

| Thursday, August 31 |       |                             |  |           |
|---------------------|-------|-----------------------------|--|-----------|
| Start               | End   | Projects                    | Title  | Speakers  |
| 08:00               | 10:00 | Bus: Bielefeld - Hofgeismar |  |           |
| 10:00               | 10:45 | Arrival and Welcome Coffee  |  |           |
| 10:45               | 10:50 |                             | Opening  |           |
| 10:50               | 11:20 | A1                          | Asymptotic stability of the fourth order $\phi^4$ kink in the energy space | C. Maulén |
| 11:25               | 11:55 | A1-B1-B8                    | Well-posedness of the three dimensional stochastic Zakharov system         | M. Spitz  |
| 12:00               | 14:00 | Lunch                       |  |           |
| 14:05               | 14:35 | C1                          | Coalescents with migration in the moderate regime                          | S. Mellis |
| 14:40               | 15:10 | A8                          | A variational approach to a fuzzy Boltzmann equation                       | Z. He     |
| 15:15               | 16:00 | Coffee                      |  |           |
| 16:00               | 16:50 | Collaborative research      |  |           |
| 16:50               | 17:35 | B5                          | The Central Limit Theorem for Rényi divergence                             | F. Götze  |
| 18:00               | 19:00 | Dinner                      |  |           |

| Friday, September 1 |       |   |  |             |
|---------------------|-------|---|--|-------------|
| 07:30               | 09:00 | Breakfast   |  |             |
| 09:00               | 09:30 | A3  | Gaussian upper bounds for subsolutions of Leibenson's equation on Riemannian manifolds | P. Sürig    |
| 09:35               | 10:05 | A5  | On nonlinear Markov processes in the sense of Mc-Kean                                  | M. Rehmeier |
| 10:05               | 10:50 | Coffee  |  |             |
| 10:50               | 11:20 | C4  | Ergodic mean-field games of singular control with regime-switching                     | I. Tzouanas |
| 11:25               | 11:55 | C5  | State Dependent Utility and Ambiguity  | L. Mononen  |
| 12:00               | 13:30 | Lunch   |  |             |
| 13:00               | 14:30 | Meeting of principal investigators/Collaborative research |  |             |
| 14:40               | 15:10 | B7  | Properties of adaptive mesh refinements  | J. Storn    |
| 15:15               | 16:00 | Coffee  |  |             |
| 16:00               | 18:00 | Bus: Hofgeismar - Bielefeld                               |  |             |

# CRC Retreat 2023: Abstracts

August 31 – September 1, 2023

## Asymptotic stability of the fourth order $\phi^4$ kink in the energy space

Christopher Maulén

In this talk we will introduce the fourth order  $\phi^4$  model, which generalizes the classical  $\phi^4$  model of quantum field theory, sharing the same kink solution. Mathematically speaking, the kink is characterized by a fourth-order nonnegative linear operator with a simple kernel at the origin but no spectral gap. In this talk, we establish that the kink solution is orbitally stable and using an approach based on virial identities, in the spirit of Kowalczyk, Martel, Muñoz and Van den Bosch, prove that this solution is asymptotically stable for any perturbation in the energy space. This is joint work with Claudio Muñoz.

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## Well-posedness of the three dimensional stochastic Zakharov system

Martin Spitz

The Zakharov system is a model in plasma physics describing rapid oscillations of the electric field in a conducting plasma. It consists of a Schrödinger and a wave equation with quadratic coupling. In this talk we show that the stochastic Zakharov system is well-posed in the energy space in space dimension three up to the maximal existence time. The proof intertwines probabilistic techniques such as refined rescaling transforms with dispersive techniques such as the normal form method, Strichartz and local smoothing estimates. We also present a regularization by noise result which states that finite time blowup before any given time can be prevented with high probability by adding sufficiently large non-conservative noise. The talk is based on joint work with Sebastian Herr, Michael Röckner, and Deng Zhang.

