3rd International Workshop on Quantum and Topological Nanophotonics

Nanyang Technological University, Singapore
12-14 December 2019

Organized by:

Centre for Disruptive Photonics Technologies, NTU Singapore
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Thursday 12 Dec 2019	
08:45	**Registration** **Auditorium - Nanyang Executive Centre, NTU**
09:00	**Opening remarks**
09:15	**QTN group photo**
	QN1. *Quantum Nanophotonics 1* - Chair: Prof Nikolay Zheludev
09:30	**Prof Jean Jacques Greffet (Institut d'Optique, Université Paris Sud, France)** *Tailoring quantum light emission using resonators and collective effects*
10:00	**Prof Weibo Gao (Nanyang Technological University, Singapore)** *Optical gating of resonance fluorescence from GeV color center in diamond*
10:20	**Dr Logan Wang Su, Prof Jelena Vučković (Stanford University, USA)** *Optimized quantum photonics*
10:50	**Coffee & Tea Break**
	TN1. *Topological Nanophotonics 1* - Chair: Prof Cesare Soci
11:20	**Prof Alexander Khanikaev (CUNY, USA)** *New class of photonic higher-order topological states induced by long range interactions*
11:50	**Prof Justin Song (Nanyang Technological University, Singapore)** *Spontaneous symmetry breaking in collective modes and plasmonic ferromagnetism*
12:10	**Prof Shanhui Fan (Stanford University, USA)** *Topology in simple photonic structures and in synthetic dimensions*
12:40	**Lunch Break & Poster Session 1 (PS1)**
	QN2. *Quantum Nanophotonics 2* - Chair: Prof Weibo Gao
14:00	**Prof Javier García de Abajo (ICFO, Spain)** *Quantum aspects of free-electron interactions with nanophotonic structures*
14:30	**Dr Yvonne Gao (A*STAR, Singapore)** *Engineering on-demand interactions between bosonic quantum modes*
15:00	**Prof Cun-Zheng Ning (Tsinghua University & Arizona State University, China/USA)** *Ten years of plasmonic nanolasers: Progress and prospects*
15:30	**Coffee & Tea Break**
	TN2. Topological Nanophotonics 2 - Chair: Prof Javier Garcia de Abajo
16:10	**Prof Ranjan Singh (Nanyang Technological University, Singapore)** *All-silicon terahertz topological photonics: A step towards 6G communications*
16:30	**Dr Ilya Kuprov (University of Southampton, UK)** *Toroidal transitions in atoms and molecules - A chemist's view*
17:00	**End of Day 1**

Friday 13 Dec 2019	
08:45	**Registration** **Auditorium - Nanyang Executive Centre, NTU**
	QN3. *Quantum Nanophotonics 3* - Chair: Prof Mark Brongersma
09:00	**Prof Dimitri Basov (Columbia University, USA)** *Programmable quantum materials*
09:30	**Dr Anna Paterova, Dr Leonid Krivitskiy (A*STAR, Singapore)** *Quantum metrology with nonlinear interferometers*
09:50	**Prof Alex Hayat (TECHNION, Israel)** *Semiconductor-superconductor quantum optoelectronics*
10:20	**Coffee & Tea Break**
	TN3. *Topological Nanophotonics 3* - Chair: Prof Yidong Chong
10:50	**Mr Eran Lustig, Prof. Moti Segev (TECHNION, Israel)** *Photonic topological insulator in synthetic dimensions*
11:20	**Prof Baile Zhang (Nanyang Technological University, Singapore)** *3D topological light and sound*
11:50	**Prof Mark Dennis (University of Birmingham, UK)** *Topological textures in structured light*
12:20	**Lunch Break & Poster Session 2 (PS2)**
	QTN1. *Quantum and Topological Nanophotonics 1* - Chair: Prof Harry Atwater
13:50	**Prof Kobus Kuipers (TU Delft, Netherlands)** *Light twist showing the way*
14:20	**IAS@NTU Speaker** **Prof Nikolay Zheludev (NTU, Singapore & University of Southampton, UK)** *Deeply subwavelength super-oscillatory imaging*
14:50	**IAS@NTU Speaker** **Prof Mark Brongersma (Stanford University, USA)** *Dynamic 2D quantum metasurfaces*
15:20	**Coffee & Tea Break**
	TN4. *Topological Nanophotonics 4* - Chair: Prof Zexiang Shen
15:50	**Prof Yidong Chong (Nanyang Technological University, Singapore)** *Topological edge states in amorphous structures*
16:10	**Prof Mohammed Hafezi (University of Maryland, USA)** *Topological interplay between photons and electrons*
16:30	**Prof Christos Panagopoulos (Nanyang Technological University, Singapore)** *Axisymmetric topological solitons for nanomagnetism*
17:00	**End of Day 2**

