DF 8: Glasses II (joint session DF/DY)

Time: Tuesday 14:30–16:15 Location: EB 407

DF 8.1 Tue 14:30 EB 407

Glassy Solution-Space Structure of Optimization Problems — Alexander Mann[1], Wolfgang Radenbach[2], and •Alexander Hartmann[3] — [1]Institute for Theoretical Physics, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [2]University of Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany — [3]Institute for Physics, University of Oldenburg, 26111 Oldenburg, Germany

We study numerically the glassy solution-space cluster of random ensembles of two NP-hard optimization problems originating in computational complexity, the vertex-cover problem and the number partitioning problem. We use branch-and-bound type algorithms to obtain exact solutions of these problems for moderate system sizes. Using two methods, direct neighborhood-based clustering and hierarchical clustering, we investigate the structure of the solution space. The main result is that the correspondence between solution structure and the phase diagrams of the problems is not unique. Namely, for vertex cover we observe a drastic change of the solution space from large single clusters to multiple nested levels of clusters. In contrast, for the number-partitioning problem, the phase space looks always very simple, similar to a random distribution of the lowest-energy configurations. This holds in the "easy"/solvable phase as well as in the "hard"/unsolvable phase.

DF 8.2 Tue 14:45 EB 407

A Gaussian model for the energy landscape of supercooled liquids and its implications — •Andreas Heuer — Inst. f. Phys. Chemie, Corrensstr. 30, 48149 Münster

From the previous analysis [1,2] of the potential energy landscape of molten silica and of a binary Lennard-Jones system a simple picture has emerged for the properties of the potential energy landscape as well as the relation between the energy and the dynamics. Formulating these observations in a general framework one can make specific predictions about the behaviour of supercooled liquids. This involves the dependence of fragility to non-exponentiality, the invalidation of the Stokes-Einstein relation and the relation between thermodynamic and kinetic fragility.

[1] B. Doliwa, A. Heuer, Phys. Rev. Lett. 91, 235501 (2003). [2] A. Saksaengwijit, J. Reinisch, A. Heuer, Phys. Rev. Lett. 93, 235701 (2004).

DF 8.3 Tue 15:00 EB 407

Fluorescence lifetime fluctuations and molecular reorientation of single molecules as observables of the dynamics in supercooled poly(methyl acrylate) — Renaud Vallée[2], •Gerald Hinze[1], Taoufik Rohand[2], Noel Boens[2], Wim Dehaen[2], and Thomas T. Basché[1] — [1]Institute of Physical Chemistry, Johannes-Gutenberg University, Mainz, Germany — [2]Department of Chemistry , Katholieke Universiteit Leuven, 3001 Leuven, Belgium

The dynamics of supercooled poly(methyl acrylate) has been explored on a nanoscale by tracking single fluorescing molecules as local reporter. We could follow the molecular orientation and the fluctuating fluorescence lifetime of single dyes in time. To meet the requirements of high photostability and a very high quantum yield, custom-built BODIPY dyes have been used. Experiments were performed in bulk sample to prevent interface effects.

While the rotational dynamics of the dyes strongly depends on the interaction between matrix and the probe molecules, the fluorescence lifetime could alter solely by matrix fluctuations without structural dynamics of the dye. We have analyzed the fluctuations by means of correlation functions and discuss their relationship to the dynamics of the supercooled matrix.

DF 8.4 Tue 15:15 EB 407

Properties of the Incoherent Scattering Function as derived from a Continuous Time Random Walk Analysis — •Oliver Rubner and Andreas Heuer — Institut für Physikalische Chemie der Universität Münster

We have shown in previous work that it is possible to describe the dynamics of a binary mixture Lennard-Jones (BMLJ65) model system above the glass transition in terms of a continuous time random walk (CTRW). Here we focus on the connection to experimentally accessible quantities. Approximating the incoherent intermediate scattering function $F(q,t)$ as a stretched exponential function $\exp(-\left(\frac{t}{t_0}\right)^{\beta})$ we have been able to derive analytical expressions for the q-dependence of the two parameters $t_0(q)$ and $\beta(q)$. These expressions are well reproduced by simulations of the BMLJ65 system.

We analyse the behaviour of the resulting equations in different q-regimes and are able to interpret their physical content exhibiting close connections to existing work, e.g. on facilitated spin systems. Furthermore system size effects are discussed.

DF 8.5 Tue 15:30 EB 407

Finite size corrections in mean-field spin glasses — •Timo Aspelmeier[1], Alain Billoire[2], Enzo Marinari[3], and Michael A. Moore[4] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen — [2]Service de physique théorique, CEA Saclay, 91191 Gif-sur-Yvette, France — [3]Dipartimento di Fisica, INFM and INFN, Sapienza Università di Roma, P. A. Moro 2, 00185 Roma, Italy — [4]School of Physics and Astronomy, University of Manchester, Manchester, M13 9PL, UK

Finite size corrections in mean-field spin glasses are poorly understood theoretically because calculation of the loop expansion beyond Gaussian order is practically impossible. Here we present arguments and simulations to show that a system of finite size N is stabilized by a finite number of replica symmetry breaking steps K as opposed to the infinite replica symmetry breaking found in the thermodynamic limit. The number K is shown to be proportional to $N^{1/6}$. Using this correspondence between K and N we calculate the finite size dependences of internal energy, free energy, Edwards-Anderson order parameter and sample-to-sample fluctuations of the free energy.

DF 8.6 Tue 15:45 EB 407

The critical behavior of 3D Ising spin glass models: universality and scaling corrections — •Martin Hasenbusch[1], Andrea Pelissetto[2], and Ettore Vicari[3] — [1]Institut für theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig, Deutschland — [2]Dipartimento di Fisica dell'Universita di Roma I and I.N.F.N., I-00185 Roma, Italy — [3]Dipartimento di Fisica dell'Universita di Pisa and I.N.F.N., I-56127 Pisa, Italy

We perform high-statistics Monte Carlo simulations of three three-dimensional Ising spin glass models: the +-J Ising model for two values of the disorder parameter p, p=1/2 and p=0.7, and the bond-diluted +-J model for bond-occupation probability p_b = 0.45. A finite-size scaling analysis of the quartic cumulants at the critical point shows conclusively that these models belong to the same universality class and allows us to estimate the scaling-correction exponent omega related to the leading irrelevant operator, omega=1.0(1). We also determine the critical exponents nu and eta. Taking into account the scaling corrections, we obtain nu=2.53(8) and eta=-0.384(9).

DF 8.7 Tue 16:00 EB 407

The m-component spin glass on a Bethe lattice — •Axel Braun[1] and Timo Aspelmeier[2] — [1]Institut für theoretische Physik, Universität Göttingen — [2]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen

Using an extension of the cavity method to m-component vector spins on a Bethe lattice, we have derived a self-consistent equation of cavity fields, with $m \to \infty$. We have improved these findings by calculating corrections for a finite number of spin components and used these self consistent field equations to investigate the distribution of cavity fields in the low temperature phase. We provide numerical evidence that the RS distribution is unstable for finite m slightly below the critical temperature, indicating a second transition to a RSB state.