Physikalisches Institut der
Friedrich-Alexander-Universität
Lehrstuhl für Optik

Prof. Dr. Gerd Leuchs

Physik. Inst./Optik, Staudtstr. 7/B2, D-91058 Erlangen

Tel.: 09131 / 85-28371
Fax: 09131 / 13508
e-mail: leuchs@physik.uni-erlangen.de

Erlangen, den 25. Mai 2003

# Veilbronn meeting
# Summary

On the first day of the Veilbronn meeting, the focus was on new quantum simulation methods. These allow simulation of master equations for many-body systems in the time domain. This was once thought to be impossible, due to the complexity of the problem. However, some new methods are known, which makes this challenge quite feasible.

The group of Drummond et al (Humboldt award-holder from Australia) presented a general technique called the 'stochastic gauge' method, which were applied to a range of examples ranging from genetics to atom optics. The results included a new analytic solution to the quantum image problem, results for density correlations in a one-dimensional bose gas at ultra-low temperatures, and calculations of squeezing including Raman noise, which are relevant to the Erlangen fibre soliton experiments.

The group of Castin et al (ENS, Paris) presented their own simulation methods, which included an exciting development in the form of a bound on the wave-function sampling error. This represents a new departure, in that it allows a quantitative estimate of errors and hence the time required to simulate for a given quantum problem. In addition, some new specific numerical results were obtained for a variety of atom-optics problems - an unexpected and welcome development was a new way to treat fermionic atomic systems.

The group of Fleischhauer et al (Kaiserslautern) developed a range of new ideas. The most intriguing of these was an idea of a type of block decomposition for quantum systems with discrete lattice sites. These have not been used before, and may give much better methods for treating systems with very strong nonlinearities. Walser, from Ulm, also presented a summary of more traditional mean-field methods, but extended to include molecules.

On the second day the focus was primarily on experimental issues. In the experiments on BEC-solitons, on optical fiber solitons and on superconducting flux solitons the quantum character of the dynamics was clearly measurable or even dominant. The experiments on dissipative solitons, on spatial solitonsand on optical cavity solitons, on the other hand, are today still clearly in the classical domain where quantum effects are insignificant. The role of quantum effects in these

different systems was discussed at length. Physical insight was gained from the comparison of the various experimental observations. This was also the link to the first day. Most interesting will be the regime where non-linear interactions and phase shifts will dominate even when dealing with few particles or a single particle only. In this sense the perspective is best for the atom optics scenario. The photonic systems, however, are closer to applications.