Title and Abstracts

Day 1 : Wednesday, 25.05.2022

(1) **Fay Dowker, Imperial College London**

Title : The Positivity axiom in a sum-over-histories framework for quantum theory
Abstract : The path integral provides the basis for a framework for the foundations of quantum theory and it is a work in progress to establish the axioms of this framework. I will examine the "positivity axiom." Boes and Navascues (BN) proved that the set of all *strongly positive* systems—which I will explain—is maximal among sets of systems that are closed under composition. That means no other system can be added to the set of strongly positive systems without spoiling closure under composition. I will show that the strongly positive set is the unique set satisfying this condition—maximal among sets of systems that are closed under composition. This is an argument to adopt the strong positivity axiom for histories-based quantum theories, including quantum gravity.

(2) **Brien Nolan, Dublin City University**

Title : Motion of a gyroscope on a closed timelike curve
Abstract : We consider the motion of a gyroscope on a closed timelike curve (CTC). A gyroscope is identified with a unit-length spacelike vector - a spin-vector - orthogonal to the tangent to the CTC, and satisfying the equations of Fermi-Walker transport along the curve. We investigate the consequences of the periodicity of the coefficients of the transport equations, which arise from the periodicty of the CTC, which is assumed to be piecewise C^2. We show that every CTC with period T admits at least one T-periodic spin-vector. Further, either every other spin-vector is T-periodic, or no others are. It follows that gyroscopes carried by CTCs are either all T-periodic, or are generically not T-periodic. We consider examples of spacetimes admitting CTCs, and address the question of whether T-periodicity of gyroscopic motion occurs generically or only on a negligible set for these CTCs. We discuss these results from the perspective of principles of consistency in spacetimes admitting CTCs.

(3) **Cisco Gooding, University of Nottingham**

Title : Detecting the Unruh Effect in an Analogue
Abstract : Discovered soon after black hole evaporation, the closely-related Unruh effect predicts a thermal response for a detector accelerating through the vacuum. The small magnitude of this temperature under achievable experimental conditions has hindered attempts to observe the effect, though a recent proposal indicates that an analogue of the circular Unruh effect should be observable in a cold-atom system. In this talk, I describe conceptual aspects of detection and signal extraction for the analogue Unruh effect.

(4) **Bassano Vacchini, Università degli Studi di Milano and INFN**

Title : Current directions in open quantum system dynamics
Abstract : The talk is aimed at providing an introduction to the foundations of open system theory in the light of quantum information concepts. We will briefly introduce the basic assumptions and general concepts of the theory, such as complete positivity and quantum dynamical map, relevant to the description of dissipation and decoherence effects in quantum mechanics. We will consider some of the main methods for the treatment of open system dynamics, pointing to the relevance of correlations such as entanglement and discord. We will further mention recent developments in the definition and treatment of non-Markovian dynamics as well as quantum thermodynamical system, where quantum information notions appear to plan an important role. Relevant open questions and possibly promising future research directions will be finally mentioned.

(5) **Mark Mitchison, Trinity College Dublin**

Title : Thermometry by decoherence with impurity qubits
Abstract : The precise measurement of temperature is a crucial prerequisite for the coherent control of cold quantum systems. In this talk, I will describe how temperature can be inferred by monitoring the decoherence of a qubit embedded within the system of interest [1,2]. This approach can be implemented in ultracold atomic gases [3], for example, and has several interesting advantages compared to standard thermometry schemes. Surveying some of our recent results in this direction, I will first present a proposal for thermometry by decoherence in a single-component Fermi gas [1]. Next, I will discuss the general thermodynamics of decoherence [4], which shows that such measurements come at a fundamental energetic cost in the form of heat dissipation. Finally, I will describe how this idea can be extended to generic, strongly interacting systems that thermalise. This leads to a temperature scale based purely on quantum interference, which may even be used to take the temperature of a pure quantum state [2].

