IOP Institute of Physics
Nanoscale Physics and Technology Group

Newsletter
Volume 1
Issue 1
Summer 2018

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"The group exists to represent the interests of its members, and I hope that the reports below help highlight what help is available at all stages of the career track."

Message from the Chair

Dear members,

As the new chair of the group, it gives me great pleasure to welcome you to the summer 2018 newsletter of the Nanoscale Physics and Technology Group (NPTG) of the IOP.

My first duty is to welcome in the new executive, including Samuel Jarvis from the University of Lancaster, and Paul Mulheran from the University of Strathclyde, who have taken over as treasurer, and secretary, respectively. I must also extend my thanks to Stephen Schofield, and Richard Woolley, who recently stepped down as group chair, and treasurer/secretary respectively, and thank them for their help in ensuring a smooth transition as the new committee has found its feet.

I would also like to take time to welcome onto the committee not one, but two new early career members; Iddo Amit, and Adolfo De Sanctis, who will be representing the early career interests of members in the group, and also liaising with the newly formed early career members IOP group.

Since taking over as chair, it has been a great pleasure to see how much help the group is able to offer to its membership through support of meetings, and travel bursaries for students. The group exists to represent the interests of its members, and I hope that the reports from our members below help highlight what assistance is available at all stages of the career track for our members. It has been particularly gratifying to see the number of meetings supported in collaboration with other IOP groups and the wide range of interests represented within the Nanoscale Physics community.

In this newsletter you will find details of upcoming meetings that may be of interest, and I would like to encourage you to get in touch with the committee if there are any events you would like to see promoted in the next newsletter.

Lastly, it is important to remember that the group is only as good as its members, and the degree to which the committee is able to represent their interests. Therefore, I strongly urge members who have ideas that require support (be they for travel, conferences, or outreach), or issues that they wish to be taken forward at a policy level, to get in touch so the committee can best represent the interests.

Best wishes,

Adam Sweetman (NPTG Chair)
School of Physics and Astronomy
University of Leeds
a.m.sweetman@leeds.ac.uk

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Recently Sponsored Events

Advances in Quantum Transport in Low Dimensional Systems (AQT2017)

Held at University College London, during September 4-5, 2017. The conference was organised by the IOP NPTG, and was sponsored by the Oxford Instruments (primary sponsor), National Instruments, Nanomagnetics Instruments, Zurich Instruments, University College London, Specs, IOP Nanoscale Physics and Technology Group and IOP Quantum Electronics and Photonics Group.
The aim of this conference was to bring together experts from various areas of solid state quantum physics with specialisations in quantum transport in low-dimensional systems. AQT2017 provided an opportunity for both academia and industries to seek new future possibilities in the emerging solid state quantum technologies and nano devices with special interest in the spin physics of low-dimensional systems.
We are grateful to all the invited speakers for their exciting, enriching talks and sharing their current research activities with us. In this regard, we thank Prof Sir Michael

Pepper, UCL, Prof Jainendra Jain, Penn State, Prof Moty Heiblum, Weizmann, Prof Seigo Tarucha, Tokyo, Prof Irfan Siddiqi, Berkeley, Dr Masaya Kataoka, NPL, Prof Karl-Fredrik Berggren, Linkoping, Dr Konstantin Matveev, Argonne, Prof Charles Smith, Cambridge, Prof Chris Ford, Cambridge and Prof Irina Grigorieva, Manchester for their enlightening presentations on respective research fields. We also thank Dr Graham Batey, Oxford Instruments for a fascinating talk on the history of dilution refrigerators. In addition to the technical sessions comprising of presentations by the experts and contributed speakers, a poster session was organised as a forum for networking as well as opportunity to interact with the experts in the field.

We are grateful to the IOP for assistance in organising this conference, and thank members of the advisory and local organising committee, attendees and all the sponsors without their active participation and support, organising this conference would not have been possible.
http://aqt2017.iopconfs.org
S Kumar, IOP Conf. Series: Journal of Physics: Conf. Series 964 (2018) 011001.

The Silicon Quantum Information Processing (SiQIP17)

The meeting took place at Lancaster University on 11th September 2017. The event brought together over forty members of the European silicon QIP community who are working towards scalable architectures and components for quantum information processing in silicon. The meeting covered topics including qubit implementation, schemes for qubit-qubit coupling, and the challenge of scalability in fabrication and architecture design.

