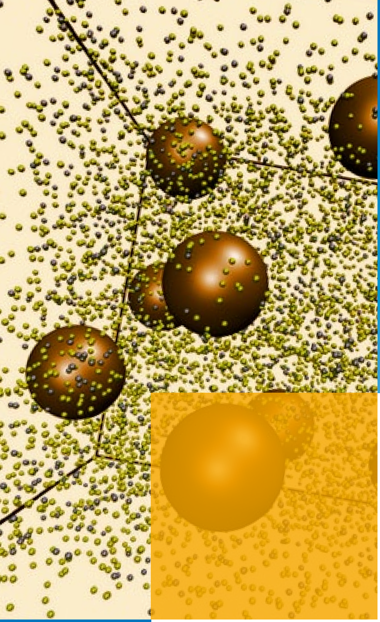


39th SFB 716 Colloquium

February 7, 2013 | 4 pm

University of Stuttgart
Campus Vaihingen
Allmandring 3
Room 1.079

The Collaborative Research Center (SFB) 716 invites colleagues and interested person to the upcoming colloquium. In this lecture series renowned researchers and members of our subprojects talk about their research findings regarding dynamic simulation of systems with large particle numbers.

www.sfb716.uni-stuttgart.de

TALK 1

Prof. Dr. Nikolaus Adams

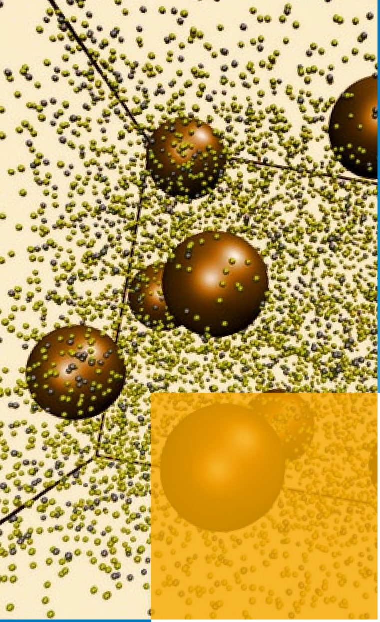
Technische Universität München, Institute of Aerodynamics and Fluid Mechanics, Speaker of the SFB-TR 40

Potential and Limitations of SPH and SDPD Models of Complex Fluids and Complex Flows

Particle discretizations based on the Smoothed-Particle-Hydrodynamics concept of Gingold, Monaghan and Lucy offer a deceptively simple and straightforward modeling paradigm for complex flows, as by their Lagrangian particle nature they have some inherent self-adaptation capabilities. Moreover, their main formulations can be derived from a Hamiltonian and conserve total mass, momentum and energy. The preservation of such essential properties may not be necessary for an accurate prediction of short time local-in-space behavior but they are essential for the prediction of long-term behavior of physical systems. Despite the fact that following classical numerical analysis SPH is near to useless, actual implementations have turned out to give surprisingly good results for quite complex flows. Although the SPH formulation is simple and straightforward to implement, numerical analysis is overwhelmingly more involved than for vortex-particle methods or for grid-based methods.

Random error behavior introduces artificial energy transfer mechanisms that are particularly pronounced at large Reynolds numbers. At low Reynolds numbers, however, proper formulations of SPH deliver results of an accuracy comparable to that of grid-based methods. This is the reason why SPH is attractive for micro-flows of complex multiphase or particle-laden fluids. Furthermore, it lends itself to a straight-forward meso-scaling concept, leading to the so-called Smoothed-Dissipative-Particle-Dynamics concept. SDPD even allows to model phenomena below the continuum-flow scale and naturally recovers increasingly smaller scales towards the molecular level.

In this presentation we will discuss the potential and limitations of SPH and SDPD based on our research over the past 10 years in this field that have led to a number of ground-breaking developments, such as robust and stable weakly-compressible formulations, efficient incompressible ap-



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proaches, multi-phase models for interfaces and contact-lines, and models for the interaction of fluids with immersed macro-molecules. The focus will be placed on working out limitations of standard or previous models, explain how these limitations can be removed or reduced, and demonstrate the current level of modeling capability with some benchmark cases.

Pause 15 minutes

TALK 2

Dr. Martin Weigel

Coventry University, Coventry (United Kingdom), Applied Mathematics Research Centre

Fractal geometry and Stochastic Loewner Evolution in disordered systems

The description of fractal geometry in critical systems has seen a major leap forward with the advent of the concept of stochastic Loewner evolution (SLE), that provides a unified description of domain boundaries of many lattice spin systems in two dimensions. While such interfaces in a number of pure systems, including various phase boundaries in Potts models, are well-known to be described by SLE_k, recently a number of numerical studies have found interfaces in disordered systems to be also (partially) consistent with SLE (see, e.g., Ref. [1]).

Here, we study domain walls in random-field Ising models and the Ising spin glass. Using exact ground-state calculations on systems of up to around 109 spins, we examine domain walls in these systems and compare with predictions from SLE. For the random-field model, we find strong evidence for conformal invariance and compliance with the domain-Markov property, implying compatibility with Schramm-Loewner evolution with parameter $k = 6$ [2,3]. For the spin-glass, new algorithms allow us to determine the spin-stiffness exponent and fractal dimension of domain walls with unprecedented accuracy [4]. We uncover a strong dependence of SLE properties for the Gaussian and bimodal models on the specific choice of boundary conditions in these systems.

[1] M. Weigel and W. Janke, Phys. Lett. B 639, 373 (2006).
[2] J. D. Stevenson and M. Weigel, Comput. Phys. Commun. 182, 1879 (2011).
[3] J. D. Stevenson and M. Weigel, Europhys. Lett. 95, 40001 (2011).
[4] H. Khoshbakht, M. Weigel and J. D. Stevenson, in preparation.

Get Together on the occasion of the end of the semester