SUSSP71: Frontiers in Quantum Dynamics & Quantum Optics

71st Scottish Universities Summer School in Physics

21st July to 2nd August 2015

University of Strathclyde
Glasgow, Scotland
Dear SUSSP71 Participant,

It is a pleasure to welcome you to the University of Strathclyde in Glasgow, Scotland, UK for the Seventy-First Scottish Summer School in Physics, whose topic is Frontiers in Quantum Dynamics and Quantum Optics. The SUSSP series of schools has been running since 1960, with a school almost every year in that period. For SUSSP71 we have assembled a cast of lecturers of the highest calibre to enlighten us all with the latest developments in our field. The schedule includes plenty of room for discussion sessions and a social programme, both with formal and informal elements. Summer schools are primarily a gathering of scientists at a similar early stage in their careers and can therefore provide research contacts and, more importantly, friendships that can last a lifetime. We hope that you enjoy your time in Glasgow and find the School stimulating and exciting.

With Best Wishes,

John Jeffers,
School Director, on behalf of the Organising Committee.

Summer school scope
The two topics, quantum optics and control of quantum dynamics, make up the themes of the 71st Scottish Summer School in Physics, which has three main objectives:

• To broaden and deepen the background knowledge of young researchers in the general areas of quantum optics and quantum dynamics through the simple medium of a series of advanced lectures given by acknowledged experts in the field.
• To provide a perspective of the latest research and future trends in this area via a set of hot topics shorter sessions.
• To stimulate new research collaborations and ideas among peers.

Speakers for SUSSP71
- Sir Peter Knight, Imperial College, UK
- Peter Zoller, University of Innsbruck, Austria
- Philippe Grangier, Institut d’Optique, France
- Gerd Leuchs, Max-Planck-Institute for the Science of Light, Germany
- Ed Hinds, Imperial College, UK
- Howard Carmichael, University of Auckland, New Zealand
- Ferdinand Schmidt-Kaler, University of Mainz, Germany
- Miles Padgett, University of Glasgow, UK
- Leticia Tarruell, Institute of Photonic Sciences, Spain
- Randy Hulet, Rice University, USA
- Giovanna Morigi, Universität des Saarlandes, Germany
- Joachim Brand, Massey University, New Zealand

SUSSP71 committee – University of Strathclyde
Dr. John Jeffers (Director)
Dr. Paul Griffin, Dr. Daniel Oi & Dr. Alison Yao (Secretaries)
Dr. Marco Piani (Treasurer)
Dr. Aidan Arnold & Prof. Gian-Luca Oppo (Proceedings Editors)
Prof. Erling Riis, Prof. Andrew Daley & Prof. Stefan Kuhr (Scientific Committee)
Information

Conference venue
The Technology and Innovation Centre (TIC),
99 George Street
G1 1RD

Meals
• Breakfast @ Aroma Cafe – Breakfast will be provided for the participants staying in the University accommodation
• Lunch @ The Technology and Innovation Centre
• Dinner @ Aroma Cafe – Dinner is open to all participants

Aroma Cafe (The Lord Todd)
6 Richmond St
G1 1XQ

Banquet
Barony Hall,
1 McLeod St
Glasgow G4 0RA

Civic reception
Glasgow City Chambers
George Square
G2 1DU

Internet connection
If you are visiting from an institution that participates in the eduroam scheme, you can connect to the “eduroam” SSID to gain basic Internet connectivity. Your device will require to be configured in advance before you arrive. To log in you should use the credentials supplied by your home institution.

We also provide access to the free service “_The Cloud” for visitors. When you connect to this service you will have to create an account.

