2024 人大-中大反应扩散方程研讨会日程表

2024 年 11 月 23 日周六，人民大学国学馆 228		
时间	会议内容	主持人
8:15-8:40	柯嫒元教授代表中国人民大学数学学院致辞 姚正安教授代表中山大学数学学院致辞 合影	向　田
8:40-9:15	王治安（香港理工大学） Boundary-layer problem for the Keller-Segel model	尹景学
9:15-9:50	何俊锋（深圳技术大学） Propagation phenomena of reaction-diffusion equations with effective boundary condition	李万同
9:50-10:25	陶为润（东南大学） Global boundedness and Turing-Hopf bifurcation of prey-taxis systems with hunting cooperation	周蜀林
10:25-10:45	休息、茶歇	
10:45-11:20	郭宏骏（同济大学） Spreading speeds for spatially periodic reaction-diffusion equations	吴雅萍
11:20-11:55	王　巍（大连理工大学） Global boundedness in a 2D chemotaxis Navier-Stokes system with flux limitation and nonlinear production	穆春来

12:00-14:00	午餐　(中区食堂三层汇贤府大厅自助)	
14:10-14:45	王玉兰（西华大学） Global existence and finite-time blow-up in a 2D Keller-Segel system	陶有山
14:45-15:20	孙宁奎（山东师范大学） A free boundary problem with advection and seasonal succession	张正策
15:20-15:55	李庚霖（上海交通大学） Analysis of a two-dimensional nutrient taxis system with doubly degenerate diffusion and logistic proliferation	向昭银
15:55-16:15	休息、茶歇	
16:15-16:50	曹　杨（大连理工大学） Analysis of local behavior near fronts for degenerate pseudo-parabolic equation	王一夫
16:50-17:25	侯倩倩（哈尔滨工业大学） Boundary layer problem on the chemotaxis-Navier-Stokes system with Robin boundary conditions on oxygen	李玉祥
17:25-18:00	漆达镛（北京大学） Global existence and boundedness in the oncolytic virus model in 2 and 3 dimensional spaces	张　超
18:00-21:00	会议晚宴 (中区食堂三层汇贤府)	

2024 年 11 月 24 日周日，人民大学国学馆 228		
时间	会议内容	主持人
8:30-9:05	王 琪（西南财经大学） Spatial Solow models with labor migration and technology spillover	王明新
9:05-9:40	王小六（东南大学） The anisotropic curvature flow with forcing term in the plane	娄本东
9:40-10:15	姚若飞（华南理工大学） Uniqueness of critical points of the second Neumann eigenfunctions on triangles	周茂林
10:15-10:35	休息、茶歇	
10:35-11:10	赵 昆（哈尔滨工程大学） Vasculogenesis: Insights from PDE models	桂长峰
11:10-11:45	汪泓泽（香港中文大学（深圳）） Boundary spiky steady states of chemotaxis systems in a symmetric convex planar domain	崔仁浩
11:45-12:00	闭幕式	李慧聪
12:00	午餐 (中区食堂三层汇贤府大厅自助)	
14:00	自由讨论、离会	

《2024 人大-中大反应扩散方程研讨会》
报告题目与摘要

Analysis of local behavior near fronts for degenerate pseudo-parabolic equation
曹杨（大连理工大学）

摘 要： In this talk, we introduce a model with dynamical saturation-pressure relation for groundwater flow. The resulting model equation is a nonlinear degenerate pseudo-parabolic equation. We discuss the travelling wave solutions and the local behavior near fronts.

Spreading speeds for spatially periodic reaction-diffusion equations
郭宏骏（同济大学）

摘要： In this talk, we consider the large time dynamics of solutions of spatially periodic reaction-diffusion equations with unbounded initial support. We establish the F-G formula for the spreading speed.

Propagation phenomena of reaction-diffusion equations with effective boundary condition
何俊锋（深圳技术大学）

摘 要： In this talk, we are mainly concerned with propagation phenomena of reaction-diffusion equations with effective boundary condition, which is meant to model the physical scenario of a road with fast diffusion as the width of the road shrinks. We show that, in an

infinite strip, with effective boundary condition on one boundary and homogeneous Neumann boundary condition on the other, the reaction-diffusion equation with either ignition type or bistable type nonlinearity admits a unique traveling wave solution. Precise decay rates of the traveling wave solutions are also derived.

