn, FZ Jülich, IEK-2, b.kuhn@fz-juelich.de

**HITEC Project # 3: Immobilisation of long-lived radionuclides by means of structural incorporation in monazite-type phosphates**

The disposal of high level radioactive waste is one of the most pressing and demanding challenges of the 21st century. With respect to long-term safety aspects of geological disposal actinide elements are of particular concern due to their long half-lives and high radiotoxicity. Ceramic waste forms for the immobilisation of actinides have been investigated extensively in the last decades since they seem to exhibit certain advantages over other waste forms (incl. borosilicate glasses and spent fuel). This HITEC-Fellowship will focus on the long-term behaviour of single phase phosphates with monazite structure (LnPO₄, Ln=La-Gd) under conditions relevant to nuclear disposal. Monazite ceramics exhibit remarkable properties, such as high capacity, high chemical durability and high resistance to irradiation damages making them a promising material for the conditioning of Minor Actinides, such as Americium and Curium. The properties of these materials are described in the literature mainly phenomenologically. Conversely, fundamental understanding allowing reliable assessment of the long-term behaviour is sparsely.

The research program planned within this fellowship includes:
1. synthesis (powder and single crystals) and pelletisation of LnPO₄ (Ln = La – Gd) solid solutions containing surrogates for actinides e.g. Eu as well as actinides such as Th, Pu or Am,
2. structural and microstructural characterisation (XRD, Raman, TRLFS, SEM and FIB/TEM),
3. dissolution experiments under conditions relevant for nuclear disposal,
4. radiation damages.

**Location of the HITEC Fellow:**

Forschungszentrum Jülich, Institute of Energy and Climate Research, Nuclear Waste Management and Reactor Safety (IEK-6; Director Prof. Dr. Dirk Bosbach)

**Partners of the HITEC Project:**

- RWTH Aachen University, Institute for Crystallography; Prof. G. Roth
- Karlsruhe Institute of Technology, Institute for Nuclear Waste Disposal, PD Dr. T. Stumpf, Institut de Chimie Séparative de Marcoule (ICSM), Marcoule-Site, France, Prof. Dr. N. Dacheux, Dr. N. Clavier; Nuclear Research and Consultancy Group (NRG), Petten, NL, Dr. F. Klaassen
- Subatech, Nantes, France; Prof. Dr. B. Grambow

**Specific requirements**

- Master in Chemistry; Handling of radioactive materials

**For project specific questions please contact**

- Dr. Stefan Neumeier, FZ Jülich, IEK-6, s.neumeier@fz-juelich.de

**HITEC Project # 4: Cirrus cloud formation, evolution and geographical distribution: linking large-scale observations and 3D modelling**

The advanced high precision Jülich ice water package, consisting of the established high-precision hygrometer FISH, the newly developed open/closed path hygrometer HAI and the novel cloud and aerosol particle spectrometer NIXE-CAPS, is developed for the new German research aircraft HALO (High Altitude and LOng Range Research Aircraft) to investigate cirrus formation and evolution processes in close detail. In accompany, a cirrus process model is currently implemented in the established IEK-7 global model CLaMS (CLaMS-Ice) to be able to simulate cirrus clouds based on the measurements. In the study proposed here, cirrus clouds measurements from the recent HALO aircraft campaign TACTS as well as the forthcoming campaigns CIRRUS-ML and ACRIDICON should be reproduced by CLaMS-Ice. The aim of the study is to improve the understanding of cirrus cloud formation, development and spatial distribution using the new approach of closely linking aircraft observations and 3D modelling. By using the observations from HALO, all types of cirrus clouds can be studied for a larger spatial distribution than possible from earlier field campaigns due to the long range of HALO (about 12000 km). In combination with the model simulations for the first time a representative large-scale picture of cirrus
clouds will be provided which can be used to verify the cirrus representation in global models.

