Helmholtz - OCPC - Programme 2017-2021
for the Involvement of Postdocs in Bilateral Collaboration Projects with China

PART A

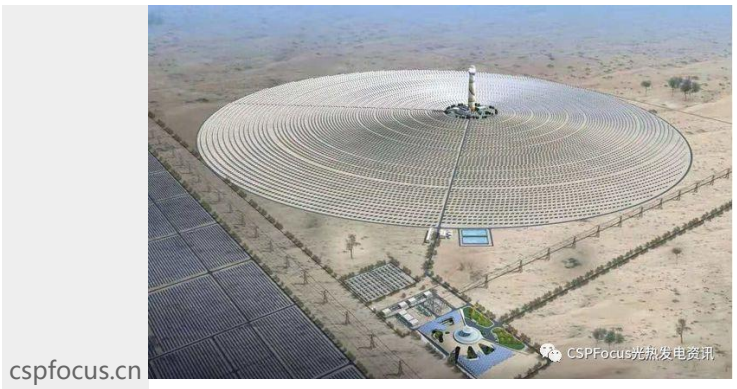
Title of the project: Optimal Heat Flux Distribution on the Surface of Molten Salt Receivers in Solar Tower Power Plants

Helmholtz Centre and institute: Karlsruhe Institut of Technology (KIT) – Steinbuch Centre for Computing (SCC)

Project leader: Prof. Dr. Martin Frank

Web-address
http://www.scc.kit.edu/en/research/8037.php

Description of the project (max. 1 page)**:**
This project focuses on solar tower power plants, where large mirrors (heliostats) are used to concentrate sunlight rays on a receiver. On the receiver, which is mounted on a central tower, a fluid (e.g. molten salt) is being heated up, and this heat is converted into steam to power a turbine and generate electricity.



During operation, the focal spots of heliostats are distributed on the receiver's surface, such that the conversion from optical to thermal power is optimal. This distribution highly depends on the flow medium and the receiver technology, e.g. for open volumetric air receivers a homogeneous distribution is optimal, while for direct steam generating receivers the distribution should increase to the centre of the receiver. A detailed model of the receiver would help to find an optimised flux distribution on the receiver surface. Within this project, a dynamic model of molten salt receivers

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is investigated. The desired heat distribution on the receivers' surface is optimised under changing solar irradiation conditions. This approach is finally tested in a feasibility study. The tasks to be performed are:

- Literature review on modelling the heat transfer and transient flow in receiver systems
- Development of a thermal model for describing the heat transfer at the molten salt driven receiver considering all relevant physical effects
- Model implementation by using ANSYS Fluent for the simulation of the numerical part
- Model extension which includes a strategy for controlling the mass flow and then reach a desired outlet temperature
- Consideration of safety and lifetime limits that must be taken into account in receiver models, e.g. receiver outer tube temperature, salt film temperature (degradation), tube stress and others
- Model coupling to an optimizer to find out a best possible heat flux distribution on the receivers' surface. The final goal is to reach as much mass flow as possible (at the desired temperature)
- Investigation of the optimal heat flux distribution in the frame of a feasibility study for a demonstration solar tower power plant (e.g. Hami, http://en.cspplaza.com/chinese-demonstration-project-short-list-finally-being-released-all-you-want-is-here/).

This project is offered by the Steinbuch Centre for Computing and the Computational Science & Mathematical Methods research group headed by Prof. Dr. Martin Frank.

The project will be co-supervised by
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Description of existing or sought Chinese collaboration partner institute (max. half page)**:**
NONE.
First contact with Professor Ni Dong from Zhejiang University in Hangzhou during SolarPACES Conference 2018.

Required qualification of the post-doc:

- PhD in Physics/Computer Science/Engineering
- Experience in modelling and simulation with at least one of the following software packages: ANSYS Fluent, Comsol Multiphysics, Matlab, Dymola
- Programming language: C++ and/or others
- Additional skills: basic knowledge of German would be appreciated

PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team

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