The meeting was supported by IOP groups including Nanoscale Physics and Technology and four industrial sponsors: Hitachi, Oxford Instruments, Leybold and Tektronix. Their generous support made this meeting possible and allowed us to host three invited speakers from Delft University of Technology and CEA Grenoble.

Materials Modelling: Simulation Meets Experiment

The Nanoscale Physics and Technology Group supported this meeting held in September 2017 at the University of Strathclyde. The meeting also served as the Annual General Meeting of CCP5. The meeting ran for 3 days, with 77 participants from around the UK, across Europe, and beyond. The NPTG support enabled Prof. Friedrich Kremer from the University of Leipzig to provide a keynote address, as part of a successful session on nanoscale dynamics.

Dr Karen Johnston, the meeting organiser, said "I was delighted that so many signed up and we had excellent invited speakers from academia and industry. What was exciting scientifically was to see how scientists are bridging the gap between simulations and experiment.

Recent NPTG Sponsored Events

Sept 4-5, 2017
Advances in Quantum Transport in Low Dimensional Systems

Sept 11, 2017
Silicon Quantum Information Processing Meeting (SiQIP17)

Sept 11-13, 2017
Materials Modelling: Simulation Meets Experiment

Sept 19-20, 2017
University of York Department of Physics — Postgraduate Research Conference

Sept 20, 2017
High-pressure XPS of Energy Materials 2

Oct 11-12, 2017
Vacuum Symposium UK

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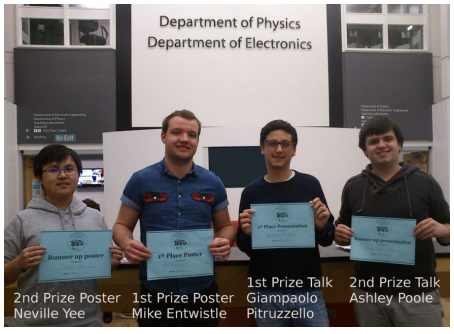
Recently Sponsored Events

There is still a challenge in connecting simulations to industrial applications, but in this we are also making progress, especially in the field of adsorption. "

The Best Poster Prize being awarded to Leyorla Ohene-Yeboah (right), from the University of Bath. The prize is presented by Neil Allan, Chair of CCP5

University of York Department of Physics — Postgraduate Research Conference

This conference was held on 19 and 20 September 2017 and was a great success. The conference featured an invited "Industry Perspective" talk from Dr Tom Henry (Frazer-Nash Consultancy), nearly thirty talks, a poster session and a conference dinner. Dr Phil Hasnip said 'choosing the prize-winning talks and posters was extremely difficult, but in the end the honours for the talks went to Giampaolo Pitruzzello (best talk) and Ashley Poole (runner-up), and for the posters to Mike Entwistle (best poster) and Neville Yee (runner-up)'.



Special thanks to the IOP for sponsoring the prizes, Andy Higginbotham and Ale Pastore for helping judge the posters, Nicola Farthing and Steve Biggs for organising such a fantastic event, and all the postgraduates who put such an enormous effort into their presentations.

High-Pressure XPS of Energy Materials 2

The 2nd one-day conference on High-pressure XPS of Energy Materials (HP-XPS-EM2) was held in the Keighton Auditorium at the University of Nottingham on the 20th September 2017. The meeting was organised by James O'Shea on behalf of the University of Nottingham Energy Technologies Research Institute (ETRI) and the IOP Thin Films & Surfaces group, and supported by the IOP Nanoscale Physics group, and Scanwel/SPECS. Around forty people attended all or part of the meeting throughout the day, ranging from PhD students to senior academics. Kicking off proceedings was the plenary lecture of Andrew Thomas from the University of Manchester, presenting recent near-ambient pressure XPS results in the areas of solar energy and carbon capture and storage. The rest of the day included talks from academic and industry researchers on new developments in the x-ray photoelectron spectroscopy of the solid-liquid interface, fuel cells, solar water splitting, organic molecules, and x-ray absorption spectroscopy at near ambient pressures. The meeting concluded with a discussion drinks reception.