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<tr>
<th>Location of the HITEC Fellow:</th>
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<tr>
<td><strong>Partners of the HITEC Project:</strong></td>
<td>University of Wuppertal, Institute for Atmospheric Physics, Prof. Dr. Ralf Koppmann</td>
</tr>
<tr>
<td><strong>Specific requirements</strong></td>
<td>Master in Meteorology or Physics, experience in cloud physics</td>
</tr>
<tr>
<td><strong>For project specific questions please contact</strong></td>
<td>Dr. Martina Krämer, FZ Jülich, IEK-7, m.krä<a href="mailto:mer@fz-juelich.de">mer@fz-juelich.de</a></td>
</tr>
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</table>

**HITEC Project # 5: Impacts of possible future N₂O increase (e.g. from biofuels) on the stratosphere**

Global atmospheric nitrous oxide (N₂O) concentrations have increased markedly as a result of human activities since 1750. N₂O is an important greenhouse gas due to its long atmospheric lifetime and radiative forcing and is projected to be the dominant ozone-depleting gas in the 21st century.

In this project, possible consequences of enhanced N₂O emissions including the potential use of biofuels on the stratosphere, in particular on the ozone layer, and on future climate will be investigated. The Lagrangian three-dimensional Chemistry Transport Model CLaMS developed in Jülich will be used in combination with stratospheric in situ measurements of N₂O and a suite of long-lived tracers obtained by the HAGAR (High Altitude Gas Analyzer) instrument operated by the University of Wuppertal. The synergistic use of high quality HAGAR measurements and CLaMS simulations constitutes a unique tool to evaluate and constrain the simulated stratospheric N₂O sink as well as stratospheric transport for past and future N₂O emission scenarios. This study helps to evaluate if the future utilization of biofuels is a reasonable and safe alternative to fossil fuels.

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<td><strong>Partners of the HITEC Project:</strong></td>
<td>University of Wuppertal, Atmospheric Physics, Prof. Dr. C. Michael Volk</td>
</tr>
<tr>
<td><strong>Specific requirements</strong></td>
<td>Master (or equivalent) in Atmospheric Science, Meteorology, Geophysics, or Physics; Experience in data analysis and programming (e.g. IDL, FORTRAN)</td>
</tr>
<tr>
<td><strong>For project specific questions please contact</strong></td>
<td>Dr. Bärbel Vogel, Forschungszentrum Jülich, IEK-7, <a href="mailto:b.vogel@fz-juelich.de">b.vogel@fz-juelich.de</a>; Prof. Dr. C Michael Volk, University of Wuppertal, <a href="mailto:M.Volk@uni-wuppertal.de">M.Volk@uni-wuppertal.de</a></td>
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**HITEC Project # 6: Stochastic Modelling for Uncertainty Quantification in Climate Simulations and Solar Energy Capture**

The simulation of uncertainties of atmospheric models is a newly emerging issue in environmental sciences. The mathematical modelling of climate and air quality and related quantities like solar energy potentials is based on reaction-diffusion-advection equations, which represent partial differential equations for atmospheric effects. Significant uncertainties appear in several parameters of the models, since the exact values are unknown due to measurement errors or estimations. Specifically, emission rates and other model parameters are not sufficiently well known, and engender uncertainties of the model result.

The aim of the project is to quantify the uncertainties by the introduction of random variables. Consequently, a stochastic model is to be simulated to obtain estimates of the output together with error bars by confidence intervals. A key approach is related ensemble modelling. These results can be also applied to data assimilation purposes.

This interdisciplinary project will combine areas of applied mathematics (numerics) with meteorology, atmospheric physics and chemistry. The successful candidate, who is expected to have numerical experiences in one of these fields, will extend the deterministic chemistry-transport model EURAD-IM to a stochastic ensemble approach and demonstrate the ability to forecast its predictive skills by this approach.
**Location of the HITEC Fellow:**
University of Wuppertal, Prof. Roland Pulch and/or Forschungszentrum Jülich, Institute of Energy and Climate Research, Troposphere (IEK-8, Director Prof. Dr. Andreas Wahner); Rhenish Institute of Environmental Research at the University of Cologne (RIU, Director Prof. Dr. Andreas Wahner)

**Partners of the HITEC Project:**
University of Wuppertal and/or Forschungszentrum Jülich

**Specific requirements**
Master in Mathematics, Physics, Meteorology, Chemistry, or Geophysics. Experience in numerical treatment of partial differential equations.

