CRC Retreat 2020

Monday, August 31

Morning session: Young researchers' talks (each talk 30 minutes + 10 minutes questions/discussion)		
09:15 – 09:55	Shinya Kinoshita (A1)	The Cauchy problem of the Zakharov-Kuznetsov equation
10:00 – 10:40	Simon Nowak (A3)	Higher Hölder regularity for nonlocal equations with irregular kernel
10:45 – 11:25	Anna Balci (A7)	Elliptic equations with degenerate weights
11:30 – 12:15	Zimo Hao (B1)	Euler approximation for SDEs with irregular drift
12:15 – 14:00	Lunch Break	
Preparations for the renewal proposal **Afternoon session 1: Joint methodologies** (Principal Investigators only)		
14:00 ~ 17:00	Sebastian Herr	Current status of the proposal
	Plenum	• Joint methodology • Buzzwords • Early career support Discussion / Collection of ideas
	Break Out Rooms	Detailed discussions about joint methodologies in smaller groups according to discussion before

Tuesday, September 1

Morning session: Young researchers' talks (each talk 30 minutes + 10 minutes questions/discussion)		
09:15 – 09:55	Patrick Schuhmann (C4)	Singular control of the drift of a Brownian system
10:00 – 10:40	Huanyu Yang (B2)	Stochastic Cahn-Hilliard equations and sharp interface limits
10:45 – 11:25	Fernando Cordero (C1)	General selection models: Bernstein duality and (minimal) ancestral structures
11:30 – 12:15	Philipp Gohlke (A6)	Zero measure Cantor spectrum for Schrödinger operators with quasi-periodic potentials
12:15 – 14:00	Lunch Break	
Preparations for the renewal proposal **Afternoon session 2: Joint subprojects** (Principal Investigators only)		
14:00 ~ 17:00	Plenum	Joint subprojects 1. short presentations of planned joint subprojects 2. discussion and collection of new ideas
	Break Out Rooms	Detailed discussions about joint subprojects in smaller groups according to discussion before

Abstracts

Shinya Kinoshita: The Cauchy problem of the Zakharov-Kuznetsov equation
In this talk, we consider the Cauchy problem of the Zakharov-Kuznetsov equation. The Zkharov-Kuznetsov equation can be seen as a multidimensional extension of the KdV equation. The Zakharov-Kuznetsov equation is not completely integrable but admits soliton solutions. I will introduce the recent local and global well-posedness results. In high dimensions, the Cauchy problem is shown to be globally well-posed for small initial data in scaling critical spaces and it is proved that solutions scatter to free solutions. The talk is based on a joint work with Sebastian Herr (Bielefeld).

Simon Nowak: Higher Hölder regularity for nonlocal equations with irregular kernel
We present a recent result concerning higher Hölder regularity for nonlinear nonlocal equations with kernels that satisfy a mild continuity assumption. An interesting feature of our main result is that the obtained regularity is better than one might expect when considering corresponding results for local elliptic equations with continuous coefficients, so that in some sense our result can be considered to be of purely nonlocal type.

Anna Balci: Elliptic equations with degenerate weights
In recent years Calderon-Zygmund type regularity estimates were established for solutions of different classes of linear weighed degenerate elliptic problems with matrix coefficients. For non-linear setting the results known till now do not allow degenerate weights. We establish new kind of condition on the weight: Instead of a BMO-smallness condition for the weight itself, we use a BMO smallness condition on its logarithm , which is new even for the linear case. We study also the situation "beyond the regularity" where Lavrentiev gap can appear.

Zimo Hao: Euler approximation for SDEs with irregular drift
This talk is concerned with two different types of SDEs with irregular drift. In the first work, we show the existence and uniqueness for a class of density dependent SDEs with bounded measurable drift, where the existence part is based on Euler’s approximation for density dependent SDEs and the uniqueness is based on the associated nonlinear Fokker-Planck equation. As an application, we obtain the well- posedness of a nonlinear Fokker-Planck equation. (This is a joint work with Michael Röckner and Xicheng Zhang). In the second work, we use Schauder’s estimates to obtain the rate of convergence of strong Euler approximation for SDEs driven by cylindrical alpha-stable processes with Hölder drift. (This is a joint wrok with Mingyan Wu).

Patrick Schuhmann: Singular control of the drift of a Brownian system
We consider a standard Brownian motion whose drift can be increased or decreased in a possibly singular manner. The objective is to minimize an expected functional involving the time-integral of a running cost and the proportional costs of adjusting the drift. The resulting two-dimensional degenerate singular stochastic control problem is solved by combining techniques of viscosity theory and free boundary problems. We provide a detailed description of the problem's value function and of the geometry of the state space, which is split into three regions by two monotone curves. Our main result shows that those curves are continuously differentiable with locally Lipschitz derivative and solve a system of nonlinear ordinary differential equations.

Huanyu Yang: Stochastic Cahn-Hilliard equations and sharp interface limits
We first consider the 2-d stochastic Cahn-Hilliard equation driven by the spatial derivative of the white noise. By using the SPDE argument and Dirichlet form approach, the global well-posedness and restrict Markov uniqueness are obtained. Moreover, we study the sharp interface limit of stochastic Cahn-Hilliard equation driven by various types of noise. In a special case, we proved that

the solution to stochastic Cahn-Hilliard equation converges to a solution to the stochastic Hele-Shaw model.
This is a joint work with Michael Röckner, Lubomir Banas and Rongchan Zhu.

Fernando Cordero: General selection models: Bernstein duality and (minimal) ancestral structures
Lambda-Wright--Fisher processes provide a flexible framework to describe the type-frequency evolution of an infinite neutral population. We model interactions via a general polynomial drift vanishing at the boundary. An appropriate decomposition of the drift allows us to approximate the solution of the associated stochastic differential equation by a sequence of finite population models. The genealogical structure inherent to these models leads in the large population limit to a generalization of the ancestral selection graph of Krone and Neuhauser. Next, we construct an ancestral process that keeps track of the sampling distribution along the ancestral structures and that satisfies a duality relation with the type-frequency process. We refer to it as Bernstein coefficient process and to the relation as Bernstein duality. As an application, we derive criteria for the accessibility of the boundary. An intriguing feature in our construction is that multiple ancestral processes can be associated to the same forward dynamics. If there is enough time, I will explain how to characterize the set of optimal ancestral structures.

Philipp Gohlke: Zero measure Cantor spectrum for Schrödinger operators with quasi-periodic potentials
Spectral properties of Schrödinger operators determine the time evolution of an associated quantum mechanical system. Zero measure Cantor spectrum - first considered to be a rather exotic exception - is shown to be "generic" (in an appropriate sense) for more and more classes of potential functions.
The phenomen is well-known for so-called Sturmian sequences which arise from minimimal translations on the one-dimensional torus. More generally, quasi-periodic potentials are obtained by sampling along translation orbits on a finite-dimensional torus. Built on recent developments that relate torus translations to multidimensional continued fraction algorithms and generalized substitution systems, we show that zero measure Cantor spectrum can be found for almost every two-dimensional torus translations.
This is joint work with Jonathan Chaika, David Damanik and Jake Fillman.