BRIDGING THE GAP OBERSEMINAR ANALYSIS

WEDNESDAYS 11:00 AM VIA ZOOM

Schedule

04.11.20 **Gustav Holzegel**

Wave Equations on Black Hole Spacetimes – An Introduction

Abstract: This will be an introductory talk on the study of wave equation on black hole spacetimes. I will describe some of the fundamental geometric properties of black holes and how they are reflected in the PDE estimates. I will discuss the geometric origin of vectorfield estimates for the linear wave equation on Schwarzschild (and time permitting also the Kerr spacetimes) and explain in what ways they are robust to perturbations. The connection to the stability of black holes and the analysis of the Teukolsky equation will also be made.

18.11.20 **André Schlichting**

Oscillatory behavior of bubbleator dynamics

Absract: It is well known that kinetic models satisfying the so-called detailed balance condition have an entropy functional which can be used to derive convergence to equilibrium results. On the other hand, there are many physical situations (typically open systems) where it is natural to use kinetic equations for which a detailed balance condition does not hold. In these cases, more complicated dynamical behavior can arise, for instance, oscillatory behaviors. A class of kinetic equations where it is not a priori evident if temporal oscillations can occur are the coagulation-fragmentation equations.

In the talk, we concentrate on Becker-Döring type dynamics, in which only a single monomer can attach or detach from a cluster. These equations have been extensively used to model chemical-physical systems and especially bubbleator dynamics. In this talk, I will describe such models for which the onset of periodic oscillations can be proven by formal asymptotics. One of the models represents the formation of large clusters in a Becker-Döring equation having a source of monomers and removal of large clusters.

Joint work with Barbara Niethammer, Bob Pego, and Juan Velazquez.

25.11.20 **Angela Stevens**

Cross-Diffusion, "Aggregation"-Equations, and Singularities - an Introduction

Absract:Cross-diffusion models in biomathematics are of strong interest, e.g. in ecology. A well known example in microbiology is the by now classical Keller-Segel model for chemotaxis. The original system of four PDEs can be reduced to two PDEs: a diffusion equation with strong nonlinear drift for chemotactically

moving cells and a reaction-diffusion equation for the attractive chemical agent. In a further reduction this model relates to classical models for self-gravitational collapse. A change of sign for the nonlinear drift relates to semi-conductor equations.

Interestingly, the occuring blowup of solutions relates to the biological phenomena of self-organisation. In two spatial dimensions a crucial dichotomy was proved in the 90's, namely blowup of solutions vs. existence of global solutions in dependence of a critical parameter, which relates to the strength of the nonlinear drift or to a critical mass. Proofs depend, e.g. on the Moser-Trudinger inequality and non-trivial stationary states relate to a certain extent to the Gauss-Bonnet formula.

Solving the stationary reaction-diffusion equation for the chemical agent, and plugging it into the diffusion-drift equation, a non-local equation with Newtonian or Bessel potential results. Generalizing these potentials relates to the analysis of by now so-called aggregation equations.

In this talk we present qualitative results on pattern formation within this class of nonlinear equations, including the development of singularities.

02.12.20 **Joachim Lohkamp**

The Secret Hyperbolic Life of Positive Scalar Curvature

Abstract: This is a non-technical introduction to some ideas to derive results in scalar curvature geometry and general relativity using also singular solutions of variational problems. A typical class of such solutions are area minimizing hypersurfaces. They are known to admit complicated singular sets. We will see how, even without knowing the structure of these singular loci, Gromov hyperbolic geometry gives us a fine control over the asymptotic analysis of elliptic operators on such hypersurfaces towards their singularities.

09.12.20 **Konstantinos Zemas**

Rigidity estimates for isometric and conformal maps on the sphere

Abstract: In this talk I would like to discuss both linear and nonlinear stability aspects of the class of rigid motions (resp. Möbius transformations) of the standard round sphere among maps from the sphere into the ambient Euclidean space. Unlike similar in flavour results for maps defined on domains, not only an isometric (resp. conformal) deficit is necessary in this more flexible setting, but also a deficit measuring the distortion of the sphere under the maps in consideration. The latter is defined as an associated isoperimetric type of deficit.

We will mostly focus on the case when the ambient dimension is 3 and also explain why, in both cases, the estimates are optimal in their corresponding settings. The adaptations needed in higher dimensions will also be addressed. We also obtain linear stability estimates for both cases in all dimensions. These can be regarded as Korn-type inequalities for the combination of the quadratic form associated with the isometric (resp. conformal) deficit on the sphere and the isoperimetric one.

This is joint work with S. Luckhaus.

16.12.20 **Christopher Kauffman**

tba

20.01.21 **tba**

tba

27.01.21 **tba**

tba

03.02.21 **tba**

tba