**For project specific questions please contact**
PD Dr. Hendrik Elbern, Forschungszentrum Jülich, Germany, h.elbern@fz-juelich.de; Prof. Dr. Roland Pulch, University of Wuppertal, Germany, pulch@math.uni-wuppertal.de

**HITEC Project # 7: Climate effects of tropopause region aerosol: Process-oriented studies using combined in-situ observations and the chemistry-climate model ECHAM-HAMMOZ**

The largest uncertainties in our current knowledge on climate change are associated with the complex feedback mechanisms of aerosols in the climate system. In particular the understanding of the climate impact of natural and anthropogenic aerosols in the upper troposphere and lower stratosphere (UTLS) is still poor although the greenhouse effect is largely generated in this layer of the atmosphere. This project aims at quantification of the UTLS aerosol sources, sinks and transformation processes, their impact on the global radiation budget (direct climate effect), and their interaction with cloud formation and cloud properties (indirect climate effect) based on data from recent aircraft measurements and on results from a chemistry-climate model. The successful applicant will analyze the available data sets from routine in-service aircraft measurements (IAGOS infrastructure including CARIBIC; see www.iagos.org and www.caribic-atmospheric.com for more information) and field campaigns in collaboration with the partners at DLR Institute of Atmospheric Physics and Leibniz Institute for Tropospheric Research, and develop suitable statistical methods to employ these data for the evaluation of coupled chemistry-climate models. The global chemistry-climate model ECHAM-HAMMOZ contains a detailed description of aerosol composition in four soluble and three insoluble size classes (modes) with a comprehensive parameterization of aerosol microphysics and aerosol-cloud interactions. The correlation of aerosol observations with numerical model results shall be used to identify potential model errors (e.g. too rapid or too slow scavenging of UTLS aerosol) and shortcomings of the measurement data, and to improve the model parameterizations accordingly. Particular emphasis shall be given to the analysis of interactions between transport processes and aerosol microphysics.

The proposed work addresses a highly relevant research topic and offers the potential for making substantial contributions to better understanding the role of the UTLS aerosol in the global climate system.

**Location of the HITEC Fellow:**
Forschungszentrum Jülich, Institute of Energy and Climate Research, Troposphere (IEK-8; Director Prof. Dr. Andreas Wahner)

**Partners of the HITEC Project:**
DLR Institute of Atmospheric Physics, Oberpfaffenhofen, Dr. Andreas Minikin; Leibniz Institute for Tropospheric Research, Leipzig, Dr. Markus Hermann; University of Bonn, Dept. of Meteorology, Prof. Dr. Andreas Bott

**Specific requirements**
Master in Physics, Meteorology, or Physical Chemistry; Programming experience (Unix, FORTRAN, Python)

**For project specific questions please contact**
PD Dr. Martin G. Schultz, FZ Jülich, IEK-8, m.schultz@fz-juelich.de or PD Dr. Andreas Petzold, FZ Jülich, IEK-8, a.petzold@fz-juelich.de

**HITEC Project # 8: Oxidation studies on model alloys with Ambient Pressure (AP) XPS**

In the development of new energy concepts metallic construction materials which will be used in e.g. power plants, high temperature batteries or fuel cells need to exhibit high corrosion resistance in the service environments. The materials are subjected to harsh environmental conditions including temperatures in the range of 600°C to 1000°C and atmospheres containing mixtures of e.g. O₂, N₂, H₂O and/or CO₂.
Although numerous technologically oriented investigations are available, only very little knowledge on the influence of additional gas constituents on the oxidation mechanism, and therefore on materials degradation is available, especially during the first minutes of the oxidation process in respect to the nucleation of e.g. oxide, nitrides or carbide which will strongly influence the long term corrosion process. In the frame of this project, a number of mono-crystalline model alloys will be investigated under different environments (T=600-1000°C, gas mixtures of e.g. O₂, N₂, H₂O, CO₂) with AP-XPS. Basic knowledge gained in this approach will be used to develop new and improved alloy concepts. The Ph.D. student will use the AP-XPS and will cooperate with the scientists presently involved in the project “Oxidation mechanism of metallic carrier materials for gas separation membranes in power generation systems with carbon dioxide capture” which is supervised by Prof. J. Mayer and Prof. W.J. Quadakkers.