The HP-XPS-EM meeting series is associated with the near-ambient pressure XPS facility at Nottingham and in future years will incorporate the annual user meeting and tours of the instrument facility. The NAP-XPS is capable of measuring surfaces at pressures up to 20 mbar of a range of gases and is suitable for studying energy materials under ambient conditions such as fuel cells, batteries, and photo-electrochemical cells.

Vacuum Symposium UK

Vacuum Symposium UK is the umbrella organisation seeking to embrace all of the UK vacuum community. Its aim is to bring together academics, industrialists, engineers, manufacturers and anyone using vacuum to promote UK pre-eminence in the subject. See website www.vacuum-uk.org .

The meetings within Vacuum Symposium UK are free to attend. We welcome anyone with experience and contacts to organise a vacuum related meeting that will attract and interest the diverse spectrum of vacuum users.

Support from IOP Groups is a key contributor to the establishment and continued success of the annual event. In particular, financial support from NPTG was put towards production of the Abstract Booklet and speaker expenses.

The Vacuum Symposium event is co-located with Vacuum Expo – the UK's premier exhibition of vacuum equipment – all on one site, under one roof. Attendees are welcome on one or both days of the event that is held annually mid-October.

Call for Event

The NPTG is accepting event sponsorship applications for 2018-19.

If your nanoscale physics and technology related UK event would like to apply for funding, please contact the NPTG

Upcoming Events

IOP Summer School on nanoScience@Surfaces

The summer school will be held in the Cavendish Laboratory at the University of Cambridge, 1-4th August 2018. The School is primarily aimed at PhD students carrying out research involving the study of surfaces and interfaces at the atomic and molecular scale, including Condensed Matter Physics, Material Science and Physical Chemistry.

The School will include a combination of lectures, research talks and workshops that will cover the basics of experimental and computational techniques which may be applied to surface science and engineering

Upcoming NPTG Sponsored Events

Aug 1-4, 2018

IOP Summer School on nanoscience@Surfaces

Sept 7, 2018

Silicon Quantum Information Processing Meeting (SiQIP18)

Oct 10-11, 2018

Vacuum Symposium UK

Nov/Dec 2018

High-pressure XPS of Energy Materials 3

July/Aug, 2019

Advances in Quantum Technologies 2019 (AQT2019)

Silicon Quantum Information Processing Meeting (SiQIP18)

This one day IOP meeting will be help 7 September, 2018, at University College London.

Silicon Quantum Information Processing (QIP) is highly appealing due to long electron and nuclear spin lifetimes and the expertise of the integrated circuit industry in device scaling. Recent demonstrations of long-lived, high-fidelity silicon qubits, multi-qubit gates and spin–photon coupling, are promising for scalable QIP architectures. Further requirements are robust and scalable fabrication processes, fast control and data processing, and schemes to correct errors and protect against decoherence. This meeting will bring together leading researchers from the silicon QIP community who are interested in meeting these challenges. Topics of interest include: Recent demonstrations of long-lived, high-fidelity silicon qubits, multi-qubit gates and spin–photon coupling, are promising for scalable QIP architectures. Further requirements are robust and scalable fabrication processes, fast control and data processing, and schemes to correct errors and protect against decoherence. This meeting will bring together leading researchers from the silicon QIP community who are interested in meeting these challenges.

Topics of interest include:

- Silicon nanodevices and qubit implementations
- Qubits and nanodevices based on semiconductor-superconductor hybrids
- Circuit quantum electrodynamics interfaced with spins in semiconductors
- Scalable architectures and fabrication processes
- Digital-quantum interfaces for control, readout and fast data processing of multi-qubit circuits
- Improving immunity to environmental noise.

9th Vacuum Symposium UK

The 9th Annual Vacuum Symposium UK meeting will be held on 10 & 11 October 2018, at the Ricoh Arena, Coventry.

