



<b>Project title</b>	Noise-induced complexity in multiscale systems
<b>Principal supervisor</b>	Marc Pradas
<b>Second supervisor</b>	Michael Wilkinson
<b>Discipline</b>	Applied mathematics
<b>Research area/keywords</b>	Stochastic processes, critical phenomena, Brownian motion
<b>Suitable for</b>	Full time students

### **Project background and description**

Multiscale systems are ubiquitous in nature and modern society and they are characterised by the presence of several length and/or time scales which are nonlinearly interacting with each other. This nontrivial interaction often leads to complex spatio-temporal behaviour, such as chaotic dynamics or the emergence of pattern formation.

Additionally, these systems may be affected by external or internal random fluctuations, i.e. noise, which under some conditions may be able to change the dominant dynamics of the system or induce a completely different behaviour. This is called noise-induced phenomena and examples include pattern and order created out of noise, noise-induced stabilization, and noise-induced phase transitions and intermittent behaviour; with applications found in many areas such as climate prediction, chemical plants, cell biology problems, nonlinear networks, or economics.

This project concerns with the study (both analytically and numerically) of how the noise interacts with the different scales of the system to induce unexpected complex behaviour. It will require the use of stochastic processes and probability theory tools as well as critical phenomena theory. Suitable students will have a strong background on statistical physics or applied mathematics.

If you are interested, contact Marc Pradas: [marc.pradas@open.ac.uk](mailto:marc.pradas@open.ac.uk)

### **Background reading/references**

- See on Marc Pradas' website <http://www.open.ac.uk/people/mp22246#tab2> the list of publications, particularly those about noisy systems.
- A classic reference on this problem is the book: *Noise-Induced Transitions: Theory and Applications in Physics, Chemistry, and Biology*. W. Horsthemke, R. Lefever. Springer, 1984.