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New York University, Abu Dhabi Campus - United Arab Emirates
Visiting scholar invited by laboratory AGM
Curriculum Vitae / Projet

Research project

Analysis of PDEs with a focus on singularity formation of solutions and long-time asymptotic behaviors. I'm interested in PDEs arising from physics, geometry and mathematical biology:

- *Nonlinear Reaction-Diffusion equations like semilinear parabolic equations/systems, higher order parabolic equations;*
- *Geometric evolution equations like the harmonic map heat flow, wave maps;*
- *Nonlinear Aggregation-Diffusion equations like the Keller-Segel equation;*
- *Nonlinear wave equations.*

I'm also interested in numerical methods for PDEs, in particular in blowup problems.

In this project we focus on the study of singularity formation for the classical Keller-Segel system modeling biological chemotaxis processes and stellar dynamics. Singularity formation is important for understanding the physical limitations of the models: at the singularity, the physical validity of the model necessarily breaks down. Even if the singularity is known to occur, understanding the precise dynamics would be important for determining what additional physical effects need to be taken into account for a proper model. Moreover, for models lacking simple monotonicity formulas, proving the singularity formation may simultaneously require a precise description of the dynamics near the singularity. After the works [1, 3, 2], we are interested in investigating new types of singularities such as multiplecollapsing solutions (collision phenomenon) in both L 1 -critical and L 1 -supercritical regimes. A few results that describe the collision of solitons have been established for wave-type equations, see for example [4], [5] [6, 7, 9], [8] from which basic ideas could be used to tackle the Keller-Segel system. This is a joint project with C. Collot, T. Ghoul, N. Masmoudi.