Saturday 14 Dec 2019	
08:45	**Registration** **Auditorium - Nanyang Executive Centre, NTU**
	TN5. *Topological Nanophotonics 5* - Chair: Prof Rob Simpson
09:00	**Prof Harald Giessen (University of Stuttgart, Germany)** *Topological plasmonics: Ultrafast vector movies on the nanoscale*
09:30	**Prof Natalia Litchinitser (Duke University, USA)** *Optically tunable topological photonic crystals*
10:00	**Prof Shaffique Adam (National University of Singapore, Singapore)** *The role of topology and electron-electron interactions in two-dimensional electronic materials*
10:20	**Coffee & Tea Break**
	QTN2. *Quantum and Topological Nanophotonics 2* - Chair: Dr Jinghua Teng
10:50	**IAS@NTU Speaker** **Prof Harry Atwater (CALTECH, USA)** *Quantum dynamics of hexagonal boron nitride quantum emitters*
11:20	**Prof Cheng Wei Qiu (National University of Singapore, Singapore)** *Some unexpected opportunities in parity-time symmetry and exceptional-point physics*
11:40	**Prof Qijie Wang (Nanyang Technological University, Singapore)** *Photonic topological quantum cascade lasers*
12:00	**Closing Remarks & End of Technical Program**

Abstracts

Invited Talks

QN1. Quantum Nanophotonics 1 (Thursday 12 Dec, 9:30-10:50)

T1. Tailoring quantum light emission using resonators and collective effects
Jean Jacques Greffet, Institut d'Optique, Université Paris Sud, France

Cavity quantum electrodynamics teaches how to control light emission of a single emitter. In this talk we extend this concept by introducing collective effects. We consider two different cases: i) two strongly coupled emitters in a resonator and ii) a thermalized ensemble of emitters coupled to a resonator.

T2. Optical gating of resonance fluorescence from GeV color center in diamond
Weibo Gao, Nanyang Technological University, Singapore

Scalable quantum photonic networks require coherent excitation of quantum emitters. However, many solid-state systems can undergo a transition to a dark shelving state that inhibits the resonance fluorescence. Here we demonstrate that by a controlled gating using a weak non-resonant laser, the resonant fluorescence can be recovered and amplified for single germanium vacancies (GeVs).

Employing the gated resonance excitation, we achieve optically stable resonance fluorescence of GeV centers. Our results are pivotal for the deployment of diamond color centers as reliable building blocks for scalable solid state quantum networks.

T3. Optimized quantum photonics
Logan Wang Su, Stanford University, USA.

Our inverse design approach offers a powerful and a fast tool to implement photonic circuits with superior properties, including robustness to fabrication errors, compact footprints, novel functionalities, and high efficiencies. We discuss outlooks on leveraging this approach to build chip-scale quantum networks using color centers in diamond and silicon carbide.

TN1. Topological Nanophotonics 1 (Thursday 12 Dec, 11:20-12:40)

T4. New class of photonic higher-order topological states induced by long range interactions
Alexander Khanikaev, CUNY, USA

Here we experimentally study photonic higher-order topological states in a microwave Kagome metacrystal. In addition to conventional corner states, we show that the coupling beyond next nearest neighbors due to far-field interactions leads to the emergence of a new class of higher-order topological corner states.

T5. Spontaneous symmetry breaking in collective modes and plasmonic ferromagnetism
Justin Song, Nanyang Technological University, Singapore

Spontaneous symmetry breaking lies at the heart of the description of interacting phases of matter. Here we argue that a driven electronic interacting metal subject to a linearly polarized (achiral) driving field can spontaneously magnetize (acquire chirality) and dynamically warp the Bloch bands of the metal.

T6. Topology in simple photonic structures and in synthetic dimensions
Shanhui Fan, Stanford University, USA

We consider non-trivial topological effects in th elight scattering from simple photonic structures. We also present some of our recent theoretical and experimental works towards demonstrating non-trivial topological effects in synthetic dimensions.

QN2. Quantum Nanophotonics 2 (Thursday 12 Dec, 14:00-15:30)

T7. Quantum aspects of free-electron interactions with nanophotonic structures
Javier García de Abajo, ICFO, Spain

We will discuss recent results of plasmons in atomically thin materials, including few-atomic-layer crystalline silver films.

