

# DPG Physics School on Efficient Algorithms in Computational Physics

Organized by Alexander K. Hartmann (University of Oldenburg)  
and A. Peter Young (University of California Santa Cruz)

10. - 14. September 2012, Physik Zentrum Bad Honnef, Germany

## Subject of the school

Computer simulations play an ever increasing role in physics research. For example, more than 20% of all publications in Physical Review Letters are concerned, at least partially, with numerical methods. The reason for this success is that, with the widespread availability of powerful computing facilities, computer simulations allow to us study systems which are intractable analytically, to measure “arbitrary” quantities which are out of reach of experiments, and to study a wide range of models, some of which are very close to experiment while others are very artificial but contain an important piece of physics. This school will provide an introduction to the field, including up-to-date research topics. A drawback of computer simulations, the limited size of the systems, can be overcome in principle by “finite-size scaling” which extrapolates results from finite-size systems to the thermodynamic limit. However, even including finite-size scaling, the accuracy of the results improves if larger sizes can be included. Hence, a particular emphasis of this school will be efficient algorithms, which allow one to study larger system sizes than with standard approaches. Since doing computer simulations means learning by doing, the school comprises, in addition to lectures, of a considerable amount of hands-on exercises at the computer. For this purpose, if at all possible, attendants should bring their own laptops.

The school addresses students which have a physics background and basic knowledge in a higher programming language. like Pascal, C/C++, or Fortran. The language used throughout the school will be the C programming language (and some Python scripts). For this purpose, all participants will obtain in advance an concise text containing an introduction to C. Basic knowledge in Computational Physics and Statistical Physics are not required but advantageous.

All participants will receive a free copy of the textbook “A Practical Guide to Computer Simulations” (author: A.K. Hartmann, World Scientific, Singapore, 2009).

## Lecturers

- Anthonius Coolen  
King's College, London, UK
- Alexander K. Hartmann  
University of Oldenburg, Germany
- Helmut G. Katzgraber  
Texas A&M University, College Station, USA
- Werner Krauth  
Ecole Normale Supérieure Paris, France
- Frauke Liers  
FAU Erlangen-Nuremberg, Germany
- Roger G. Melko  
University of Waterloo, Canada
- Heiko Rieger  
University of Saarbruecken, Germany
- A. Peter Young  
University of California, Santa Cruz, USA
- Robert M. Ziff  
University of Michigan, Ann Arbor, USA

## Schedule (L: lecture, E: hands-on computer exercise)

Lectures are 75 min. without break, or 90 min. including 15 min. break.

- Sunday 9. September 2012

Arrival

18:30-19:30 *dinner*

- Monday 10. September 2012

9:00-10:15	(L) Algorithms & Data Structures I (Liers)
	<i>coffee break</i>
11:00-12:15	(L) Monte Carlo Methods I (Katzgraber)
12:30	<i>lunch</i>
14:30-15:45	(L) Algorithms & Data Structures II (Liers)
	<i>coffee break</i>
16:30-18:00	(E) Exercises Algorithms & Data Structures (Liers)
18:30-19:30	<i>dinner</i>
	(E) continuation exercises

- Tuesday 11. September 2012

9:00-10:15	(L) Monte Carlo Methods II (Katzgraber)
	<i>coffee break</i>
11:00-12:15	(L) Advanced Percolation Algorithms (Ziff)
12:30	<i>lunch</i>
14:30-15:45	(L) Kinetic Monte Carlo (Rieger)
	<i>coffee break</i>
16:30-18:00	(E) Exercises Monte Carlo Methods (Katzgraber)
18:30-19:30	<i>dinner</i>
	(E) continuation exercises

- Wednesday 12. September 2012

9:00-10:15	(L) Quantum Monte Carlo I (Melko)
	<i>coffee break</i>
11:00-12:15	(L) Quantum Monte Carlo II (Melko)
12:30	<i>lunch</i>
14:00-19:00	<i>excursion</i>
18:30-19:30	<i>dinner</i>

- Thursday 13. September 2012

9:00-10:15	(L) Advanced Data Analysis I (Young)
	<i>coffee break</i>
11:00-12:15	(L) Network Algorithms I (Coolen)
12:30	<i>lunch</i>
14:30-15:45	(L) Cluster Algorithms for Glasses (Krauth)
	<i>coffee break</i>
16:30-18:00	(E) Exercises Advanced Data Analysis I (Young)
18:30- ...	<i>conference dinner</i>

- Friday 14. September 2012

9:00-10:15	(L) Network Algorithms II (Coolen)
	<i>coffee break</i>
11:00-12:15	(L) Phase transitions in optimization problems (Hartmann)
12:30	<i>lunch</i>
15:00	<i>departure</i>