References:
[1] M. T. Mitchison, T. Fogarty, G. Guarnieri, S. Campbell, T. Busch, and J. Goold, Phys. Rev. Lett. 125, 080402 (2020)
[2] M. T. Mitchison, A. Purkayastha, M. Brenes, A. Silva, and J. Goold, Phys. Rev. A 105, L030201 (2022)
[3] D. Adam, Q. Bouton, J. Nettersheim, S. Burgardt, and A. Widera, arXiv:2105.03331 [quant-ph] (2021)
[4] M. Popovic, M. T. Mitchison, and J. Goold, arXiv:2107.14216 [quant-ph] (2021)

(6) **Yasaman Yazdi, Imperial College London**

Title : Can One Hear the Shape of a Quantum Spacetime?
Abstract : Spectral geometry offers a new and powerful means to describe quantum spacetimes using the spectra of operators defined on them. I will review the study of Lorentzian spectral geometry using discrete spacetimes in the framework of causal set quantum gravity. I will discuss what geometric information can be gleaned from the spectra of various operators on causal sets describing various spacetimes, and I will show recent results indicating that one can "hear" a spacetime's dimension and manifoldlike nature.

(7) **Ana Retore, Trinity College Dublin**

Title : The free-fermion condition in lower-dimensional AdS/CFT
Abstract : Integrability is a powerful property of some physical systems, which has provided tools to advance our understanding of different areas of theoretical physics. In particular, it is present in several instances of AdS/CFT. In this talk, I will present new integrable deformations of AdS_2 and AdS_3 S-matrices. I will show that, remarkably, all these S-matrices also satisfy the so-called free-fermion condition and explain how to use this property to simplify and reinterpret several known results in this area.

(8) **Matteo Carlesso, Queen's University Belfast**

Title : Present status and future challenges of non-interferometric tests of collapse model
Abstract : The superposition principle is the cornerstone of quantum mechanics, leading to a variety of genuinely quantum effects. Whether the principle applies also to macroscopic systems or, instead, there is a progressive breakdown when moving to larger scales, is a fundamental and still open question. Collapse models predict the latter option, thus questioning the universality of quantum mechanics. Technological advances allow to challenge collapse models and the quantum superposition principle more and more with a variety of different experiments. Among them, non-interferometric experiments proved to be the most effective in testing these models. In this talk, I provide an overview of such experiments, including cold atoms, optomechanical systems, X-rays detection, bulk heating as well as comparisons with cosmological observations. We also discuss

avenues for future dedicated experiments, which aim at further testing collapse models and the validity of quantum mechanics.

(8) **Qiongyuan Wu, Queen's University Belfast**

Title : Nonequilibrium Quantum Thermodynamics of a Particle Trapped in a Controllable Time-Varying Potential
Abstract : Many advanced quantum techniques feature non-Gaussian dynamics, and the ability to manipulate the system in that domain is the next stage in many experiments. One example of meaningful non-Gaussian dynamics is that of a double-well potential. Here we study the dynamics of a levitated nanoparticle undergoing the transition from a harmonic potential to a double well in a realistic setting, subjected to both thermalization and localization. We characterize the dynamics of the nanoparticle from a thermodynamic point of view, investigating the dynamics with the Wehrl entropy production and its rates. Furthermore, we investigate coupling regimes where the the quantum effect and thermal effect are of the same magnitude, and look at suitable squeezing of the initial state that provides the maximum coherence. The effects and the competitions of the unitary and the dissipative parts onto the system are demonstrated. We quantify the requirements to relate our results to a bonafide experiment with the presence of the environment, and discuss the experimental interpretations of our results in the end.

Day 2 : Thursday, 26.05.2022

(1) **John Ellis, King's College London**

Title : Has the Standard Model finally Broken?
Abstract : TBA

(2) **Peter Coles, Maynooth University**

Title : Fuzzy Cosmology
Abstract : I discuss some applications of the Schrodinger-Poisson wave-mechanical approach to cosmological structure formation. The most obvious use of this formalism is to "fuzzy" dark matter, i.e. dark matter consisting of extremely light particles whose effective de Broglie wavelength is sufficiently large to be astrophysically relevant, but it can be used to model more general scenarios and has a number of advantages over standard methods based on Eulerian perturbation theory. I illustrate the formalism with some calculations for cosmic voids and discuss its application to the cosmological reconstruction problem(s).