T8. Engineering on-demand interactions between bosonic quantum modes
Yvonne Gao, A*STAR, Singapore

Multiphoton states stored in superconducting microwave cavities are promising elements for quantum computing, quantum metrology, and quantum simulations. In this talk, I will discuss some recent work on engineering on-demand interactions between two otherwise isolated modes to enable coherent energy exchange and deterministic entanglement generation between two them.

T9. Ten years of plasmonic nanolasers: progress and prospects
Cun-Zheng Ning, Tsinghua University & Arizona State University, China/USA

A summary overview of progress is presented since the first demonstration of plasmonic nanolasers and spasers, as well as major issues and challenges that remain to be resolved.

TN2. Topological Nanophotonics 2 (Thursday 12 Dec, 15:30-16:10)

T10. All-silicon terahertz topological photonics: A step towards 6G communications
Ranjan Singh, Nanyang Technological University, Singapore

Terahertz waveguides have tremendous significance in high resolution sensing, spectroscopy and terabit communications. I will show all-silicon THz topological photonic crystal waveguides that are excellent information carriers due to their robustness, single-mode propagation, and linear dispersion. These are key features for the next generation THz communications.

T11. Toroidal transitions in atoms and molecules - A chemist's view
Ilya Kuprov, University of Southampton, UK

The quantum mechanical equivalent of the classical toroidal moment operator includes spin. This alters the selection rules for spectroscopic transitions, and may allow transitions that are forbidden under the standard optical spectroscopy selection rules.

QN3. Metamaterials and Nanophotonics 2 (Friday 13 Dec, 09:00-10:20)

T12. Programmable Quantum Materials
Dimitri Basov, Columbia University, USA

Novel quantum phases with controllable properties are essential for new electronic and photonic functionalities. Quantum materials offer particularly appealing opportunities for the implementation of on-demand quantum phases. In this talk I will focus on programmable quantum phenomena that we investigate using nascent nano-optical methods developed in our group.

T13. Quantum metrology with nonlinear interferometers
Anna Paterova, A*STAR, Singapore

Nonlinear interferometers with correlated photons hold a promise to advance optical characterization and metrology techniques by improving their performance and affordability. We overview the use of nonlinear interferometers in metrology and imaging, where information in the detection-challenging infrared region is revealed using inexpensive and efficient components for visible light.

T14. Semiconductor - superconductor quantum optoelectronics
Alex Hayat, TECHNION, Israel

We demonstrate experimentally Cooper-pair injection and enhanced light emission in super-semiconductor structures, proposed by us for enhanced two-photon gain, electrically-driven entangled-photon generation and Bell state analyzers. We also demonstrate high-Tc superconductor-semiconductor devices.

TN3. Topological Nanophotonics 3 (Friday 13 Dec, 10:50-12:20)

T15. Photonic topological insulator in synthetic dimensions
Eran Lustig, TECHNION, Israel

Topological physics enables protected transport along edges of materials. Interestingly, such edge transport can flow not only on edges in real-space, but also on the interface of a synthetic space, such as modal space. Here, we report the first experimental realization of photonic topological insulators in synthetic dimensions. Our work leads to combining high-dimensional physics and long-range connectivity with phenomena such as PT-symmetry, topological lasers and more.

T16. 3D topological light and sound
Baile Zhang, Nanyang Technological University, Singapore

The birth of photonic crystals decades ago was largely stimulated by the pursuit of a three-dimensional photonic bandgap. A lot of efforts have been devoted to construct two-dimensional topological phases in classical systems. Here we will discuss the design and implementation of three-dimensional topological phases for light and sound.

T17. Topological textures in structured light
Mark Dennis, University of Birmingham, UK

Structured light, whose polarization varies in 3D, offers many possibilities for topological beam shaping. I will describe:

• Recent work on knotted polarization singularity lines, which are spanned by a texture of Seifert surfaces giving nontrivial global topological structure;

• Examples of knotted beams which are 3D optical polarization hopfions and skyrmions.

QTN1. Quantum and Topological Nanophotonics 1 (Friday 13 Dec, 13:50-15:20)

T18. Light twist showing the way
Kobus Kuipers, TU Delft, Netherlands

Optical spin plays a crucial role in new nanophotonic paradigms. In this lecture I will show how it can couple the valley pseudo spin of 2D materials to propagation direction and how it directly links to the propagation of edge states at interfaces of non-trivial topological photonic crystals.

T19. IAS@NTU Talk: Deeply subwavelength super-oscillatory imaging
Nikolay Zheludev, NTU, Singapore & University of Southampton, UK

We introduce new free-space label-free imaging approach that exploit optical singularities in super-oscillatory optical fields. Imaging resolution beyond λ/200 has been demonstrated.