Local details and general information
http://sussp71.phys.strath.ac.uk/

Organiser Contacts
E-mail: sussp71@gmail.com
Dr. John Jeffers
john.jeffers@strath.ac.uk
Dr. Paul Griffin
paul.griffin@strath.ac.uk
+44 (0) 7926 688 310
<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30</td>
<td>Breakfast</td>
<td>Breakfast</td>
<td>Breakfast</td>
<td>Breakfast</td>
<td>Breakfast</td>
<td>Breakfast</td>
<td>Breakfast</td>
</tr>
<tr>
<td>09:00-10:20</td>
<td>Arrivals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:20-10:50</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
</tr>
<tr>
<td>10:50-12:10</td>
<td>PZ, GL, PK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:10-13:30</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:30-14:50</td>
<td>PZ, GL, RH, HC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:50-15:50</td>
<td>Register</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:50-15:50</td>
<td>Discuss/Question</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:50-16:20</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
</tr>
<tr>
<td>16:20-17:40</td>
<td>PK, HC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:40-18:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18:30-19:30</td>
<td>Welcome buffet</td>
<td>Dinner</td>
<td>Dinner</td>
<td>Dinner</td>
<td>Dinner</td>
<td>Dinner</td>
<td>Banquet:</td>
</tr>
<tr>
<td>Evening</td>
<td></td>
<td>Civic reception</td>
<td>Dinner</td>
<td>Dinner</td>
<td></td>
<td></td>
<td>Dinner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lecture programme

Howard Carmichael, University of Auckland
Lecture 1: Open quantum systems
Lecture 2: Jumps & photon counts
Lecture 3: Intervention & feedback

Gerd Leuchs, Max-Planck-Institute for the Science of Light
Lecture 1: Temporal and spectral properties of classical light
Lecture 2: Quantum optics of a single mode
Lecture 3: Quantum optics of several modes

Peter Zoller, University of Innsbruck and IQOQI
Lectures 1, 2 & 3: Open many-body quantum systems with atoms and ions

Randy Hulet, Rice University
Lecture 1: Magnetism of fermions in optical lattices I
Lecture 2: Magnetism of fermions in optical lattices II
Lecture 3: Matter-wave solitons: Collisions on the edge of Integrability

Peter Knight, Imperial College
Lecture 1: Bipartite systems, entanglement and the Schmidt decomposition
Lecture 2: Spin boson interaction and the Jaynes Cummings model as an exemplar
Lecture 3: Beam splitters, mode correlations, quantum walks, Boson Sampling

Miles Padgett, University of Glasgow
Lectures 1 & 2: Light’s twist: Orbital angular momentum
Lecture 3: Computational imaging

Joachim Brand, Massey University
Lecture 1: Solitons as nonlinear waves
Lecture 2: Multidimensional solitons
Lecture 3: Quantum solitons and beyond

Ferdinand Schmidt-Kaler, University of Mainz
Lecture 1: Introduction to ion trapping and cooling
Lecture 2: Precision measurements with trapped ions
Lecture 3: Applications of trapped ions in quantum computing and quantum simulation

Philippe Grangier, Institut d’Optique
Lecture 1: Quantum optics with continuous variables
Lecture 2: Quantum cryptography with discrete and continuous variables
Lecture 3: Towards optical quantum networks

Ed Hinds, Imperial College
Lecture 1: Is the electron round? Searching for the electron’s electric dipole moment.
Lecture 2: Are the fundamental constants constant?
Lecture 3: Atom interferometry: from navigation to cosmology.

Giovanna Morigi, Universität des Saarlandes
Lecture 1: Mechanical effects of light on atoms in optical resonators
Lecture 2: Transition to spontaneous ordering: characterization
Lecture 3: Ultracold atoms in resonators: Bose–Hubbard models and the superfluid–Mott–insulator transition

Leticia Tarruell, ICFO - The Institute of Photonic Sciences
Lecture 1: Quantum simulation and non-interacting fermions in an optical lattice
Lecture 2: Interactions: the Fermi–Hubbard model
Lecture 3: Quantum magnetism with fermions in optical lattices
Poster Sessions

All posters should be put up before the first session, on 25th July, and should be taken down after the second session, on 27th July.

Posters will be numbered as below. Odd numbers should be presented on the 25th and even numbers on the 27th.