(3) **Jeremy Green, Trinity College Dublin**

Title : Baryon-baryon interactions and the H dibaryon from lattice QCD
Abstract : Using lattice QCD, one can study hadrons and their interactions starting from quantum chromodynamics. In the baryon-baryon sector, this offers the prospect of a first-principles basis for nuclear physics. I will discuss the methodology and challenges of these calculations and present a study of the conjectured H dibaryon, a bound state of hyperons with quark content $uuddss$, at a single $SU(3)$-flavour-symmetric quark mass point. For the first time, an extrapolation to zero lattice spacing was performed, which had an unexpectedly large effect on the binding energy. I will also review the status of calculations in the nucleon-nucleon sector.

(4) **Alessandro Romito, Lancaster University**

Title : Topological transitions in continuously monitored free fermion systems
Abstract : Recent studies of quantum circuits have shown that local measurement gates can induce transitions between steady-state phases of many-body systems with different entanglement scaling properties (volume vs area law) or different topological orders [1]. Such transitions can be induced by continuous measurement too, for which analytical treatments and efficient large-size

numerical simulations are possible in free fermion models. Here we consider a free fermion model where two sets of non-commuting continuous measurements induce a transition between area-law entanglement scaling phases of distinct topological order [2]. We show that, in the presence of unitary dynamics, the two topological phases are separated by a region with sub-volume scaling of the entanglement entropy and that the transition universality class of the measurement-only model differs from that in interacting models with stroboscopic dynamics and projective measurements. We show that the phase diagram is qualitatively captured by an analytically tractable non-Hermitian Hamiltonian model obtained via post-selection. By the introduction of a partial-post-selection continuous mapping, the topological distinct phases of the stochastic measurement-induced dynamics are uniquely associated with the topological indices of the non-Hermitian Hamiltonian. Our results mark a clear distinction between the topological phase transition induced by projective and continuous measurements and open a door to the construction of topological invariants for stochastic quantum dynamics.

1. Y. Li, X. Chen, and M. P. A. Fisher, Phys. Rev. B 98, 205136 (2018); A. Chan, R. M. Nandkishore, M. Pretko, and G. Smith, Phys. Rev. B 99, 224307 (2019); B. Skinner, J. Ruhman, and A. Nahum, Phys. Rev. X 9, 031009 (2019).
2. G. Kells, D. Meidan, A. Romito, arXiv: 211209787 (2021).

(5) **Tomasz Maciazek, School of Mathematics, University of Bristol**

Title : Braiding on one-dimensional wire networks

Abstract : World lines of anyons that exchange in 2D form braids in spacetime. These braids are subject to certain universal topological relations coming from their continuous deformations. In 2D, such an approach leads to the well-known braiding relation also known as the Yang-Baxter relation. In my talk, I will show how to define counterparts of braids and derive braiding relations for anyons constrained to move on planar wire networks. In particular, I will demonstrate that anyons on wire networks have fundamentally different braiding properties than anyons in 2D. My analysis reveals an unexpectedly wide variety of possible non-abelian braiding behaviours on networks. The character of braiding depends on the topological invariant called the connectedness of the network. As one of our most striking consequences, particles on modular networks can change their statistical properties when moving between different modules. However, sufficiently highly connected networks already reproduce braiding properties of 2D systems.

(6) **Emma Albertini, Imperial College**

Title : Interacting field theory on causal sets

Abstract : This talk focuses on interacting field theory on causal sets. In this framework, the road to quantization is taken through a Sum-over-Histories approach. I will show how an expression for the interacting k-point function on a fixed background causal set can be formulated in terms of the decoherence functional. In particular, I will deal with the two-point function in ϕ^4 theory, developing a diagrammatic method to represent the perturbative expansion to all orders, and an arbitrary number of interaction points, assigning a mathematical expression to each element of the pictorial representation. To conclude, I propose rules to construct the allowed diagrams, estimating all terms at any order in terms of retarded and Feynman propagator. As the two-point function is the key ingredient to evaluate the entanglement entropy in the free theory, I will also comment on the analogous entropy calculation for the interacting theory, and the possible implications.