T20. IAS@NTU Talk: Dynamic 2D quantum metasurfaces

Mark Brongersma, Stanford University, USA

I will describe the creation and operation of atomically-thin metasurfaces, whose response is dominated by exciton resonances as opposed to the typical plasmonic or Mie resonances.

TN4. Topological Nanophotonics 4 (Friday 13 Dec, 15:50-17:00)

T21. Topological edge states in amorphous structures

Yidong Chong, Nanyang Technological University, Singapore

We present a theoretical and experimental study of topological waveguides in T-symmetric amorphous photonic lattices. Unlike topological waveguides in crystalline lattices, these can bend in arbitrary directions and terminate at points in the bulk. Unlike previous amorphous lattice waveguides, they are protected against localization. They occur in amorphous honeycomb lattices containing string-like disclinations generated by topological lattice defects.

T22. Topological interplay between photons and electrons

Mohammed Hafezi, University of Maryland, USA

I review our progress in topological silicon photonics, quantum topological photonics and recent effort in optical manipulation of electronic topological states.

T23. Axisymmetric topological solitons for nanomagnetism

Christos Panagopoulos, Nanyang Technological University, Singapore

Two- and three-dimensional localized structures are unstable in most condensed matter systems. However, in certain low symmetry systems, magnetic interactions imposed by the underlying crystallographic structure can stabilize axisymmetric localized states (also known as magnetic vortices or skyrmions). I will discuss the physical principles and microwave resonances of these states.

TN5. Topological Nanophotonics 5 (Saturday 14 Dec, 09:00-10:20)

T24. Topological plasmonics: Ultrafast vector movies on the nanoscale

Harald Giessen, University of Stuttgart, Germany

We present an ultrafast vector microscope with 10 nm spatial and subfemtosecond temporal resolution which is capable of mapping all three vector components of the electric field as well as the magnetic field of light on nanophotonic structures. As first application, we record and analyze the temporal evolution of plasmonic skyrmions and the skyrmion number on a nanostructured gold surface.

T25. Optically tunable topological photonic crystals

Natalia Litchinitser, Duke University, USA

Photonic topological insulators offer the possibility to eliminate backscattering losses and improve the efficiency of optical communication systems. We combine the properties of a planar silicon photonic crystal and the concept of topological protection to demonstrate dynamically controlled transmission in a topological photonic crystal that exhibits the valley Hall effect.

T26. The role of topology and electron-electron interactions in two-dimensional electronic materials

Shaffique Adam, National University of Singapore, Singapore

Recent experimental and numerical evidence suggesting an intriguing universal relationship between the Fermi surface anisotropy of the non-interacting parent two-dimensional electron gas and the strongly correlated composite Fermi liquid formed in a strong magnetic field close to half-filing. Inspired by these results, in this talk, we explore more generally the role of topology on the effect of correlations in interacting 2D Fermi systems. Using a recently developed non-perturbative and numerically-exact projective quantum Monte Carlo simulation as well as other numerical and analytic techniques, we show that only for topological Dirac fermions with long-range Coulomb interactions do we find a universal square-root decrease of the Fermi-surface anisotropy. For the half-filled composite Fermi liquid, this result is surprising since a Dirac fermion ground state was only recently proposed as an alternative to the usual HLR state. The importance of the long-range interaction, expected for Dirac systems, is also consistent with recent transport measurements. Our proposed universality can be tested in several anisotropic Dirac materials including graphene, topological insulators, organic conductors, and magic-angle twisted bilayer graphene.

QTN2. Quantum and Topological Nanophotonics 2
(Saturday 14 Dec, 10:50-12:00)

T27. IAS@NTU Talk: Quantum dynamics of hexagonal boron nitride quantum emitters

Harry Atwater, CALTECH, USA

Recently point defects in hexagonal boron nitride have emerged as excellent candidates for single-photon sources. We systematically investigate the quantum dynamics of optically excited point defects in h-BN over a wide of temperature (4K-300K) and describe an approach to photon quantum addition using h-BN single emitter sources.

T28. Some unexpected opportunities in parity-time symmetry and exceptional-point physics

Cheng Wei Qiu, National University of Singapore, Singapore

In this talk, we present parity-time physics to realize an ultrasensitive readout of implantable microsensor locked to an exceptional point. On the other hand, we demonstrate anti-parity-time physics in diffusive systems to achieve phase transition from motionless temperature profiles to moving temperature profiles, despite the mechanical motion of the background.

T29. Photonic topological quantum cascade lasers

Qijie Wang, Nanyang Technological University, Singapore

In this presentation, we are going to show the first demonstration of an electrically pumped topological laser with valley edge states, in a quantum cascade semiconductor laser platform. We have shown experimentally that photonic topological protected lasing states are realized in such designed photonic structures.