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## Coalescents with migration in the moderate regime

Sophia Mellis

We consider a population of size  $K^\gamma$ ,  $\gamma \geq 1$ , that is divided into  $d \geq 2$  colonies. Between these colonies individuals may migrate at a rate proportional to  $K$ . In this setting, we study the ancestral lines of said population by using a coalescent model where pairs of ancestral lines within the same colony coalesce at rate 1. More specifically, we work with a vector of empirical measures, such that each component keeps track of both the number of ancestral lines present in colony  $i$  at time  $t$  and the initial locations of all the lines they merged with. Our main concern then lies with its behavior as  $K$  goes to infinity for small times  $t$ . We will see that, in the proper rescaling of time and space, it converges to the solution of a  $d$ -dim. coagulation equation that has a probabilistic interpretation connected to either multitype branching processes (case  $\gamma = 1$ ) or multitype Feller diffusions (case  $\gamma > 1$ ). Joint work with Fernando Cordero, Sebastian Hummel and Emmanuel Schertzer

## A variational approach to a fuzzy Boltzmann equation

Zihui He

We study a fuzzy Boltzmann equation, where the particles interact via delocalized collisions compared to the classical Boltzmann equations. We discuss the existence and uniqueness of solutions and provide a variational characterization casting the fuzzy Boltzmann equation into the framework of GENERIC (General Equations for Non-Equilibrium Reversible-Irreversible Coupling) systems.

This talk is based on joint work with Matthias Erbar.

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## The Central Limit Theorem for Rényi divergence

Friedrich Götze

We review previous joint results with S. Bobkov and G. Chistyakov for the central limit theorem in the Rényi divergence distances of order larger than one and discuss recent progress for the case of infinite order as well as related questions concerning classes of strongly sub-Gaussian distributions. In particular we provide necessary and sufficient conditions which guarantee a strong normal approximation for densities of sums  $p_n$  to the normal density  $\varphi$  of type  $\sup_x (p_n(x) - \varphi(x))/\varphi(x) \rightarrow 0$  as  $n \rightarrow \infty$ .

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## Gaussian upper bounds for subsolutions of Leibenson's equation on Riemannian manifolds

Philipp Sürig

We consider solutions of the differential inequality  $\partial_t u \leq \Delta_p(u^{1/(p-1)})$ , on complete Riemannian manifolds, where  $p > 1$ . We prove that non-negative bounded weak solutions to this inequality have a pointwise Gaussian upper bound.

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## On nonlinear Markov processes in the sense of McKean

Marco Rehmeier

We study nonlinear Markov processes in the sense of McKean and present a large new class of examples. Our notion of nonlinear Markov property is in McKean's spirit, but more general in order to include examples of such processes whose one-dimensional time marginals solve a nonlinear parabolic PDE, such as Burgers' equation, the porous media equation, or variants of the latter with transport-type drift. We show that the associated nonlinear Markov process is given by path laws of weak solutions to a corresponding distribution-dependent stochastic differential equation whose coefficients depend singularly (i.e. Nemytskii-type) on its one-dimensional time marginals. Moreover, we show that also for general nonlinear Markov processes, their path laws are uniquely determined by one-dimensional time marginals of suitable associated conditional path laws. This is joint work with Michael Röckner.

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## Ergodic mean-field games of singular control with regime-switching

Ioannis Tzouanas

In this work we stationary mean-field games of singular control with regime-switching. The representative agent adopts an ergodic criterion and interacts through a long-time (stationary) mean-field parameter. The solution strategy is divided into two steps. Firstly, for fixed mean-field parameter, we prove the existence of optimal control for the representative agent. To the best of our knowledge this is the first result for ergodic singular stochastic control problems with regime-switching. Secondly, we prove the existence and uniqueness of mean-field equilibria. By using the mean-field equilibria, an approximate result for the Nash equilibrium of (symmetric) N-player game is provided.

This talk based on the joint work with Jodi Dianetti and Giorgio Ferrari.

## State Dependent Utility and Ambiguity

**Lasse Mononen**

Models of choice under uncertainty study choice behavior when outcomes depend on the realized state of the world. The typical assumption is that utilities of outcomes do not depend on the realized state and are state independent. Without this simplifying assumption, it is difficult to separately identify utilities and beliefs. This paper provides novel general foundations for models with state dependent utilities: once we depart from expected utility, it is often possible to uniquely identify utilities and beliefs. Specifically, we show that with general models of non-expected utility under ambiguity we have complete identification of utilities and probabilities under full-dimensional uncertainty. Additionally, we consider applications to social choice for the identification of the fairness of the society and to intertemporal choice for the identification of evolving tastes.

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## Properties of adaptive mesh refinements

**Johannes Storn**

This talk discusses the adaptive mesh refinement routine of Maubach and Traxler for conforming simplicial partitions. In particular, we prove existence of a regularized mesh size function with grading two, that is, we show that the local mesh size changes in some average by at most a factor of two. Moreover, we remove the restrictive assumptions on the initial triangulation. This is joint work with Lars Diening (Bielefeld University), Lukas Gehring (Friedrich-Schiller-Universität Jena), and Tabea Tscherpel (TU Darmstadt).