**Location** of the HITEC Fellow:
Forschungszentrum Jülich, Central division of Analytical Chemistry, (ZCH, Director Dr. Stefan Küppers)

**Partners** of the HITEC Project:
Forschungszentrum Jülich, Institute of Energy and Climate Research, (IEK-2; Director Prof.Dr.-Ing. Lorenz Singheiser); High Temperature Corrosion and Corrosion Protection; Prof. W. J. Quadakkers RWTH Aachen Central facility for electron microscopy and Forschungszentrum Jülich Ernst Ruska-Center for Microscopy and spectroscopy with electrons; Prof. Dr. Joachim Mayer

**Specific requirements**
Master in Materials Science and Engineering or Physics; experience in high temperature alloys or photoelectron spectroscopy desirable

**For project specific questions please contact**
Dr. Astrid Besmehn; FZ Jülich, ZCH a.besmehn@fz-juelich.de; Prof. Dr.-Ing. Willem J. Quadakkers; w.quadakkers@fz-juelich.de

**HITEC Project # 9:** Atmospheric profiling of clouds, temperature and humidity using a ground-based infrared spectrometer

Recently, the Atmospheric Emittance Radiance Interferometer (AERI) has been added to the Jülich Observatory for Cloud Evolution (JOYCE; http://www.geomet.uni-koeln.de/en/general/research/joyce). It continuously measures atmospheric emission (3.3 to 19 μm or 3020 to 520 1/cm) at 1/cm resolution. Simulation studies (Löhnert et al. 2009; Turner et al. 2007) have been performed to study the information of measurements for temperature and humidity profiling and to show the potential of AERI measurements to retrieve ice and liquid cloud microphysical properties.

The aim of the Ph.D.-thesis is to expand the theoretical work to real measurements and continuous application. Specific focus shall be on the synergetic use of the JOYCE microwave radiometer and cloud radar measurements, i.e. using these measurements to constrain the retrieval. The work will include the performance of radiative transfer simulation, the development of retrieval algorithms and the respective application to measurements. Using the suite of observations available at JOYCE and radiosoundings the retrieval performance shall be validated.

**Location** of the HITEC Fellow:
University of Cologne, Institute of Geophysics and Meteorology (Director Prof. Dr. Susanne Crewell)

**Partners** of the HITEC Project:
Forschungszentrum Jülich, Institute of Energy and Climate Research, Stratosphere (IEK-7, Prof. Dr. Martin Riese) and Troposphere (IEK-8, Prof. Dr. Andreas Wahner); NOAA, Severe Storms Laboratory, Norman, USA, David D. Turner, Ph.D.

**Specific requirements**
Master in Atmospheric Physics, Geophysics, Physics or Mathematics; Experience in remote sensing and retrieval development is beneficial

**For project specific questions please contact**
Dr. Ulrich Löhnert, University of Cologne, Institute of Geophysics and Meteorology, loehnert@meteo.uni-koeln.de

**HITEC Project # 10:** Synthesis and Characterisation of single-crystalline Lanthanides-Zirconate and Hafnate pyrochlores for immobilisation of Actinides

Together with FZ Jülich, IEK6, we work on several ceramic systems with the aim to explore possibilities to use these materials for the immobilization of actinides (“conditioning”). Due to their higher thermodynamic stability in comparison with glasses, crystalline ceramics could be an alternative with respect to radioactive waste treatment and repositories.

**Location** of the HITEC Fellow:
University of Cologne, Institute of Geophysics and Meteorology (Director Prof. Dr. Susanne Crewell)

**Partners** of the HITEC Project:
Forschungszentrum Jülich, Institute of Energy and Climate Research, Stratosphere (IEK-7, Prof. Dr. Martin Riese) and Troposphere (IEK-8, Prof. Dr. Andreas Wahner); NOAA, Severe Storms Laboratory, Norman, USA, David D. Turner, Ph.D.