Posters

PS1. Quantum & Topological Nanophotonics (Thursday 12 Dec, 12:40-14:00)

P1. Topology and interactions in qubit array coupled to a waveguide
Janet Zhong *et al.,* Australian National University, Australia

We study the interplay of topology and interactions in arrays of qubits coupled to a waveguide. These systems can exhibit collective effects, topological edge states, bound photon pairs and bound pair edge states. We also predict a novel interaction-induced localisation in these qubit arrays.

P2. Near-field nanoimaging of topologically nontrivial waveguiding in the telecom band
Alexander Dubrovkin *et al.,* Nanyang Technological University, Singapore

Using scattering-type scanning near-field microscopy we perform deeply subwavelength imaging of topologically nontrivial waveguiding in suspended-slab valley photonic crystals operating at the telecom frequency. Launching and guiding of transverse-magnetic modes along straight and zigzag boundaries between topologically-distinct domains with opposite valley Chern-indices is experimentally demonstrated and supported by theoretical simulations.

P3. In-plane symmetry breaking induced terahertz bound states in the continuum
Han Song *et al.,* Nanyang Technological University, Singapore

Symmetry is fundamental to photonic crystal design and symmetry breaking has been exploited as an efficient way of realizing numerous exotic photonic phenomena. Here, we report on a C4v symmetric metasurfaces and their diverse counterparts of in-plane symmetry breaking to attain multiple bound states in the continuum (BICs) at terahertz spectral region. Four groups of samples with different degrees of asymmetry were fabricated for multiple extended BICs. Our study provides a practical route for achieving enhanced field localization through BIC modes, not only inside but also outside the resonance structures. Hence, this opens up wide avenues for various applications, such as bio-/chemical sensing, high-order harmonic generation, and low-threshold lasing.

P4. Quantum states filtering of single photons by fiber-integrated metamaterial
Ruixiang Guo *et al.,* Nanyang Technological University, Singapore

We demonstrate quantum states filtering by plasmonic metamaterial integrated in a fiber network. By measuring the quantum state of heralded single photons passing through the metamaterial, we show that the metamaterial is transparent for an anti-symmetric part of the single photon wavefunction while it is opaque for its symmetric part.

P5. Stark-induced exciton multi-stability and spontaneous valley exciton symmetry breaking
Xiong Ying *et al.,* Nanyang Technological University, Singapore

Exciton-photon coupling leads to the mutual tuning between their resonance energies, and the shifts of the resonances are functions of both exciton and photon populations. We demonstrate exciton multistability and spontaneous valley symmetry breaking induced by this mutual tuning by coupling valley excitons in monolayer transition metal dichalcogenides with an optical cavity.

P6. Design of perovskite-structured barium titanate thin films for electro-optic photonic devices
Minmin Zhu *et al.,* Nanyang Technological University, Singapore

Main constrains for silicon photonics are the low speed of silicon modulator and high operating voltage which is also not compatible with complementary metal-oxide-semiconductor (CMOS). By contrast, these constrains for silicon photonics above are not present in discrete modulators which always utilize the Pockels effect in special perovskite oxides. Barium titanate

($BaTiO_3$ exhibits a giant EO coefficient (rc ~ 930 pm/V) among all oxides, thereby leading to high-speed devices in optical communication and beyond. Utilizing A-site and B-site dopants, our study provides insights into doping engineering as a general strategy to obtain functional perovskite oxides for power-efficient, ultra-compact integrated photonic devices.

P7. Topological triply-degenerate point with double Fermi arcs

Yihao Yang *et al.,* Nanyang Technological University, Singapore

We report on the experimental observation of a spin-1 Weyl point and a charge-2 Dirac point in a 3D phononic crystal. The former one is a band degeneracy point (BDP) that cannot be described in terms of an emergent relativistic field theory. The latter one is also a novel BDP that has four bands similar to the 3D Dirac point but carries a topological charge of 2.

P8. Long-lifetime coherence in a quantum emitter induced by a metasurface

Emmanuel Lassalle *et al.,* IMRE, A*STAR

We investigate the spontaneous emission of a multi-level atom in an anisotropic quantum vacuum (AQV), and we predict the construction of a long-lifetime coherence in an atomic Λ-transition induced by a distant metasurface, which presents the advantage of removing the need for coherent laser excitation.

