PhD Program between the Freie Universität Berlin (FUB) and the China Scholarship Council (CSC)

**Open PhD Position** at Freie Universität Berlin, offered only to Chinese CSC scholarship candidates 2020

Please Note: this PhD position is only offered to Chinese PhD candidates for the application in the framework of the FUB-CSC PhD Program.

**Department/Institute:** Mathematics and Computer Science/Mathematics Institute  
**Subject area:** Dynamics of Particle Systems  
**Name of Supervisor:** Prof. Dr. Christof Schütte  
**Number of open PhD positions:** 1  
**Type of the PhD Study:** Fulltime or Sandwich  
**Project title:** Mathematical modeling of multi-particle systems

**PhD Project description:**

Modeling, simulation and analysis of interacting particle systems build a very active field of research. In computational biology, the particles typically are representing molecules, while the main interactions are chemical reactions and association processes. On a particle-based level of modeling, the individual diffusive trajectories of all particles are traced in continuous space, and interactions are stochastic events which require spatial proximity of the reactants. Mathematical analysis is based on the construction of a Fock space – a symmetrized function space for the corresponding probability density functions.

In a more coarsened setting, the spatial environment is discretized, and continuous diffusion is replaced by stochastic jumps between compartments. In combination with interactions taking place within compartments, this leads to the well-known reaction-diffusion master equation which characterizes the temporal evolution of the associated probability distributions.

In this project, the PhD candidate is expected to develop a generic and consistent mathematical model for particle-based dynamics. Different types of operators need to be defined for spatial transport, interaction, and creation or annihilation of particles. The reaction-diffusion evolution equation in Fock space has to be derived and analyzed. Using Galerkin methods, the evolution equation then needs to be projected onto a suitable subspace, in order to transform it into a reaction-diffusion master equation and to uncover the relation between the two types of stochastic modeling approaches.

**Language requirements:**

IELTS: 6.5 or TOEFL: 95 ibt
Academic requirements:
Master in mathematics, physics or closely related disciplines.
Experience in functional analysis, approximation theory, mathematical modeling or quantum theory.

Information of the professor or research group leader (website, awards etc.):
The research of Christof Schuette focuses on application-oriented mathematics / scientific computing for complex systems, in particular on modelling, simulation and optimization for multiscale processes, especially for biomolecular, cellular, and network dynamics. He is a pioneer of the transfer operator approach to metastable processes and its use in model reduction, and machine learning. In recent years, he has started to concentrate on stochastic particle systems and agent-based modelling. See [http://www.zib.de/schuette/](http://www.zib.de/schuette/)

Stefanie Winkelmann is head of the research group Computational Systems Biology at Zuse Institute Berlin. Her research focuses on mathematical modeling and numerical simulation of spatio-temporal stochastic processes of interacting particle systems and on Markov control theory, with applications in biochemistry, medical science and human sociology. See [http://www.zib.de/members/winkelmann](http://www.zib.de/members/winkelmann)

Please Note: In a first step, the complete application should be submitted to [csc@international.fu-berlin.de](mailto:csc@international.fu-berlin.de) for evaluation by January 4th, 2020. Please do not contact the professor before. He/she will get in contact with you after having received the complete application via the International Office of Freie Universität Berlin in January.