



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)

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an Oxford Instruments company

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

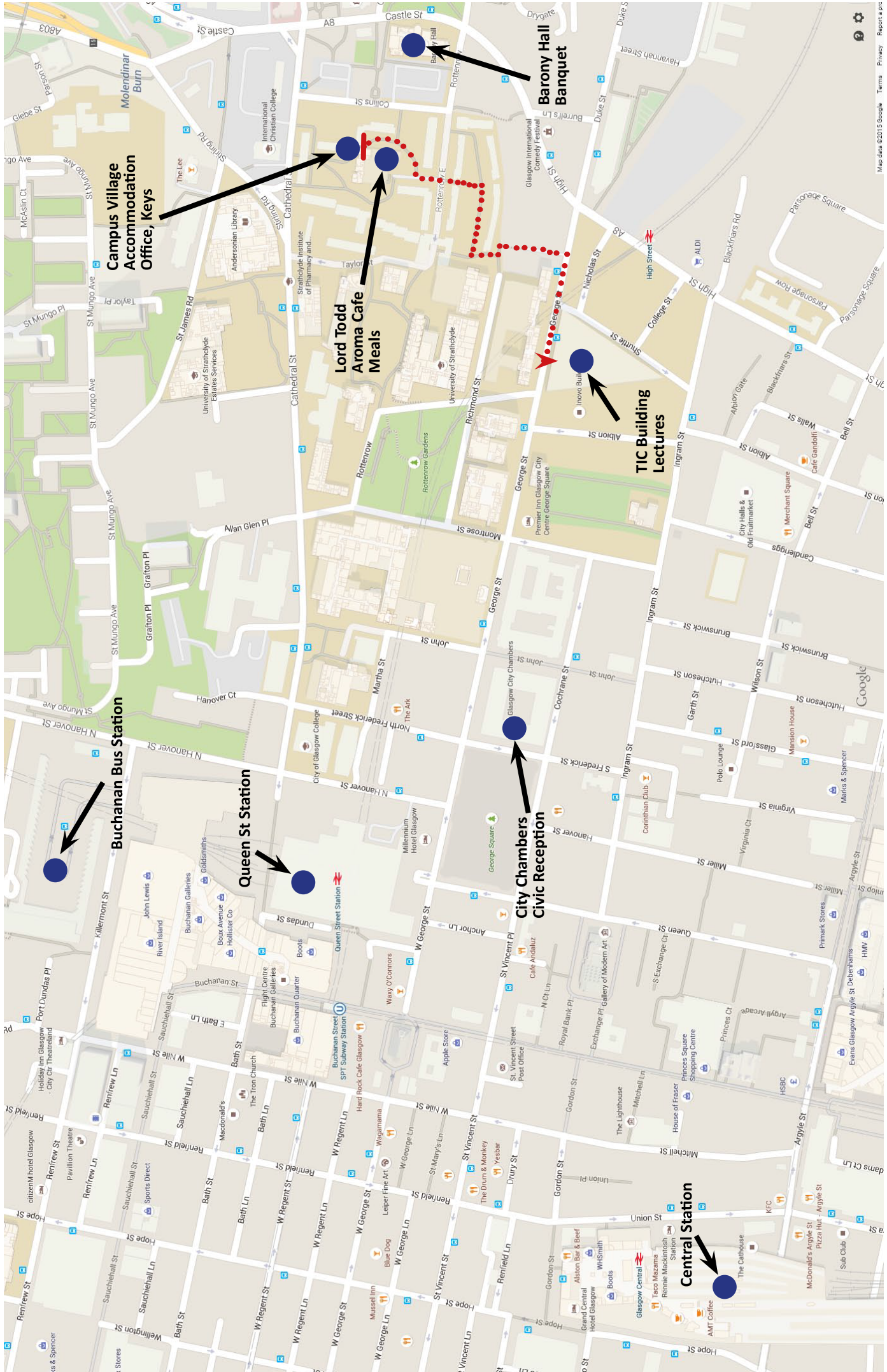
<http://sussp71.phys.strath.ac.uk/>

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



Campus Village Accommodation Office, Keys

Lord Todd Aroma Cafe Meals

TIC Building Lectures

Barony Hall Banquet

Buchanan Bus Station

Queen St Station

City Chambers Civic Reception

Central Station

Schedule

	Tue 21/7	Wed 22/7	Thu 23/7	Fri 24/7	Sat 25/7	Sun 26/7	Mon 27/7	Tue 28/7	Wed 29/7	Thu 30/7	Fri 31/7	Sat 1/8	Sun 2/8
7.30	A	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast	Breakfast : Breakfast
9.00 - 10.20	r	HC	RH	RH	PZ	Breakfast 8.00 - 9.30	MP	FSK	PG	EH	Free Time	GM	
10.20 - 10.50	r	Break	Break	Break	Break		Break	Break	Break	Break	Break	Break	
10.50 - 12.10	i	GL	PZ	GL	PK		JB	PG	FSK	PG	LT	LT	
12.10 - 13.30	v	Lunch	Lunch	Lunch	Lunch		Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	
13.30 - 14.50	a	PZ	GL	RH	HC		MP	JB	EH	FSK	GM	Hot Topics	
14.50 - 15.50	I	Discuss/Question	Discuss/Question	Discuss/Question	Discuss/Question		Discuss/Question	Discuss/Question	Discuss/Question	Discuss/Question	Discuss/Question	Discuss/Question	Discuss/Question
15.50 - 16.20	Register	Break	Break	Break	Break		Break	Break	Break	Break	Break	Break	
16.20 - 17.40		HC	PK	PK	Posters		JB	EH	MP	GM	LT		
17.40 - 18.30													
18.30 - 19.30	Welcome buffet	Dinner	Civic reception	Dinner	Dinner	Dinner 7pm	Dinner	Dinner	Dinner	Banquet	Dinner	Dinner	
Evening							Posters						
													Breakfast 8.00 - 9.30
													D e p a r t u r e

Key: EH: Ed Hinds GM: Giovanna Morigi LT: Leticia Tarruell PZ: Peter Zoller
 FSK: Ferdinand Schmidt-Kaler HC: Howard Carmichael MP: Miles Padgett PG: Philippe Grangier
 GL: Gerd Leuchs JB: Joachim Brand PK: Peter Knight RH: Randy Hulet

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}

¹Quantum Photonics Laboratory, School of Electrical and Computer Engineering, RMIT University, Australia

²School of Physics, The University of Sydney, Australia

- 11) Spin-mixing Interferometry with Bose-Einstein Condensates**
Marco Gabbrielli
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 ^{1,2}
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. Krešić
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
- 41) Atom interferometry: Tuned Atom Optics for Magnetic Field Gradiometry.**
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 Bilitewski
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