P9. Infrared dielectric metamaterials from high refractive index chalcogenide crystals

Harish N. S. Krishnamoorthy *et al.,* Nanyang Technological University, Singapore

We show that by virtue of their exceptionally high infrared refractive indices, chalcogenide topological insulators are a compelling platform for dielectric nanophotonics architectures. Metamaterial nanoslit arrays in such materials support complex mode structures alluding to the excitation of poloidal surface currents providing new opportunities to combine dielectric, plasmonic and magnetic metamaterials in a single platform.

P10. Mid-IR phonon resonance for nanophotonics

Qiang Bo *et al.,* Nanyang Technological University, Singapore

We investigate localized surface phonon resonance and surface phonon polariton in mid-IR using both near field and far field techniques. Phonon resonance simultaneously exhibits low loss and high confinement in longer wavelength. We foresee that phonon resonance will be an important building block for mid-IR nanophotonics.

P11. Observation of an unpaired photonic Dirac point

Guigeng Liu *et al.,* Nanyang Technological University, Singapore

We report on the first observation of an unpaired Dirac point in a planar two-dimensional photonic crystal. The structure incorporates gyromagnetic materials, which break time-reversal symmetry; the unpaired Dirac point occurs when a parity-breaking parameter is fine-tuned to a topological transition between a photonic Chern insulator and a conventional photonic insulator phase.

P12. Higher-order topological states in acoustic systems

Haoran Xue *et al.,* Nanyang Technological University, Singapore

Higher-order topological insulators are novel types of topolgical phases beyond conventional understanding. Here, various higher-order topological phases are realized using coupled acoustic resonators. We experimentally realized second and thrid order topologcial states arising from quantized bulk polarizations in 2D and 3D systems, respectively. Moreover, we demonstrate a 3D quantized octupole insulator with a full cascade structure of multipole moments and topology.

PS2. Quantum & Topological Nanophotonics (Friday 13 Dec, 12:20-13:50)

P13. Transition-metal dichalcogenides for 2d optics
Zeng Wang *et al.,* IMRE, A*STAR

We have demonstrated an imaging platform which is realized by atomically thin transition metal dichalcogenide (TMD) layers. Through fabricating well-designed photonsieves on thin TMD film, we shrink the thickness conventional holograms and flat superoscillatory lens from several hundred nanometers to just 10nm, which enables high efficiency holography with a large angle of view and sub-diffraction limit focusing with a focal spot of ~0.41λ. The work has the potentials to be applied to direct laser writing, compact imaging system and holographic display.

P14. Stable mode locking with narrow RF linewidth in a single-section InP-based multiple-quantum-well laser emitting at ~1654 nm
Li Xiang *et al.,* Nanyang Technological University, Singapore

Stable self-starting mode locking is achieved in a single-section InP-based multiple-quantum-well laser emitting at ~1654 nm for the first time. The mode locking operation is confirmed by a strong radio frequency (RF) signal at ~19.4 GHz with extremely narrow linewidth (~10 kHz).

P15. Phase stabilization of a coherent fibre network by single-photon counting
Yanikgonul Salih *et al.,* Nanyang Technological University, Singapore

Coherent optical fibre networks provide a scalable platform for quantum light processing and quantum communication. However, these networks are extremely sensitive to phase noise; thus, they require resource demanding stabilization or data post selection techniques. We propose a simple method of phase stabilization based on single-photon counting, which is far less resource demanding, and apply it to fully-fiberized quantum networks operating at the single-photon regime. We achieved phase stability comparable to conventional stabilization schemes, which enables dissipative single-photon switching by coherent perfect absorption in fiberized plasmonic metamaterial absorber.

P16. Fermi arc induced vortex structure in Weyl beam shifts
Udvas Chattopadhyay *et al.,* Nanyang Technological University, Singapore

In periodic media, despite the close relationship between bulk geometrical effects and topological surface states, the two are typically probed separately. We show theoretically that when beams in a Weyl medium reflect off an interface with a gapped medium, the trajectory is influenced by both bulk geometrical effects and Fermi arc surface states. The reflected beam experiences a Goos-Hänchen-like shift that forms a half-vortex in the 2D surface momentum space, centered where the Fermi arc of the reflecting surface touches the Weyl cone. This provides a way to use bulk transport to probe the topological characteristics of a Weyl medium.

P17. Plasmonic control of interlayer charge transfer in TMDC heterostructure
Matej Sebek *et al.,* IMRE A*STAR, Singapore

Plasmonic nanostructures have been recently employed with two-dimensional transition metal dichalcogenide (TMDC) films to enhance photoluminescence and induce strong light-matter interaction. Herein, we show how plasmonic nanocavities created by gold nanoparticles interact with excitons in the TMDC heterostructure and modulate the interlayer charge transfer within them. We explore the interaction with photoluminescence spectroscopy and dark-field microscopy.