- **Poster session 1:** 25th July – *odd numbers*
- **Poster session 2:** 27th July – *even numbers*

List of posters and presenters

1) **Sensing with Quantum-Error-Correction**  
   Tuvia Gefen  
   Hebrew University, Israel

2) **Towards double degenerate mixtures of 6Li and 40K**  
   Mihail Rabinovic  
   Laboratoire Kastler Brossel, France

3) **Engineering a Source of Multi-Photon, Multidimensional Spatially Entangled States for Quantum Control of Nanostructures**  
   Andrea Tabacchini  
   Macquarie University, Australia

4) **Self-organisation of cold atoms in optical cavities: multicritical behaviour and chaotic dynamics**  
   Maria Laura Staffini  
   School of Physics and Astronomy, University of St. Andrews, UK

5) **Temperature dependence of the vacuum Rabi splitting in quantum dot-micropillars**  
   M. Strauß  
   Institut für Festkörperphysik, Technische Universität Berlin, Germany

6) **Quantum properties and correlations of microcavity polariton solitons**  
   G. Buonaiuto  
   Department of Physics and Astronomy, University of Sheffield, UK

7) **Characterisation of Superconducting Nanowire Single Photon Detectors**  
   L. Baker  
   Glasgow University, UK

8) **Waveguide integrated superconducting nanowire single photon detectors for quantum information processing**  
   Kleanthis Erotokritou  
   School of Engineering, University of Glasgow, UK

9) **Observation of localised multi-spatial-mode quadrature squeezing in four wave mixing**  
   Joshua Hordell  
   University of Birmingham, UK

10) **Experimental Perfect Quantum State Transfer**  
    Robert J. Chapman$^{1,2}$  
    $^1$Quantum Photonics Laboratory, School of Electrical and Computer Engineering, RMIT University, Australia  
    $^2$School of Physics, The University of Sydney, Australia
11) Spin-mixing Interferometry with Bose-Einstein Condensates
Marco Gabbielli
Physics Department, University of Florence, Italy

12) Disordered Bose-Einstein Condensates
G. Faraoni
Physics Department, University of Florence, Italy

13) Limitations of obtaining unambiguous information for the lifted trine states
Graeme Weir
University of Glasgow, UK

14) High-purity Rb-resonant pairs of identical photons via filtered down-conversion
Joanna A. Zielińska
Institute of Photonics Sciences, Spain

15) High-fidelity Creation of Two-particle Quantum States Via Spatial Adiabatic Passage
Irina Reshodko
Okinawa Institute of Science and Technology, Japan

16) Phase-engineered Light Patterns for Ultracold Atom Experiments
D. Bowman
University of St. Andrews, UK

17) Observation of a dynamic electric Paschen-Back effect
Matthias Körber
Max Planck Institute of Quantum Optics, Germany

18) Quantisation of metallic nanoparticle arrays
Marek Nečada
COMP Centre of Excellence, Aalto University, Finland

19) Accessing Non-Markovianity by Geometric Phase
Wei Nie
National University of Singapore, Singapore

20) Quantum Dynamics of an Atom-Driven Cavity QED System
K. N. Tolazzi
Max Planck Institute of Quantum Optics, Germany

21) A Portable Magneto-Optical Trap for Public Engagement Events
P. Ireland
University of St. Andrews, UK

22) Ground state and rotational properties of a rotating two-component dipolar condensate
Xiao-Fei Zhang
National Time Service Center, Chinese Academy of Sciences, China

23) Nonlinear dynamics of ultracold Bose atoms subject to a density-dependent gauge potential
Robert Dingwall
Heriot Watt University, UK

24) Many-Body Dynamics Through Measurement and Feedback
Jonas Lammers
1 Institute for Theoretical Physics, Leibniz Universität Hannover, Germany
2 Max-Planck-Institute for Gravitational Physics (Albert-Einstein-Institute), Germany
25) Dynamics of quantum systems coupled to a structured reservoir  
G. Pleasance  
Department of Physics and Astronomy, University of Sussex, UK