(7) **Aradhita Chattopadhyaya, Trinity College Dublin**

Title : Black Holes and Modularity

Abstract : Will discuss briefly how modular forms and mock modular forms help in computing the entropy of super-symmetric black holes.

(8) **Aaron Conlon, Maynooth university**

Title : Comparability of braiding and fusion on wire networks

Abstract : Exchanging particles on graphs, or more concretely on networks of quantum wires, has been proposed as a means to perform fault tolerant quantum computation. This was inspired by braiding of anyons in planar systems. However, exchanges on a graph are not governed by the usual braid group but instead by a graph braid group. By imposing compatibility of graph braiding with fusion of topological charges, we obtain generalized hexagon equations. We find the usual planar anyons solutions but also more general braid actions. We illustrate this with Abelian, Fibonacci and Ising fusion rules.

(9) **Abraham Harte, Dublin City University**

Title : Can a classical massless object be localized?
Abstract : No, at least if the object has spin. More precisely, there exist reasonably-defined centroids which are infinitely distant from one another. This is related to the fact that a spinning massless object must violate energy conditions: Certain observers see large amounts of both positive and negative energy density. This is interesting because a high-frequency electromagnetic pulse is at least approximately massless, and it can remain so even in an approximation where it has nonzero spin. Nevertheless, it is physically clear that pulses can be localized. The resolution here is that the usual high-frequency approximations fail to preserve the energy conditions satisfied by exact Maxwell configurations. It follows that although high-frequency approximations result in good predictions in many contexts, they can be arbitrarily wrong when describing the "average trajectory" of a spinning wavepacket. For this, it can be essential to take into account that spinning EM wavepackets are in fact massive, not massless.

Day 3 : Friday, 27.05.2022

(1) **Steve Simon, Oxford University**

Title : The Story of Anyons
Abstract : I will review the history of anyons, particles that are neither bosons nor fermions, starting with their theoretical proposal all the way to their definitive experimental observation over 40 years later.

(2) **Zlatko Papic, University of Leeds**

Title : Weak ergodicity breaking and many-body scars in a Bose-Hubbard quantum simulator
Abstract : The ongoing quest for understanding nonequilibrium dynamics of complex quantum systems underpins the foundation of statistical physics as well as the development of quantum technology. Quantum many-body scarring has recently opened a window into novel mechanisms for delaying the onset of thermalization, however its experimental realization has been limited to a single initial condition in the Rydberg atom system. In this talk, I will present our recent proposal for realizing quantum many-body scars using bosonic ultracold atoms in a tilted optical lattice [Su et al., arXiv:2201.00821]. I will show that such a quantum simulator can not only access the previously known quantum many-body scar physics, but it also allowed us to identify an unconventional many-body scarring associated with the unit-filling Mott insulator state. This work makes the resource of scarring accessible to a broad class of ultracold-atom experiments, and it allows to explore its relation to constrained dynamics in lattice gauge theories, Hilbert space fragmentation, and disorder-free localization.

(3) **Grazia Salerno, Aalto University**

Title : Quasi-BIC mode lasing in plasmonic lattices
Abstract : Plasmonic lattices of metal nanoparticles have emerged as an effective platform for strong light-matter coupling, lasing, and Bose-Einstein condensation. However, the full potential of complex unit cell structures has not been exploited. On the other hand, bound states in continuum (BICs) have attracted attention, as they provide topologically protected optical modes with diverging quality factors. Here, we show that nanoparticle lattices with complex unit cells enable lasing in a quasi-BIC mode with a highly out-of-plane character. By combining theory with

polarization-resolved measurements of the emission, we show that the lasing mode has a non-trivial topological charge. Our analysis reveals that the mode is primarily polarized out-of-plane as a result of the unit cell structure. The quality factors of the out-of-plane BIC modes of the quadrumer array can be exceedingly high. Our results unveil the power of complex multi-particle unit cells in creating topologically protected high-Q modes in periodic nanostructures.