P18. Frequency selective rerouting of terahertz waves in terahertz photonic topological insulator
Abhishek Kumar *et al.,* Nanyang Technological University, Singapore

The remarkable expansion of wireless data traffic owing to exponential growth of wireless devices has put immense pressure on the existing wireless technologies. Terahertz, which lies between electronics and photonics has envisioned as potential candidate for future high-speed wireless communication. Here, we propose topological cavity integrated terahertz Photonic Topological

Insulator (PTI) for frequency selective rerouting of terahertz waves at chip-scale, which will pave the path in developing terahertz integrated circuits for future wireless technology.

P19. Ultrathin superconductor terahertz metamaterials

Yogesh Srivastava *et al.,* Nanyang Technological University, Singapore

In this work, we introduce thinnest superconductor terahertz metamaterials of thickness 25nm, which supports excitation of Fano resonances while identical metallic samples do not show any Fano resonance. Upon irradiation with an optical pump, ultrathin superconducting metamaterials show extremely low threshold switching and manifests new ways to realize low threshold ultrafast dual-channel switchable devices.

P20. Optical contrast in Sb_2Te_3

Jose Martinez *et al.,* Singapore University of Technology and Design, Singapore

The optical contrast exhibited by phase-change materials is central to the physics of data storage. Identifying the oscillator energy as the cause, a calculation of crystalline-field and spin-orbit interaction (SOI) effects on valence p-orbitals is undertaken. During amorphization, Friedel oscillations introduce a sign change in the SOI of conduction-band pz-orbitals.

P21. Circuit realization of a four-dimensional quantum Hall lattice

Wang You *et al.,* Nanyang Technological University, Singapore

We realize a new type of 4DQH system in electric circuits. Unlike previous models, it requires neither artificial gauge fields nor TRS breaking. This allows directly realization in electric circuits instead of using synthetic dimensions. It will be a good platform to explore topological features of high dimensional lattices.

P22. Robust waveguiding in amorphous valley hall photonic lattices with topological defects

Qiang Wang *et al.,* Nanyang Technological University, Singapore

We show theoretically and experimentally the robust waveguiding in the amorphous valley hall photonic lattice. By introducing pentagon or heptagon defects in the honeycomb lattice with sublattice symmetry broken., the amorphous valley hall edge mode will bound to the string and terminate at the topological defect.

P23. The interlayer exciton in multilayer van der Waals heterostructures

Qinghai Tan *et al.,* Nanyang Technological University, Singapore

The interlayer exciton (IX) in van der Waals heterostructures has attracted much attention owing to its fascinating properties. Here, we reported the IXs from multilayer WSe2-monolayer MoS2 heterostructures. We found these IXs can be used to probe the evolution of the conduction band with the number of WSe2 layers.

P24. Utilization of resist stencil lithography for multi-dimensional fabrication on a curved surface