Boundary layer problem on the chemotaxis-Navier-Stokes system with Robin boundary conditions on oxygen

侯倩倩（哈尔滨工业大学）

摘要：This talk is concerned with the boundary layer problem on a chemotaxis-Navier-Stokes system modelling boundary layer formation of aerobic bacteria in fluid. Neglecting the influence of the fluid, and completing the chemotaxis-only subsystem with physical Robin-type boundary conditions for oxygen, we first show that the gradients of its radial solutions in a region between two concentric spheres possessing boundary layer effects as the oxygen diffusion rate ε goes to zero. Then we proceed to show that the full chemotaxis-Navier-Stokes system in the half plane of R^2 also possesses boundary layer effects and the thickness of the boundary layer is of order $O(\varepsilon^{1/2})$.

Analysis of a two-dimensional nutrient taxis system with doubly degenerate diffusion and logistic proliferation

李庚霖（上海交通大学）

摘要：This talk presents recent advances in the mathematical analysis of a nutrient taxis system characterized by doubly degenerate diffusion and

logistic proliferation. The model, motivated by the behavior of bacteria in nutrient-poor environments, introduces a novel 'cross degeneracy,' which contrasts sharply with conventional chemotaxis consumption models with nondegenerate diffusion, particularly in terms of the asymptotic behavior of solutions. In the first part of the talk, we will discuss some recent analytical results on cross degeneracy. In the second part, we will focus on establishing the global existence of continuous weak solutions, demonstrating how the inclusion of a logistic growth term prevents blow-up and ensures global solvability.

Global existence and boundedness in the oncolytic virus model in two-dimensional and three-dimensional spaces

漆达镛（北京大学）

摘要：Oncolytic virotherapy is an emerging biological treatment strategy. In 2019, Alzahrani et al. proposed a triply haptotactic cross-diffusion system to describe the spatiotemporal changes in cancer cells after treatment with this therapy. Previous studies simplified the model's assumptions. Our primary focus is on the original model, under the premise of triply haptotactic, to explore the conditions for the existence and boundedness of solutions to the system in both two-dimensional and three-dimensional spaces. We have concentrated on addressing the lack of regularity arising from the asymmetry between virus particles and the extracellular matrix and have weakened the restrictive conditions as much as possible.

A free boundary problem with advection and seasonal succession

孙宁奎（山东师范大学）

摘要： This talk is devoted to the dynamical behavior of solutions to a reaction-diffusion-advection equation with seasonal succession and free boundary conditions. We obtain that when the coefficient of advection is small, there is a vanishing-spreading dichotomy result; when the coefficient of advection is medium-sized, there is a vanishing-transition-virtual spreading trichotomy result; when the coefficient of advection is large, only vanishing happens. We also show that the profiles of (virtual) spreading solutions are uniquely determined by the corresponding periodic parabolic problem in half line.

Global boundedness and Turing-Hopf bifurcation of prey-taxis systems with hunting cooperation

陶为润（东南大学）

摘 要： This talk concerns a predator-prey system with hunting cooperation and prey-taxis under homogeneous Neumann boundary conditions. We establish the existence of globally bounded solutions in two dimensions. In three or higher dimensions, the global boundedness of solutions is obtained for the small prey-tactic coefficient. Linear stability analysis is conducted to show that hunting cooperation and prey species diffusion can drive the instability to induce Turing-Hopf bifurcation. It is also found that prey-taxis is a factor stabilizing the positive constant steady state. This talk is based on a joint work with Prof. Zhi-An Wang (PolyU).

Boundary spiky steady states of chemotaxis systems in a symmetric convex planar domain

汪泓泽（香港中文大学（深圳））

摘要：We investigate the existence of the non-radial steady states of the Keller-Segel model in a bounded convex planar domain that is symmetric with respect to two orthogonal directions via global bifurcation. It is shown that non-radial steady states exist if the chemotactic coefficient exceeds a critical threshold. To model the cell aggregation, one of the most important phenomena in chemotaxis, we also show that boundary spiky solutions exist if the chemotactic coefficient tends to infinity. Our results provide a new insight on the mechanism of the pattern formation and cell aggregation in a bounded convex planar domain with two orthogonal directions.

Spatial Solow models with labor migration and technology spillover

王琪（西南财经大学）

摘 要： Spatial Solow models attempt to explain uneven regional economic development by accounting for spatiotemporal heterogeneity in the inputs to economic growth. We consider labor mobility and technology spillovers as the two key factors contributing to heterogeneity in a spatial Solow economic market. The choice of a concave-convex aggregate production function deviates from the classical Inada conditions and allows for the simultaneous description of poverty traps and economic agglomeration, which are traditionally treated independently.