(4) **Vasilis Niarchos, University of Crete**

Title : Towards a solution of Conformal Field Theories with Artificial Intelligence
Abstract : The non-perturbative solution of Quantum Field Theories is a long-standing problem. The conformal bootstrap programme is a particularly promising approach in the context of Conformal Field Theories. I will discuss a novel numerical approach in this context that employs methods from Machine Learning and Artificial Intelligence. I will report results of a preliminary application of Reinforcement Learning algorithms to two-dimensional CFTs, and I will give an overview of the advantages and disadvantages of the approach, and its future prospects.

(5) **Brian Dolan, Dublin Institute for Advanced Studies**

Title : TBA
Abstract : TBA

(5) **Antonio Ferreiro, Dublin City Univeristy**

Title : Extended DeWitt-Schwinger renormalization
Abstract : We propose to slightly generalize the DeWitt-Schwinger adiabatic renormalization subtractions in curved space to include an arbitrary renormalization mass scale μ. The new predicted running for the gravitational couplings are fully consistent with decoupling of heavy massive fields. This is a somewhat improvement with respect to the more standard treatment of minimal (DeWitt-Schwinger) subtractions via dimensional regularization.

(6) **Alex Bullivant, University of Maynooth**

Title : Higher Quantum Double
Abstract : For a choice of finite group G, the quantum double DG is a quasi-triangular Hopf algebra providing a model of the observables in a 2+1D topological gauge theory with gauge group G. Drawing analogies with DG, in this talk I will describe a quasi-triangular Hopf category DE, for each choice of finite 2-group E, providing a model of observables in a 3+1D topological higher gauge theory with gauge 2-group E. To conclude, I will then describe how DE-module categories provide a model of the space-time evolution of string-like excitations in such theories and their relation to invariants of knotted surfaces in 4-space.

(7) **Jean-Yves Desaules, University of Leeds**

Title : Extensive multipartite entanglement from su(2) quantum many-body scars
Abstract : Recent experimental observation of weak ergodicity breaking in Rydberg atom quantum simulators has sparked interest in quantum many-body scars - eigenstates which evade thermalisation at finite energy densities due to novel mechanisms that do not rely on integrability or protection by a global symmetry. A salient feature of some quantum many-body scars is their sub-volume bipartite entanglement entropy. In this work we demonstrate that such exact many-body scars also possess extensive multipartite entanglement structure if they stem from an su(2) spectrum generating algebra. We show this analytically, through scaling of the quantum Fisher information, which is found to be super-extensive for exact scarred eigenstates in contrast to generic thermal states. Furthermore, we numerically study signatures of multipartite entanglement in the PXP model of Rydberg atoms, showing that super-extensive quantum Fisher information can be generated dynamically by performing a global qench experiment. Our results identify a rich multipartite

correlation structure of scarred states with significant potential as a resource in quantum enhanced metrology.

Posters

- **Johannes Aspman, Trinity College Dublin**

Title : Topological correlators in SQCD with masses and background fluxes
Abstract : We consider the integral over the u-plane for $\mathcal{N} = 2$ supersymmetric QCD with $N_f \leq 3$ hypermultiplets for generic values of the masses. We demonstrate that the low energy effective theory on a compact four-manifold can be consistently formulated using couplings to background fluxes. This gives an infinite family of topological partition functions. We discuss the formulation of the u-plane integral, and the general approach to evaluate these integrals.

