

EPSRC Centre for Doctoral Training in Cross-Disciplinary Approaches to Non-Equilibrium Systems (CANES)

Peter Sollich

Disordered Systems Group, King's College London



University of London

Outline

- 1 Non-equilibrium systems & the CANES mission
- 2 Vision for CANES training programme
- 3 London hub and partners
- 4 MSc programme
- 5 Research project
- 6 Transferable skills
- 7 Advice and further resources

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Non-equilibrium systems

- Typically **time-irreversible**
- Aging, driven (dissipate energy input)
- Cascades of failure, extreme events

Example non-equilibrium **challenges**

- Spread of epidemics
- Likelihood of extreme meteorological events
- Optimize nanoparticles for drug and gene delivery
- Control heating in fast electronic devices
- Stability of financial networks
- Predict the fate of cellular states

National and international context

- Emergence and physics far from equilibrium identified by EPSRC as Grand Challenge
- EPSRC NetworkPlus, to develop roadmap
- Similar initiatives in USA: Office of Science (Dept of Energy) grand challenge, Non-Equilibrium Energy Research Centre
- CANES will bring UK to forefront of this research agenda
- CANES is integrated into:
 - Thomas Young Centre (materials theory and simulation)
 - CoSyDy (complex systems dynamics) LMS network
 - European network NETADIS (statistical physics on / for networks)
 - CECAM-UK-JCMaxwell node (advanced computation)

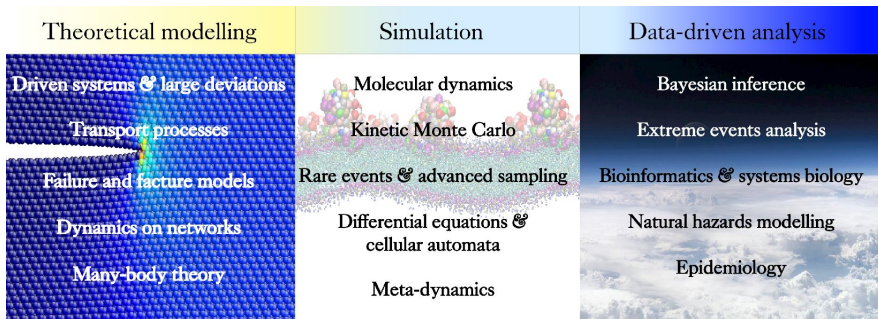
The CANES mission

The mission of CANES is to train future research leaders in the understanding, control and design of systems far from equilibrium, based on rigorous training in theoretical modelling, simulation and data-driven analysis, and a breadth of awareness of common themes across disciplines.

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Cohesive training in three strands



- Strands cut across disciplines
- Existing tools need to be applied to new areas
- Applications provide “driving questions” for new tools

Innovative 1+3-year programme

- Taught 1st year, cohort integration via group research projects
- Annual retreat
- Cross-disciplinary PhD projects
- Open questions sandpits
- Master classes, journal clubs, seminars
- Transferable skills, Creativity-at-home course
- Contributions to outreach, social media channels
- Careers sessions & fora
- Internships in year 3
- Biennial CONES conference

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Participating departments and universities

Departments at King's College London

- Mathematics, Physics, Informatics, Chemistry
- Geography
- Randall Division of Cell & Molecular Biophysics
Institute of Pharmaceutical Science
Centre of Human & Aerospace Physiological Sciences

Partners

- Computational Chemical Physics, Theoretical Physics (Imperial College)
- Condensed Matter and Materials Physics (UCL)
- London Centre for Nanotechnology
- Mathematical Sciences (Queen Mary London)

Industrial and international academic partners

Industry

- National Physical Laboratory
- KAUST (Saudi Arabia)
- Microsoft Research Cambridge
- The Francis Crick Institute (under construction)
- Fios Genomics
- Financial Network Analysis
- DZB (co-operative bank network)

Academic

- Universität Potsdam, TU Berlin, Jülich, UPMC Paris, Montpellier 2, UC Irvine, Wuhan University, ...

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First semester modules

15 credits each, semester = term

- Dynamical modelling of non-equilibrium systems
- Simulation methods for non-equilibrium systems
- Statistical learning and data-driven analysis
- Rare events and large deviations in non-equilibrium systems*
- Modelling quantum systems*

*Choose one for examination, but need to audit other one – for cohort coherence and flexibility

- Mathematical foundation course (as needed)
- **Timetable** includes flexible slots for additional seminars or tutorials

Second semester modules

15 credits each

- Advanced topics in non-equilibrium systems
- Topics covered (choose 3 for examination):
 - Aging processes
 - Fluctuation theorems
 - Green's functions
 - Non-equilibrium networks
 - Advanced simulation methods
 - Non-stationary time series
- One optional module – discuss with senior CDT tutor

Research methods modules

Second semester & summer, 30 credits each

- Three modules, one for each strand of CANES
- Introductory lectures, then group-based research projects
- Output: project reports and presentations
- Deadline early Sept 2015

Mark ranges

For most modules (**level 7**):

- **40-49%**: condoned fail / D
- **50-59%**: pass / C
- **60-69%**: merit / B
- **70-100%**: distinction / A

For level 6 modules (possible as options):

- Credit for marks $\geq 33\%$
- But count as condoned fail even if mark $\geq 50\%$

Credits, MSc award conditions

- Need to take **180 credits**
- Can take up to 210 credits,
but may be better to audit extra modules instead
- Can have at most 30 credits from condoned fails
- Research methods modules are **core** and must be passed
- Final award **pass, merit or distinction**,
based primarily on mark average

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Work towards research project in year 1

- PhD project proposals presented in semester 1
- Discussion with potential supervisors
- Project selection & allocation in early 2015
- Work out detailed **project outline** by end of summer

Progression to years 2–4

- Normally requires passing MSc with **merit**
- Also approval of project outline
- Formal registration is then for MPhil in year 2
- Transfer to PhD 9-15 months later,
based on transfer report and viva
- Regular (6-monthly) progress monitoring

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Transferable skills training

- Co-ordinated by KCL **Graduate School**
- National framework: Researcher Development Programme

Topics include:

- Time management
- Being an effective researcher
- Presentation skills
- Good science writing
- Databases and e-resources
- Stress management
- Getting the most out of conferences, . . .

Training needs analysis

- Reviewed annually
- To identify what training you need, what courses would be most beneficial
- Can include additional science background, including LTCC (**London Taught Course Centre**) courses
- Also language courses (English Language Centre)

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People you can and should talk to

- **Peter Sollich** (CANES Director)
General feedback, input, suggestions
- **Chris Lorenz** (CDT tutor)
Module choices, training needs in year 1
Initial meetings Mon 22 Sept 2014
- **Lilli Cleghorn** (CANES Centre Manager)
Almost everything else
- Your **module lecturers and tutors** – after lectures,
in office hours

Other resources

- CANES **website** www.kcl.ac.uk/canes/
- **KEATS** e-learning platform
- Google **calendars** for events and timetables (to come)
- Student mailing list, facebook, twitter (to come)
- General KCL student support:
The Compass, Careers Service, ...

We are excited about building CANES

... and hopefully so are you!