This years symposium will include a one day meeting entitled, "**Nanoscale Surface Structure and Dynamics — British Vacuum Council Prize Symposium 2018**"

Investigating the structure and dynamics of surfaces with high spatial and/or temporal resolution is a rich field of fundamental science with strong technological implications. A detailed understanding of the nanoscale structure and dynamics of surfaces lies at the heart of innovation in areas as diverse as materials growth and self-assembly; nanoscale control of the electronic and magnetic properties of materials (which increasingly includes control at the quantum level); and chemical processes such as catalysis and sensing. Cutting edge developments in instrumentation and analysis techniques have always underpinned our ability to probe ever smaller and faster; e.g., the invention of the scanning tunnelling microscope (STM) provided the capability to "see" individual atoms, while the invention of quasi-elastic helium atom scattering (QHAS) provided the ability to probe dynamics at surfaces with picosecond time resolution. This symposium is composed of six invited talks from national and international leaders in the field of nanoscale structure and dynamics of surfaces utilising a range of techniques from He atom scattering, to scanning probe, to synchrotron radiation. We also invite abstract submissions for poster presentations and will offer a £100 prize for the best student poster.

Upcoming Events

9TH VACUUM SYMPOSIUM UK

The symposium will serve as a platform for the award of the 2018 BVC Senior Prize and John Yarwood Memorial Medal to Dr. William Allison of University of Cambridge for his contributions to understanding the structure and dynamics of surfaces using Helium Atom Scattering techniques. The British Vacuum Council (BVC) was founded in 1959 and is the national representative vacuum body for Britain and Ireland affiliated to the International Union for Vacuum Science, Technique and Applications (IUVSTA).

Invited Speakers:

Bill Allison
University of Cambridge

Gil Alexandrowicz
Technion - Israel Institute of Technology

Georg Held
University of Reading

Peter Sloan
University of Bath

David Duncan
Diamond Light Source

David Ward
University of Cambridge

High-Pressure XPS of Energy Materials 3

This years High-Pressure XPS of Energy Materials meeting (HP-XPS-EM3) will be a one-day meeting held in Nottingham on the Jubilee campus near the new Sustainable Energy Futures building where the HP-XPS system (Hippolyta) is now located.

The day will feature a range of invited talks covering new developments in the technique, in addition to talks from users of the facility. New for this year will be an industry-focused session with talks specifically geared towards applications of near-ambient pressure XPS to industrial research and development challenges.

The dates for this years meeting are still to be decided. Organisers will be aiming for Late November/ early December.

Contact: Dr. James O'Shea (J.Oshea@nottingham.ac.uk)

Advances in Quantum Technologies 2019 (AQT2019)

Planning is underway for the second installment of the AQT meeting, and will be organised at UCL during July-August, 2019 .

Due to the rapid development of quantum technologies active collaboration between theory, experiment and industry is essential to meet the future demands. In order to remain competitive and world-leading in both science and technology, the UK academia and industry must expand their horizon and begin a new age of collaborations. In solid-state quantum technologies, there are a number of challenges, at the level of both theory and experiments, which need to be discussed openly in a platform shared by theorists, experimentalists and industry people.

With the success of the first event titled, "Advances in Quantum Transport in Low Dimensional Systems (AQT2017)", we would like to organize the 2nd in series of the biannual conference which would be retitled to cover other aspects of emerging trends in quantum technologies. Therefore, "Advances in Quantum Technologies-2019" is proposed to be held at University College London during July-August 2019 (dates to be announced soon).

Contact: Dr. Neil Curson (n.curson@ucl.ac.uk)

Advertise Your Events

Are you or your institution planning a nanoscale physics and technology related, UK based, event?

Get in touch with the NPTG and let us know.

Advertise your event in the next issue of our newsletter.

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Sponsored Conference Attendance

The NPTG was pleased to contribute to conference attendance bursaries for the following research students, and early career

Saeed Gholhaki

School of Physics and Astronomy
Nanoscale Physics Research Laboratory

XXVI International Materials Research Congress
Cancun, Mexico
August 20-25, 2017

"*I gained a lot of experience in the field of nano-alloys theory, synthesis and characterization. I also had the opportunity to present my work to a large audience through an oral presentation and receive feedback.*"

Joel Katzen

Centre for Nanostructured Media
School of Mathematics and Physics
Queen's University Belfast

Photonics Ireland conference 2017
13-15 September, Galway – Ireland

"*I believe that the Photonics Ireland 2017 conference was successful. I found myself engaging with other students and researchers, in a way which will help me as I enter the final months of my PhD. The conference also showed me the benefits of field, as well as where it could be improved."*

Carmen Popescu

Nanoscale Physics Research Laboratory
University of Birmingham

The 61st International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication
Orlando, FLA, USA

"*The meeting had a great impact on me especially because I am the only student in the Nanoscale Physics group working on this subject.*
Presenting my work to the other participants I had the opportunity to create a new collaboration with a company that is interested in testing the material that we are developing in our group and one possible collaboration with another research group that is interested in modelling some of our experimental results."