- **Elias Furrer, Trinity College Dublin**

Title : Cutting and gluing with running couplings in N=2 supersymmetric QCD
Abstract : We consider the order parameter $u = \langle \mathrm{Tr}\phi^2 \rangle$ as a function of the running coupling constant $\tau \in \mathbb{H}$ of $\mathcal{N} = 2$ supersymmetric QCD with gauge group SU(2) and $N_f \leq 4$ massive hypermultiplets. If the domain for τ is restricted to an appropriate fundamental domain $\mathcal{F}_{N_f}$, the function u is one-to-one. We demonstrate that these domains consist of six or less images of an $\mathrm{SL}(2, \mathbb{Z})$ keyhole fundamental domain, with appropriate identifications of the boundaries. For special choices of the masses, u does not give rise to branch points and cuts, such that u is a modular function for a congruence subgroup Γ of $\mathrm{SL}(2, \mathbb{Z})$ and the fundamental domain is $\Gamma\backslash\mathbb{H}$. For generic masses, however, branch points and cuts are present, and subsets of $\mathcal{F}_{N_f}$ are being cut and glued upon varying the masses. We study this mechanism for various phenomena, such as decoupling of hypermultiplets, merging of local singularities, as well as merging of non-local singularities which give rise to superconformal Argyres-Douglas theories. For $N_f = 4$, the triality group of the flavour symmetry SO(8) gives rise to an orbit of mass configurations, which organises the order parameters into vector-valued bimodular forms.

- **Jasmine Thomson-Cooke, Dublin Institute for Advanced Studies**

Title : First-order phase transitions at the electroweak scale
Abstract : In order to get baryogenesis it is thought the Sakharov conditions need to be met: Interactions out of thermal equilibrium, C and CP symmetry violation and B number violation. This can be done with a first-order phase transition at the electroweak scale. However the standard model predicts a crossover transition and too little CP violation. This may be fixed with beyond the standard model physics. To check if this is at least in part possible we construct an effective field theory to describe phase transitions at the electroweak scale that is guaranteed to be first order. From this we show that there is a phase space of parameters that give a strong first-order transition, which allows for the production of gravitational waves.

- **Gert Vercleyen, Maynooth University**

Title : On low rank fusion rings
Abstract : We present a method to generate all fusion rings of a specific rank and multiplicity. This method was used to generate exhaustive lists of fusion rings up to order 9 for several multiplicities. We generalize the Tambara-Yamagami and Haagerup-Izumi constructions and review the structure of non-Abelian fusion rings with a subgroup. A website containing data on fusion rings is introduced and an introduction to a Wolfram Language package for working with these rings is given.

- **Jesuel Marques Leal Júnior, Maynooth University**

  Title : Efficiency study of overrelaxation and stochastic overrelaxation algorithms for SU(3) Landau gauge-fixing
  Abstract : We have carried out a comparative analysis of Landau Gauge Fixing algorithms. We present the results of our optimization analysis for the Landau Gauge Fixing overrelaxation and stochastic overrelaxation algorithms. By studying the distribution of necessary sweeps for gauge-fixing of a sample of configurations, we obtain the optimal choice of parameters for these algorithms, as well as their dynamic critical exponent.

- **Aoibhinn Gallagher, Maynooth University**

  Title : Evolution of Voids using Schrodinger Poisson systems
  Abstract : We investigate the evolution of voids in the Schrödinger-Poisson formalism. We find simple wave-mechanical solutions in a typical cosmological background. We analyse the solution and establish boundary conditions that agree with the equations and the physicality of the model. Show the results of this model solved numerically.

- **George Mihailelscu, University College Dublin**

  Title : Kondo Probes
  Abstract : The problem of accurate temperature estimation is a central task in many experimental setups but also of critical importance to NISQ quantum devices where precise knowledge of the operating parameters of devices is vital in accounting for deleterious effects that may spoil inherently fragile quantum states. Measuring the temperature of a quantum system is in particular, a highly non-trivial task, as temperature itself is not an observable quantity. However, recent studies have made great advances in designing schemes of quantum thermometry using quantum estimation theory. In particular, it has been noted that the use of quantum effects and phase transitions may lead to enhanced sensitivity surpassing the so called Heisenberg limit. We study the use of quantum impurity models as temperature probes with particular focus on how the probe sensitivity is related to the energy structure of a many-body lead. Furthermore, we investigate the sensitivity profile of the system under conditions which exhibit the Kondo effect.

