

DAAD program RISE 2009
Physics: Nonlinear Dynamics of Integrated Quantum Dot Laser Structures

Applicant:
Roland Aust

Group of Prof. Schöll “Nonlinear Dynamics and Control”
Institut für Theoretische Physik, Sekr. EW 7-1
Technische Universität Berlin
Hardenbergstr. 36
10623 Berlin, Germany
<http://www.itp.tu-berlin.de/schoell>

The activities of our group are centered around theoretical investigations and computer simulations of nonlinear dynamical systems. We deal with self-organized spatio-temporal patterns, control by time-delayed feedback, as well as with the influence of noise. As state-of-the-art applications we investigate optoelectronic and neural systems, in particular semiconductor lasers, nonlinear and chaotic charge transport in semiconductor nanostructures (quantum dots, superlattices), and neurodynamics.

An important optoelectronic application are semiconductor quantum dot lasers, which are nanostructures consisting of layers of self-organized quantum dots embedded in a pn-diode. They have been used to generate short pulses in gain switching or passive mode-locking configurations. Here we focus on integrated structures of edge emitting quantum dot lasers coupled with passive sections and external resonators such as Fabry-Perot resonators, bandpass filters, saturable absorbers, and apply the concepts of delayed optical feedback, nonlinear and noise-induced dynamics.

With our long-standing experience in the field of computer simulations of semiconductor nanostructures, as well as in dynamical systems, chaos control, and noise-induced dynamics, we are offering a project which combines both aspects. The candidate will first get an introduction to nonlinear dynamics and bifurcations. Then, the candidate learns to simulate integrated quantum dot laser structures, incorporating the influence of optical feedback and noise. Thus, the task is embedded in current state-of-the-art projects carried out in our group.

The work will be performed in the group of Prof. Schöll which is located in the Institute for Theoretical Physics at Berlin University of Technology (Technische Universität Berlin). The Technische Universität has a long tradition in science and engineering since its foundation over 125 years ago. It is nowadays a premier research institution with many international cooperations.

As the capital of Germany, Berlin is a center of science and research with many research institutions of high academic reputation. It is also a very green city with many parks, lakes around the city, and a lot of interesting sites to visit in the nearby area. Because of a wide range of cultural facilities in a very open-minded environment and because of Berlin's historical importance, the candidate will benefit from a lot of stimulating impressions not only from scientific work in our group but also from the city of Berlin itself.