26) Unidirectional Quantum Synchronization of Atomic Ensembles  
Alexander Roth  
Leibniz University Hannover, Germany

27) Grating chips for quantum technologies  
James P. McGilligan  
Department of Physics and SUPA, University of Strathclyde, UK

28) Coherent frequency conversion of microwaves to optical telecommunications band in an Er:YSO crystal  
Xavier Fernandez-Gonzalvo  
Department of Physics, University of Otago, New Zealand

29) Quantum vacuum emission from a moving refractive index front  
Maxime Jacquet  
University of St. Andrews, UK

30) Real time single-pixel camera and its applications  
Baoqing Sun  
Optics Group, School of Physics and Astronomy, University of Glasgow, UK

31) Multiparticle entanglement as an emergent phenomenon  
Nikolai Miklin  
University of Siegen, Germany

32) Intermittency as a resource for enhanced metrology  
K. Macieszczak  
University of Nottingham, UK

33) Dynamic mean field description of the driven Dicke Model  
Gianluca Francica  
Università della Calabria, Italy

34) Coherent Control of Open Systems  
Benjamin Dive  
Imperial College London, UK

35) Sensing of single nuclear spins in random thermal motion with proximate nitrogen-vacancy centers  
P. Fernandez-Acebal  
Institute of Theoretical Physics, Ulm University, Germany

36) Conditional all-optical photon routing via Rydberg interactions  
Callum Murray  
Max Planck Institute for the Physics of Complex Systems, Germany

37) Quantum Fisher information for precision measurement technologies  
Jasminder Sidhu  
Department of Physics and Astronomy, University of Sheffield, UK

38) Propagation and focalization of a quasi-Laguerre-Gaussian mode generated by phase-holography  
Aurélien Chopinaud  
Laboratoire Aimé Cotton. CNRS, Université Paris-Sud, ENS Cachan Orsay, France
39) Zeeman patterns in cold atoms in the single mirror feedback scheme
I. Krčič
Department of Physics and SUPA, University of Strathclyde, UK

40) Measuring Magnetism under the Microscope
Calum Macrae
Department of Physics and SUPA, University of Strathclyde, UK

Billy I. Robertson
Department of Physics and SUPA, University of Strathclyde, UK

42) Phase-contrast interferometry: Single-shot, phase-insensitive readout of an atom interferometer
A.R. MacKellar
Department of Physics and SUPA, University of Strathclyde, UK

43) Deterministic generation of many-body entanglement and photonic states assisted by dissipation
V. Paulisch
Max-Planck-Institute of Quantum Optics, Germany

44) Talbot-enhanced maximum-contrast interferometry and coherence in Bose-Einstein condensates
Victoria A. Henderson
Department of Physics and SUPA, University of Strathclyde, UK

45) Exciton Interactions in Two Dimensions
Valentin Walther
Max-Planck-Institute for the Physics of Complex Systems, Germany

46) Photon Number Shifting and the Quantum Carburetor Effect
Jenifer Radtke
Department of Physics and SUPA, University of Strathclyde, UK

47) Security against jamming of ghost imaging
Wojciech Roga
Department of Physics and SUPA, University of Strathclyde, UK

48) Quantum simulations of molecular systems using trapped atoms and ions
Marta Sroczynska
University of Warsaw, Poland

49) Generating entangled light between Rubidium lines and Telecom's L band (1565-1625 nm) using an OPO
Rayssa Bruzaca de Andrade
Instituto de Física, Universidade de São Paulo, Brazil

50) Resource Efficient Certification of SPDC Generated Entangled States
E. Verbanis
Group of Applied Physics, University of Geneva, Switzerland

51) Bell inequalities for hypergraph states
Mari Gachechiladze
University of Siegen, Germany

52) Quantum Radar with Microwave
U. Las Heras
University of the Basque Country, Spain
53) **Entanglement Matryoshka: Entanglement Classification with Matrix Product States**  
Mikel Sanz  
University of the Basque Country, Spain