**Specific requirements**
Master in Atmospheric Physics, Geophysics, Physics or Mathematics; Experience in remote sensing and retrieval development is beneficial

**For project specific questions please contact**
Dr. Ulrich Löhnert, University of Cologne, Institute of Geophysics and Meteorology, loehnert@meteo.uni-koeln.de
For precise structural characterization, single crystals of these materials are needed. In the current project, big single crystals of Ln-zirconates and hafnates will be obtained and characterized. Ln will be used as surrogates for tri- and tetravalent actinide-ions. It is envisaged to use neutrons to induce radiation damage (amorphisation) in the materials and study the temperature dependent kinetics of the re-crystallisation process in-situ using diffraction methods.

**Location** of the HITEC Fellow: RWTH Aachen University, Institute for Crystallography, Prof. Dr. Georg Roth

**Partners** of the HITEC Project: Forschungszentrum Jülich, Institute of Energy and Climate Research, Nuclear Waste Management and Reactor Safety (IEK 6, Director Prof. Dr. Dirk Bosbach)

**Specific requirements** Master in Materials Science or Applied Geoscience, with a strong background in crystallography

For project specific questions please contact Dr. Lars Peters, Institute for Crystallography, RWTH Aachen University, peters@xtal.rwth-aachen.de

**HITEC Project # 11: Development and application of a Smoothed Particle Hydrodynamics / Discrete Element Method framework to model complex fluid and particulate flows**

Many process steps in energy technology required for the processing of particulate solids as well as several flow phenomena in environmental sciences which are increasingly attributed to climate change like e.g. sediment transport simultaneously involve complex three-dimensional fluid and particulate flows. These flows are characterized by complex shaped sometimes even moving boundary surfaces and a distinct free-surface behavior. Computational modeling of these flow phenomena can help understand the fundamental processes involved, predict their technical and environmental effects and help improve design and energy efficiency of related machinery. Particle oriented methods such as smoothed particle hydrodynamics (SPH) in combination with discrete element methods (DEM) offer the opportunity to be inherently capable of representing the complex free-surface behavior in these systems. The concurrent use of particle based methods such as SPH and DEM is still limited in energy technology as well as environmental sciences. Underlying flow phenomena are alike and thereby open up the opportunity to apply aligned modeling frameworks. Particle based methods allow to improve energy efficiency of processes involving particulate solids as well as to better understand and study particulate/fluid flows in environmental sciences.

The HITEC Fellow will be located at the Institute of Energy Technology in Bochum, which has broad experience in particle based DEM modeling and its coupling to mesh based simulation approaches applicable to fluid flow. Partner of the HITEC Project is the chair of hydraulic engineering in Wuppertal which has experience in investigating and modeling of liquid flows forming free surfaces and simulation of flow problems by SPH. Aim of the outlined HITEC Project is the development and validation of a DEM/SPH simulation framework which is suitable both for problems in energy technology as well as environmental science. Possible applications for the novel simulation framework are washing and separation processes in energy technology and environmental phenomena like flash floods and sediment transport.

**Location** of the HITEC Fellow: Ruhr-University Bochum, Institute of Energy Technology, Department of Mechanical Engineering, Energy Plant Technology (Leat, Director Prof. Dr.-Ing. V. Scherer)

**Partners** of the HITEC Project: University of Wuppertal, Department of Civil Engineering, Hydraulic Engineering Section, Prof. Dr.-Ing. Andreas Schlenkhoff

**Specific requirements** Master in Civil, Chemical or Mechanical Engineering; Experiences in Mechanics, CFD and particle based methods (DEM, SPH) are of advantage

For project specific questions please contact Dr.-Ing. Harald Kruggel-Emden, Ruhr-University Bochum; kruggel-emden@leat.rub.de

