

PhD studentships with Prof M S Turner - Active matter

Active matter is a rapidly growing field in modern Physics. I will usually have PhD projects available for *highly motivated students* in areas that include:

1) **The physics of fluid membranes** Each living cell is bounded by a sack-like membrane. Using differential geometry and statistical mechanics we study the conformation, dynamics and heterogeneity of these membranes. One timely PhD project would involve understanding the coupling between certain channels that reside in the membrane and the membrane itself. Many of these channels are associated with diseases or neurophysiological (mis)function. The shape of this channel can determine the shape of the surrounding membrane in much the same way that a massive object distorts space-time. Recent experiments from a work leading group in Paris indicate a systematic variation of the mobility of this channel with the tension applied to the membrane. The membrane is to be treated as a quasi-two dimensional fluid and to be analysed using a fully covariant version of Stokes equation, initially in the perturbative limit where the membrane is nearly flat. A student on this theoretical project would benefit from close contact with Dr Richard Morris a postdoctoral researcher working with me on related problems.

2) **Collective motion in swarms** Collective motion occurs in animal systems, e.g. bird flocks, fish shoals, insect swarms, human crowds etc. It also occurs in thermodynamic systems in which particle motion responds to gradients in fields such as temperature or concentration of a solute species. These fields can themselves be controlled by the distribution of particles, resulting in a rich space of dynamical solutions that is only just beginning to be understood. One urgent priority is the development of continuum models of systems with *long ranged* interactions. Another is an extension of models of animal behaviour to include the effects of very short term memory. There are opportunities here both in theory and experiment, where a student would benefit from close contact with Dr Jack Cohen a postdoctoral researcher working with me on related problems.

3) **Socio-economic systems** Physicists are sometimes guilty of viewing Physics as the research field that has most relevance to the BIG problems faced by humanity. Physics does have relevance for some problems, like energy security and (perhaps) climate change. However, it is my belief that the most pressing short term problems lie in understanding socio-economic systems and the evolution of systems of governance. These problems are amenable to analytic or computational approaches and the training that a Physicist receives at tackling complex unstructured problems provides an ideal background devoid of the tribal dogmas afflicting classical economics. We are currently working at models of the hedge fund industry, evolutionary game theory and models for opinion formation in social networks that include the effects of the media. There are opportunities here in theory, where a student might benefit from close contact with Dr Alex Karlis a postdoctoral researcher working with me on related problems.

For further details see under *research* at <http://www.msturner.net>