Dr. Aditya Sadhanala,

Cavendish Laboratory, University of Cambridge, UK

3rd International Conference on Perovskite Solar Cells and Optoelectronics (PSCO-2017)

"*This conference was a great opportunity to listen, meet and discuss with the bigger scientific community about the semiconducting perovskite field. The conference was a grand success with many eminent speakers… I am glad to mention that I got the Best poster prize sponsored by ACS Energy Letters Journal for my work on binary metal semiconducting perovskites.*"

Dr. Adolfo De Sanctis

University of Exeter

5th Nano Today Conference
Hawaii, December 6-10, 2017

"*The talks I attended have been all very beneficial and allowed me to develop new ideas to put into practice in my future research. In particular, I had the opportunity to network with researchers from both South Korea and Japan to discuss future collaborations in order to develop new devices based on the materials they produce."*

The IOP provides financial support to research students and early career researchers to attend international meetings and visit international facilities.

These bursaries, worth up to £300, are awarded to qualifying Members of the Institute, through Research Student Conference Fund (RSCF), and Early Career Researchers Fund for Group Members (ECRFGM)

Applications are considered on a quarterly basis and should reach the Institute by 1 March, 1 June, 1 September or 1 December.

Further information and application forms can be found on the IOP website.

http://www.iop.org/about/grants/travel-bursaries/page_69141.html

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Franks Thesis Prize

Prof Albert Franks CBE DSc FInstP

Albert Franks spent his career from 1950 to 2003 at the National Physical Laboratory and was one of the pioneers of applications of nanotechnology and nanometrology.

His work was primarily in the fields of x-ray optics, precision machining, and he established a UK infrastructure for nanometrology to support the emerging field of nanotechnology.

In the field of x-ray optics he developed a pioneering low angle scattering camera used for studying viral structures and metal fatigue. He also developed x-ray diffraction gratings for soft x-ray spectroscopy inaccessible by crystal diffraction. This required the development of techniques for precision polishing, and the measurement of surfaces of accurate figure and low scatter all at the nanometre level. The work was one of the early applications of nanotechnology that required reliable metrology at the nanometre level. To meet this requirement Albert Franks initiated the nanometrology work at NPL, the U*K*'s national standards laboratory. The techniques he developed were later applied to the manufacture and polishing of x-ray astronomical telescopes (for NASA *and ESA*), x-ray collimators for electron synchrotron instrumentation, and x-ray microscopy.

With his group at NPL he led research projects that applied nanotechnology to the development of novel instrumentation for x-ray optics, surface topography measurement, precision machining, scanning probe microscopy, and optical interferometry in both the scientific and industrial arenas.

His work led to the establishment of the UK's first National Initiative on Nanotechnology and the DTI's LINK programme that brought together many nanotechnology projects with a strong industrial relevance, and led to 14 centres of excellence in the UK. He created a vision of the future nanomanufacturing technology, which he dubbed 'scanning tunnelling engineering', initiating multidisciplinary research areas, including the idea of 'biomolecular metrology' which led to the recognition that the integration of chemistry, biology and physics is at the heart of nanotechnology.

He played a leading role in the establishment of the UK Institute of Nanotechnology, and was its Honorary President. This achievement is recognised by the ION's annual Albert Franks Memorial Lecture. For several years he chaired the Scientific Committee of the RNID, and one of his last projects was to initiate the development of improved cochlear implants for the deaf using nanotechniques.

His ability was reflected in the number of awards and honours he received. He was elected to Fellowship of the Institute of Physics in 1960, and was awarded the Duddell Medal and Prize in 1973 in recognition of his work in x-ray optics. Fellowship of SPIE (the International Society for Optical Engineering) followed in 1991, and in 1993 he was appointed a CBE in the Queen's Birthday Honours List in recognition of his pioneering work in x-ray optics and the metrology of surfaces. He was also a Visiting Professor with the University of Warwick.