The first part of the talk presents some theoretical results such as global stabilization and bifurcation of the spatial Solow model with capital-induced labor migration. Numerical simulations and a global bifurcation diagram show how capital-induced labor migration can affect aggregate wealth, income inequality, and regional and poverty traps. The second part concerns the recovery of the spatial Solow model when technology spillovers are included. The recovery of the PDE system is then framed as an inverse problem for which a nonparametric approach is introduced. While missing more data generally leads to larger errors in system recovery and welfare prediction, our approach is robust to data corruption and data loss, and our studies underscore its practical utility in real-world applications where imperfect measurement is often unavoidable.

Global boundedness in a 2D chemotaxis-Navier-Stokes system with flux limitation and nonlinear production

王巍（大连理工大学）

摘要： In this talk we will show the global boundedness of classical solutions for a 2D chemotaxis-Navier-Stokes system with flux limitation and nonlinear production. It is proved that for any reasonably smooth initial data, the associated initial-boundary value problem possesses a globally bounded classical solution if the key parameters $\alpha \in \mathbb{R}$ and $\beta > 0$, measuring the gradient-dependent limitation of cross-diffusive fluxes and quantifying the capacity of cells to self-enhance the chemotactic attraction, satisfy $\alpha > (2\beta-1)_+ - 1$ for $0 < \beta < 1$, or $\alpha > 1 - 1/(2\beta-1)$ for $\beta \geq 1$.

The anisotropic curvature flow with forcing term in the plane

王小六（东南大学）

摘要：We investigate a class of anisotropic curvature flow with forcing term, which arises from the phase transition model. The notions of anisotropic curvature, anisotropic length and the generalization of corresponding isoperimetric inequality are employed to overcome the difficulty caused by the anisotropy. As a result, we show that there is a critical value for forcing term, which determines the evolution behavior of flow is shrinking, expanding or globally bounded.

Global existence and finite-time blow-up in a 2D Keller-Segel system

王玉兰（西华大学）

摘要：In this talk, we consider a Keller-Segel system with matrix-valued sensitivity. We shall show that there exists a critical mass to distinguish global existence and finite-time blow-up of the associated no-flux-Dirichlet initial-boundary value problem.

Boundary-layer problem for the Keller-Segel model

王治安（香港理工大学）

摘要：In this talk, we shall discuss the boundary layer problem of the singular Keller-Segel model with physical boundary conditions in any dimensions. First, we obtain the existence and uniqueness of boundary-layer solution to the steady-state problem and identify the

boundary-layer profile and thickness near the boundary. Then we find the asymptotic expansion of boundary-layer profile in terms of the radius for the radially symmetric domain, which can assert how the boundary curvature affects the boundary-layer thickness. Finally, we establish the nonlinear stability of the unique boundary-layer steady state solution with exponential convergence rate for the radially symmetric domain.

Uniqueness of critical points of the second Neumann eigenfunctions on triangles

姚若飞（华南理工大学）

摘要：In 1974, J. Rauch proposed a 50-year-old open problem concerning the second Neumann-Laplace eigenfunction, which is known as the Hot Spots Conjecture. It states that the second Neumann eigenfunction of the Laplacian attains its global maximum (hottest point) exclusively on the boundary of the domain. Notably, for triangular domains, the nonexistence of interior critical points was recently established by Judge and Mondal in [Ann. Math., 2022]. Nevertheless, several pertinent questions surrounding the second Neumann eigenfunction in triangles lingered unanswered. In this talk, we delve into these unresolved issues such as (1) the uniqueness of non-vertex critical point, (2) the sufficient and necessary conditions for the existence of non-vertex critical point, (3) the exact location of the global extrema, (4) the location of endpoints of the nodal line, and so on. Our findings not only confirm both the original theorem and Conjecture 13.6 proposed by Judge and Mondal in [Ann. Math., 2020], but also achieve a key objective outlined in the Polymath 7

research thread 1 led by Terence Tao. Our approach employs the continuity method via domain deformation. This is a joint work with Prof. Hongbin Chen (XJTU) and Prof. ChangfengGui (UM).

Vasculogenesis: Insights from PDE models

赵昆（哈尔滨工程大学）

摘要：This talk is oriented around hyperbolic-parabolic PDE models describing the mechanistic and chemotactic properties of vasculogenesis, which consist of the compressible Euler equations with linear damping and reaction-diffusion equations through nonlocal coupling. Depending on the parametric and boundary conditions, different steady state solutions are constructed on bounded domains, some of which are shown to be locally exponentially stable.