**HITEC Project # 12: Development of a Small Satellite for Climate research (DiSSECT)**

In the last years, miniaturization of scientific payloads usher a new era from large scale, multi-instrumented satellite missions towards small and cost-effective satellites. The smallest units (CubeSats) have a volume of one liter and are highly standardized. CubeSats are involved in several educational
programs by Space Agencies and Universities world-wide. Monolithic Spatial Heterodyne Spectrometers (SHS) for the visible wavelength region fit to the resources provided by CubeSats. Combined with detector arrays, they allow for the observation of atmospheric emission spectra (to derive temperature data) and dynamical wave structures at the same time. Temperatures and waves in the middle atmosphere are highly relevant in the context of global change and climate modeling. Recently, coupling processes initiated by waves attach increasing importance for the climate system and stress the importance of middle atmosphere observations. This PhD thesis will deal with the specification and prototype-analysis of a SHS instrument for the observation of temperatures in the middle atmosphere and waves as derived from $\text{O}_2$ A-band emissions. A model will be developed to simulate SHS measurements and to analyze existing measurements.

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<tr>
<th>Location of the HITEC Fellow:</th>
<th>University of Wuppertal, Atmospheric Physics, Prof. Dr. Ralf Koppmann, and Forschungszentrum Jülich, Institute of Energy and Climate Research, Stratosphere (IEK-7; Director Prof. Dr. Martin Riese)</th>
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<td>Partners of the HITEC Project:</td>
<td>Forschungszentrum Jülich, Institute of Energy and Climate Research, Stratosphere,(IEK-7), Dr. Martin Kaufmann; Max-Planck-Institute for Meteorology, Hamburg</td>
</tr>
<tr>
<td>Specific requirements</td>
<td>Master in Physics or a related subject</td>
</tr>
<tr>
<td>For project specific questions please contact</td>
<td>Dr. Martin Kaufmann, FZ Jülich, IEK-7, <a href="mailto:m.kaufmann@fz-juelich.de">m.kaufmann@fz-juelich.de</a>; Prof. Dr. Ralf Koppmann, University of Wuppertal, <a href="mailto:koppmann@uni-wuppertal.de">koppmann@uni-wuppertal.de</a></td>
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**HITEC Doctoral Fellowships 2013 - Guideline for Applicants**

**Please follow these guidelines for your application!**

These guidelines should help you as you think about applying to the Helmholtz Interdisciplinary Doctoral Training in Energy and Climate (HITEC). We are pleased that you are considering HITEC, and offer you encouragement along with some words of advice.

HITEC presents exceptional opportunities offering students the academic and intellectual resources of one research centre and five universities. Working towards a Ph.D. you will develop the capacity for independent research by working closely with a scholar, or a small group of scholars, whose work can serve as a model. It is a transition period at the end of which you will have become a colleague to your professors. Such a position is earned by commitment to the difficult, but fulfilling, craft of independent research through which you demonstrate the ability to make an original contribution to knowledge. Towards this goal HITEC provides an inspiring and accepting learning environment. Meeting this challenge requires personal sacrifice - of time, of leisure, of immediate rewards. But the achievement is well worth the cost in terms of intellectual satisfaction and the opportunity to expand the boundaries of knowledge. Before resolving to set out on the path to a doctoral degree, do reflect on the commitment that will be required. If you think you have this commitment - sufficient to sustain you through three years of intense and concentrated work and study - we welcome your application.

**General requirements**

- You need to apply for one of the 12 projects outlined in the ‘Call for Applications’. If your background meets the specific requirements of several projects, then you can apply to more than one project. **If you do not refer to one or several of the 12 projects your application will not be considered!**
- Candidates are expected to have a Master, a German "Diplom" or an equivalent degree, when they start their Ph.D. project. The specifics of the degree and the experience required are indicated for each of the projects listed in the ‘Call for applications’.
- It is not mandatory that you have completed your degree by the time you submit your application. However, the expected date of your final exam should not be later than July/August 2013.
- The integration in international co-operations requires the ability to cooperate in an international team, thus we expect good skills in the spoken and written English language.
**Documents required for application:** Please package all documents into 1 pdf-file

1. **Curriculum Vitae**
   Your CV should be between one and two pages long and list your personal data; the dates of your education and personal academic history; awards; publications; and contributions or other significant achievements.

