Title : **Probabilistic and spectral insights onto diffusion-controlled reactions in chemistry and biology**

First Name : Denis	**Name** : Grebenkov	**Laboratory** : PMC

Email : denis.grebenkov@polytechnique.edu

Webpage : https://pmc.polytechnique.fr/pagesperso/dg/

Research Area : Biophysics, Mathematical Physics

Methods: numerical simulations, spectral methods, PDE, probability

PhD track subject :

Diffusion-mediated surface phenomena are crucial for human life and industry, with examples ranging from oxygen capture in lungs to heterogeneous catalysis, gene regulation, membrane permeation, and filtration processes. A novel probabilistic approach was recently proposed to investigate the intricate dynamics of diffusing particles near a reactive surface. This general formalism allows one to describe new surface reaction mechanisms and to model various natural phenomena in physics, chemistry and biology. The candidate will gain multiple skills in theoretical tools and numerical simulations, and undertake a truly interdisciplinary study within an active international environment.

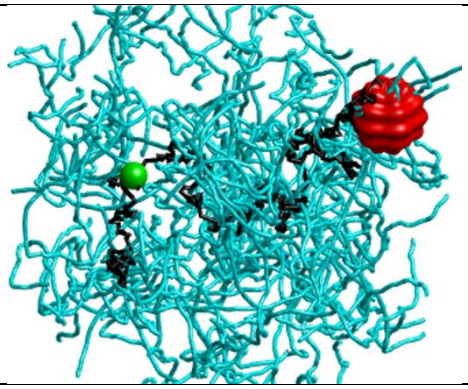

Figure. Diffusive motion of a molecule towards a protein within a mesh of actin filaments inside the cytoplasm, from [3].

References :

[1] D. S. Grebenkov, Paradigm Shift in Diffusion-Mediated Surface Phenomena, Phys. Rev. Lett. **125**, 078102 (2020)

[2] D. S. Grebenkov, *Spectral theory of imperfect diffusion-controlled reactions on heterogeneous catalytic surfaces*, J. Chem. Phys. **151**, 104108 (2019)

[3] Y. Lanoiselée, N. Moutal, and D. S. Grebenkov, *Diffusion-limited reactions in dynamic heterogeneous media* Nature Comm. **9**, 4398 (2018)