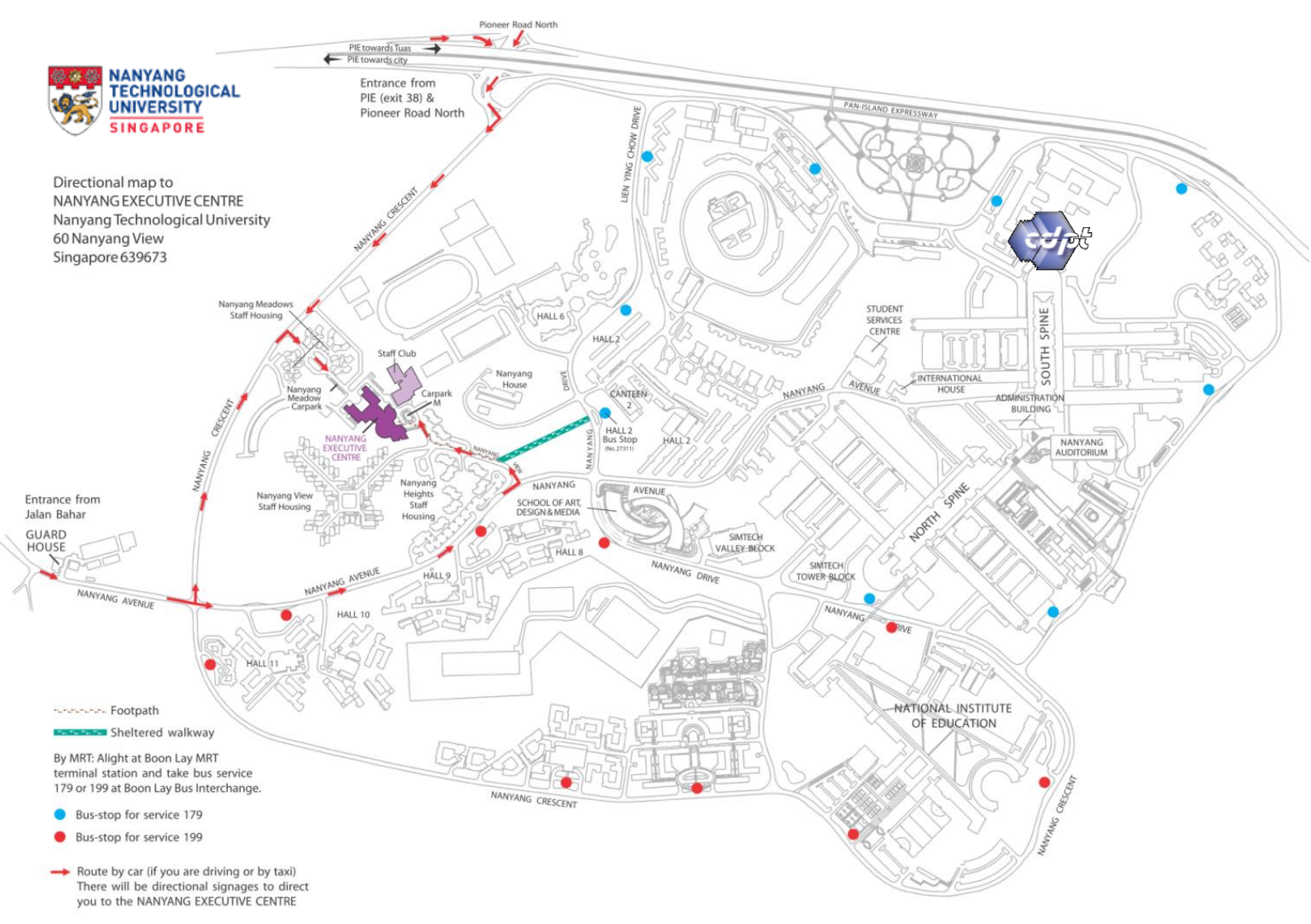
Richard Cai Hongbing *et al.,* Nanyang Technological University, Singapore

Here we report a resist stencil lithography based approach for in-situ fabrication of multi-dimensional nanostructures on both planar and uneven substrates by using the resist film as a flexible stencil to form suspending membrane with pre-designed patterns.

P25. Manipulating quantum matter at the nanoscale

Syed Abdullah Aljunid *et al.,* Nanyang Technological University, Singapore

We propose to utilise a superoscillatory lens to enhance light-atom interactions. This lens can focus light below the diffraction limit which has been used for super-resolution imaging and to trap nano-object. The superoscillatory lens can be generated either by a static mask, or dynamically configurable using Spatial Light Modulators (SLM). We also show that an optical fiber sensor bearing plasmonic metamaterial at its tip can be used to detect coupling between atomic and plasmonic excitations in a fiberized experiment.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PIE towards city
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House
DRIVE
CANTEEN
2
HALL 2
Bus Stop
(No.27311)
HALL 2
NANYANG
EXECUTIVE
CENTRE
Nanyang View
Staff Housing
Nanyang
Heights
Staff
Housing
NANYANG
AVENUE
SCHOOL OF ART,
DESIGN & MEDIA
HALL 8
SIMTECH
VALLEY BLOCK
NANYANG DRIVE
SIMTECH
TOWER BLOCK
NANYANG
DRIVE
STUDENT
SERVICES
CENTRE
INTERNATIONAL
HOUSE
SOUTH SPINE
ADMINISTRATION
BUILDING
NANYANG
AUDITORIUM
NORTH SPINE
Entrance from
Jalan Bahar
GUARD
HOUSE
NANYANG AVENUE
HALL 9
HALL 10
HALL 11
NATIONAL INSTITUTE
OF EDUCATION
NANYANG CRESCENT
Footpath
Sheltered walkway
By MRT: Alight at Boon Lay MRT
terminal station and take bus service
179 or 199 at Boon Lay Bus Interchange.
Bus-stop for service 179
Bus-stop for service 199
Route by car (if you are driving or by taxi)
There will be directional signages to direct
you to the NANYANG EXECUTIVE CENTRE

Centre for Disruptive Photonic Technologies
Nanyang Technological University
School of Physical and Mathematical Sciences
SPMS-PAP-01-28 & SPMS-PAP-02-12, 21 Nanyang Link, Singapore 637371