   **Personal data:** Name (surname, given name); date of birth; place of birth; male/female; citizenship; country of permanent residence, native language; family status; e-mail address; mailing address, where you may be contacted; telephone;

   **Educational data:**
   - Secondary school education; from – to (month/year); type of final exam (original name); awarded on (date); results
   - Higher education; from – to; at (institution); subject
     Academic year at time of application; major; minor; currently affiliated with (institution)
   - Degrees held: day/month/year; exact degree title; subject; degree results
   - Degrees expected before taking up a possible fellowship, expected date of final examination

   **Research:** Briefly outline your major research projects, completed or ongoing

   **Academic honours, awards, fellowships**

   **Publications (if applicable)**

2. **Personal and Research Statement**
   The statement (1-2 pages) should describe your academic and career plans as well as your motivation for the application and your scientific interests in regard to the HITEC project chosen. When writing your personal statement, make sure to answer the following questions:
   - what are your scientific interests in regard to the project?
   - why do you think you will be successful in working on the project?
   - why do you think is HITEC the right choice for you?
   - why do you want to come to Germany, to Jülich or to the universities of Aachen, Bochum, Cologne, Düsseldorf, Wuppertal?

3. **Letters of Recommendation**
   Two letters of recommendation from faculty members or others well acquainted with your academic work are required. Please indicate the two reviewers with names and complete contact data.

   Letters of recommendation should be submitted electronically or via postal services directly by the professors. Letters that have been submitted by the applicants themselves will not be accepted. Please be aware that the deadline for your referees to submit their letters of recommendation is the same as the application deadline. Therefore, you need to make sure that they have enough time to submit their letters before the closing of the call.

4. **Transcripts**
   One official transcript from every college or university you have attended should be submitted. To prevent delays, you should arrange with your registrar to provide transcripts as soon as possible or submit preliminary transcripts with as many grades as possible.

5. **Proof of Proficiency in English**
   If your native language is neither English nor German, you must submit a proof of your English language proficiency. This is not required if you have attended a school, university or college where English is the language of instruction. Indicate results of the followings tests, alternatively:
   - Test of English as a Foreign Language (TOEFL); reading, listening, speaking, writing; please also indicate year of test.
   - Internet-Based Test (TOEFL iBT):
   - TOEFL Computer-Based Test (CBT):
   - TOEFL Paper-Based Test (PBT):
- Certificate of Proficiency in English (CPE) or Certificate in Advanced English (CAE); please indicate year of test
- International English Language Testing System - Academic Test (IELTS); please indicate year of test

► Evaluation procedure and decision

The best 12 applicants (one candidate per project) will be invited to Germany for a week, to join the respective research group in Jülich or at one of the universities. The task during this one week is to jointly work on the project idea with faculty members and supervisors and to turn it into an outstanding and convincing HITEC (Ph.D.) Project. On the last day of the stay the candidates present their projects and the outline of their dissertations to the members of the HITEC Advisory Board. Of the 12 pairs (projects / candidates) the seven best pairs (HITEC Projects / HITEC Fellows) will be selected.

All costs (travel and accommodation) for the week in Germany will be covered by HITEC. You will receive an email notification about the admission and invitation in the mid of February. We ask you to abstain from e-mail or phone enquiries after submitting your application. Please be assured that we will inform you as soon as the decisions will have been taken. The one week stay in Germany will be scheduled from 20-27 April 2013. The earliest start of the HITEC Fellows is 1 July; later starts are possible and will be discussed between the HITEC Fellows and their supervisors.

► HITEC Fellows

HITEC Fellows will be employed as Ph.D. students. As a rule, the funding period for Ph.D. students is three years. The graduate school HITEC provides an inspiring scientific environment and a supportive supervision concept allowing HITEC Fellows to complete their thesis within the given time.

► Information about

- Jülich: www.fz-juelich.de/portal/EN/Home/home_node.html
- the Institute of Energy and Climate Research: www.fz-juelich.de/portal/EN/AboutUs/Institutes_Facilities/Institutes/InstituteEnergyClimate/_node.html
- HITEC: www.fz-juelich.de/hitec/EN/_node.html

► Contact

- HITEC Office: Dr. Bärbel Köster, Managing Director
- E-Mail: b.koester@fz-juelich.de

Submit your complete application electronically until 11 January 2013 to b.koester@fz-juelich.de