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FAKULTÄT FÜR MATHEMATIK
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Einladung zur öffentlichen Defensio von

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Thema der Dissertation

Kinetic Modelling of Colonies of Myxobacteria

Abstract: Myxobacteria are rod-shaped, social bacteria that are able to move on flat surfaces by „gliding“ and form a fascinating example of how simple cell-cell interaction rules can lead to emergent, collective behavior. Observed movement patterns of individual bac- teria include straight runs with approximately constant velocity, alignment interactionsand velocity reversals.

A new *kinetic model of Boltzmann-type for colonies of myxobacteria* of the form

$$\partial_t f + \omega(\phi)\cdot\nabla_x f = 2 \int_{\mathbb{T}^1\times\mathbb{T}^1_A} b(\tilde{\phi},\phi_*)\tilde{f}f_* d\phi_* + \int_{\mathbb{T}^1_{RE}} b(\phi^\downarrow,\phi_*^\downarrow) f^\downarrow f_*^\downarrow d\phi_* - \int_{\mathbb{T}^1} b(\phi,\phi_*) f f_* d\phi_*,$$

will be derived and investigated. Here, $\omega(\phi) = (\cos\phi, \sin\phi)$, $\mathbb{T}^1$ denotes the one-dimensional flat torus of length 2π and $\tilde{\phi} := 2\phi - \phi_*$, $\phi^\downarrow := \phi + \pi$ for $\phi, \phi_* \in \mathbb{T}^1$.
For this model an existence and uniqueness result is shown in a spatially homogeneoussetting as well as exponential decay to an equilibrium in a special setting.

Considering the above model with just *reversal interactions* between agents, existence as well as exponential convergence to a symmetric equilibrium is proved. This result could be generalized to an abstract setting for reversal dynamics on a broad class of metric spaces equipped with a suitable symmetry structure.

Further, the model extension with additional consideration of *Brownian forcing in the free flight phase* of single bacteria, which then gives rise to a directional diffusion term at the level of the kinetic equation, is matter of investigation. Besides an existence result, bifurcation behavior with respect to the diffusion parameter is characterized.

Last, the urge to overcome the simplification of instantaneous binary bacterial collisions, standard in kinetic modelling, was inspiration to introduce a kinetic model for *time-resolved binary interactions* between individuals, a completely novel approach in kinetic theory. The proposed model will also be presented and consists of a system of two equations, one for the distribution of particles in free flight, one for the distribution of pairs of particles in an alignment collision process.

Prüfungssenat

Univ.-Prof. Mag. Dr. Andreas Cap
(Vorsitz)
(Universität Wien)

Univ.-Prof. Dr. Christian Schmeiser
(Universität Wien)

Prof. Dr. Barbara Niethammer
(Universität Bonn)

Prof. Dr. Axel Klar
(TU Kaiserslautern)

Zeit:
Donnerstag, 22. April 2021, 14:00 Uhr
Time: Apr 22, 2021 02:00 pm Vienna

Ort:

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