54) **Emergence of bistability in driven dissipative systems**  
N. Sibalic  
Joint Quantum Center (JQC) Durham-Newcastle, Department of Physics, Durham University, UK

55) **Generation of Sub-Poissonian Light of High Photon Number: A Quantum Trajectory Simulation**  
Victor S C Canela  
University of Auckland, New Zealand

56) **Polaronic effects in one- and two-band quantum systems**  
Tao Yin  
Institut für Theoretische Physik, Goethe-Universität, Germany

57) **Thermometry of ultracold fermions by (super)lattice modulation spectroscopy**  
Karla Loida  
HISKP, University of Bonn, Germany

58) **Transport properties in 1D optical lattices and in sketched nanowires**  
Alexandre B. Tacla  
Department of Physics and SUPA, University of Strathclyde, UK

59) **Quench dynamics in quantum many-body systems with long-range interactions**  
Anton Buyskikh  
Department of Physics and SUPA, University of Strathclyde, UK

60) **Qubit-photon correlations in the strongly driven dissipative Jaynes-Cummings model**  
Themis Mavrogordatos  
University College London, UK

61) **Decoherence in coupled spin systems**  
H. M. Cammack  
University of St Andrews, UK

62) **Dissipative engineering of spin-entangled states in Fermi Gases**  
Jorge Yago  
Department of Physics and SUPA, University of Strathclyde, UK

63) **Bosonic entanglement effect: Coupling impurities with a reservoir**  
Saubhik Sarkar  
Department of Physics and SUPA, University of Strathclyde, UK

64) **Dynamics of coherence and quantum correlations for continuous variable systems interacting with classical environment.**  
J. Trapani  
Università degli studi di Milano, Italy

65) **Entangled quantum probes for dynamical environmental noise**  
Matteo A. C Rossi  
Dipartimento di Fisica, Università degli Studi di Milano, Italy

66) **Floquet Population Dynamics in Hofstadter Hamiltonian**  
Thomas Blitewski  
University of Cambridge, UK
67) Using COMSOL to model atom chips
   Rosemary Crawford
   School of Physics and Astronomy, University of Nottingham, UK

68) Quantum Simulation of a Lattice Gauge Theory
   Pedro Nevado
   University of Sussex, UK

69) From Dicke to Jaynes-Cummings: A connection through dissipative quantum phase transitions
   Ricardo Gutierrez-Jauregui
   The University of Auckland, New Zealand

70) Generation of extreme spin squeezing in the steady state of a generalised Dicke model
   Stuart J. Masson
   The University of Auckland, New Zealand

71) Light scattering in hybrid optomechanical systems in Diamond
   Luigi Giannelli
   Theoretische Physik, Universitaet des Saarlandes, Germany

72) Dynamics of the Spherical Quantum Model
   S. Wald
   Saarland University, Germany

73) Geometric Phase Deficit can detect Entanglement
   Namrata Shukla
   Harish-chandra Research Institute, India

74) Towards quantum gas microscopy of Rydberg dressed fermionic quantum gases
   Alda Arias
   Physics Institute, University of Heidelberg, Germany

75) Towards a structured light laser based on a phase-coherent pumping mechanism
   Rachel Offer
   Department of Physics and SUPA, University of Strathclyde, UK

76) Adiabatic state preparation in a noisy optical lattice
   Guanglei Xu
   Department of Physics and SUPA, University of Strathclyde, UK

77) Single-atom-resolved detection of fermionic 40K in an optical lattice
   Dylan Cotta
   Department of Physics and SUPA, University of Strathclyde, UK

78) Joint estimation of phase and phase diffusion using Holland Burnett states
   Magdalena Szczykulska
   University of Oxford, UK

79) Studying Dipolar Bose-Einstein condensate with different symmetry traps
   Luis E. Young-S
   Institut für Theoretische Physik, Leibniz Universität Hannover, Germany