Franks Thesis Prize 2019 Call

Nominations are now sought for the 2019 Franks Thesis Prize.

Terms

This prize will be awarded by the Nanoscale Physics and Technology Group (NPTG) of the Institute of Physics (IOP) for the best PhD thesis completed in 2018 by a student member of the NPTG.

The value of the prize is £500 and was established to encourage and recognise high quality research and scientific writing in the broad research fields of nanoscience and nanotechnology.

The Franks prize is jointly funded by the NPT group and the National Physical Laboratory.

NPL National Physical Laboratory

Nomination Process

PhD supervisors and CDT course directors can nominate for this Prize. Self-nominations from 2018 graduates are also accepted. Nominations should include a support statement to highlight the scientific impact of the work, the thesis abstract, and a list of publications stemming from the research carried out during the PhD.
The qualifying period is the calendar year 2018, during which time the thesis must have been successfully examined for a Doctoral Degree and the final version submitted (theses originally submitted in 2017 are therefore eligible if they were examined in 2018).

Nominations can be sent by email to the PhD Prize Coordinator, Dr Cate Ducati, University of Cambridge, cd251@cam.ac.uk, at any time before the closing date of 20 April 2019. The prize winner will be announced by 15 June 2019.

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Franks Thesis Prize

Franks Thesis Prize 2018 Recipient

The NPTG is pleased to announce the winner of this year's Franks Doctoral Thesis Prize for student members of NPTG.

Dr Ben Russell from Strathclyde has secured the 2018 award for his PhD thesis work entitled,

Protein encapsulated gold nanoclusters for biological applications completed in 2017 under the supervision of Dr Yu Chen.

Dr Russell explains his work,

"The broader aim of this thesis was to gain a better physical understanding of protein encapsulated gold nanoclusters (AuNCs), a new type of fluorescent molecule with many unique characteristics that could be utilised to study nanometre scale biological phenomena. Gold nanoclusters are extremely small in size (typically between 8-25 atoms); exhibiting quantum mechanical behaviour in comparison to larger gold nanoparticles. When encapsulated within proteins they essentially become "molecular lightbulbs"; with the properties of the light emitted (fluorescence) from the AuNCs highly dependent on the local environment of the gold itself. Therefore, if the changes to the AuNC local environment, i.e, changes to the encapsulating protein, can be correlated to changes in the fluorescence emission characteristics; you have a powerful reporter of molecular scale processes which could be utilised in a number of different applications such as: studying drug-protein interactions, early stage protein aggregation in Amyloidosis type diseases such as Alzheimer's or simply as a non-toxic, highly stable, near infrared emitting fluorescent probe for biological imaging and sensing.

Much work had been undertaken to understand the fluorescence properties of Albumin and Lysozyme encapsulated AuNCs, however, there was a lack of understanding of where AuNCs nucleated within proteins or how the presence of AuNCs effected natural protein characteristics. To elucidate the nucleation location of AuNCs and the effects of nucleation on the protein a multidisciplinary approach was taken, utilising both computer simulations and physico-chemical characterisation techniques in conjunction with traditional fluorescence spectroscopy. It was found that AuNCs nucleate close to a major drug binding site within Albumin and that the drug binding site became inactive towards Warfarin, a commonly used drug to study binding at the site. It was also uncovered that AuNC growth within different proteins resulted in the same characteristic changes. The isoelectric point of Lysozyme and Human Serum Albumin (HSA) were found to shift to around pH 5, with reversible aggregation taking place at the isoelectric point, compared to natural protein behaviour which does not undergo aggregation at this pH. Finally it was observed that both proteins form dimer complexes when encapsulating AuNCs; indicating that AuNC encapsulation leads to many common features despite the differences between the native protein characteristics. These findings have allowed for the development of new, intelligent strategies for further developing protein encapsulated AuNCs and improving on their comparatively weak brightness to traditionally used fluorophores."

Committee Membership & Outreach

Please visit and follow us online to keep up to date with NPTG activities.

Please contact us to get involved with the group and group events, or to request sponsorship please contact us.

Institute of Physics
Nanoscale Physics and Technology Group
76 Portland Place
W1B 1NT
London

npt.iop.org

groups@iop.org

@iop_nptg

@IoP_Nanoscale Physics