



Doctoral positions 2019

Thesis supervisor

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Thesis topic

The quantum theory of biological systems: finding quantum design rules for bio-organic nano-devices

*Supervisors: Dr Brendon Lovett (University of St Andrews); Dr Alex Chin (Sorbonne Université). *

Nanoscale biological processes must necessarily be quantum mechanical in nature. Traditional approaches to modelling these quantum dynamics capture the behaviour of only a few "system" particles by assuming they are weakly coupled to a passive thermal environment: This approach is completely inadequate for understanding quantum biology, where many degrees of freedom interact strongly together, far from equilibrium and with long-lasting 'memory' in both space and time of their encounters.

Until now, the difficulty of going beyond weak coupling models has limited what quantum mechanics can say about biology. In this project, you will expose the fundamental quantum physics that links diverse bio-processes by exploiting ground-breaking new techniques developed by the supervisory team for modelling out-of-equilibrium open quantum systems in real space and time [1,2].

You will create models based on key functional motifs found in experimental protein structures and - in the general framework of biological nanomachines (BNMs) – aim to demonstrate the crucial, ubiquitous role of strong system-environment coupling in efficient biological functions such as energy harvesting, molecular sensing and – for the first time – self-regulation and allostery. Building up a truly microscopic conceptual framework for BNMs, we ultimately aspire to establish a comprehensive blueprint for translating quantum biological insights into disruptive organic nanotechnologies.

[1] Schröder, Turban, Musser, Hine, Chin, Nature Communications *10 *(1), 1062 (2019)



[2] Strathearn, Kirton, Kilda, Keeling and Lovett, Nature Communications *9* 3322 (2018)

*The successful candidate will spend time working in both St Andrews and Paris. Please contact Dr Brendon Lovett (**bwl4@st-andrews.ac.uk* <mailto:bwl4@st-andrews.ac.uk>*) and/or Dr Alex Chin (**alex.chin@insp.jussieu.fr* <mailto:alex.chin@insp.jussieu.fr>*) for further details.*

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