- **Sindre Brattegard, Trinity College Dublin**

  Title : Multiple impurity probes in 1D Fermi gases
  Abstract : Accurately measuring the temperature of ultracold gases without obliterat- ing the state of the gas is both a challenging and important task. This holds true in particular for fermionic gases where the Pauli principle makes precise temperature measurement using time of flight measurements even more diffi- cult. Motivated by this challenge, in this work we calculate the dynamics of two impurities embedded in a 1D Fermi gas. We show how the decoherence functions of the two-impurity system is affected by the induced interactions between them from their joint interaction with the Fermi gas. We also show how the decoherence functions depend on temperature of the gas. It has previously been shown that measuring decoherences of impurity probes can be used to extract temperature information from a quantum system.

- **Oisin Culhane, Trinity College Dublin**

  Title : Extractable work in quantum electromechanics
  Abstract : Recent experiments have demonstrated the generation of coherent mechanical oscillations in a suspended carbon nanotube, which are driven by an electric current through the device above a certain voltage threshold, in close analogy with a lasing transition. We investigate this

phenomenon from the perspective of work extraction, by modelling a nano-electromechanical device as a quantum flywheel or battery that converts electrical power into stored mechanical energy. We introduce a microscopic model that qualitatively matches the experimental finding, and compute the Wigner function of the quantum vibrational mode in its non-equilibrium steady-state. We characterise the threshold for self-sustained oscillations using two approaches to quantifying work deposition in non-equilibrium quantum thermodynamics: the ergotropy and the non-equilibrium free energy. We find that ergotropy serves as an order parameter for the phonon lasing transition. The framework we employ to describe work extraction is general and widely transferable to other mesoscopic quantum devices.

- **Chiara Paletta, Trinity College Dublin**

  Title : Integrable open quantum system
  Abstract : The theory of open quantum systems aims to develop a general framework to analyse the dynamical behaviour of systems by removing the environmental degrees of freedom. If the response of the environment is Markovian, the dynamics can be described through the Lindblad Master equation: dependent on the Hamiltonian of the system under study and a jump operator describing the coupling to the environment. We focus on Yang Baxter Integrable interacting systems. After explaining a systematic method to construct them, we show some of the new models presented in PRL 126.24 (2021): 240403. For one of them, the analytical expression of the Non Equilibrium steady states will be given and also the physical properties.

- **Kevin Kavanagh, Dublin Institute for Advanced Studies**

  Title : Dissipation on the transverse XY model: Non-zero Liouvillian Gaps from Anisotropy
  Abstract : We show that a Liouvillian gap can be found which remains non-zero in the $N \to \infty$ limit, for a variety of dissipative processes. To obtain the gap, we exploit the structure of the Liouvillian super-operator which represents the Lindblad master equation. Using this approach we are able to iteratively construct the steady state and access the Liouvillian gap via non-Hermitian perturbation theory. Further, we can express explicitly a characteristic change in the behaviour of the gap originating from the phase transition of the TXY model.

Public lectures

What we talk about when we talk about the Quantum World

Prof. Fay Dowker, Imperial College London

Quantum mechanics is famously strange and counter-intuitive, differing from what we might expect based on our everyday experiences. But what, exactly, lies at the core of this strangeness? The particle physicist Richard Feynman remarked that we seem to have to walk "a logical tightrope" when we talk about a quantum system. I will suggest what Feynman might have meant by this and why he brought the question of "logic" into the discussion of the implications of quantum theory. I will describe a way of thinking and talking about a quantum system, influenced by Feynman's perspective, in which we must pay careful attention to logic if we want a picture of the physical quantum world. And in which, maybe, quantum-ness is not as counter to everyday thinking as one might suppose.

What are we? Where do we come from? Where are we going?

Prof. John Ellis, King's College London

Gauguin posed these questions in a famous painting of people pondering these metaphysical questions. Particle physicists seek scientific answers to these fundamental questions, analysing the structure of matter and its origins, the nature of dark matter and questioning whether the expansion of the Universe will continue for ever. Central role in answers to these questions involve the Higgs boson discovered 10 years ago and possibly supersymmetry, a theory to which Lochlainn O'Raifeartaigh made many fundamental contributions.