BOOK OF ABSTRACTS

20th Central European Quantum Information Processing Workshop

June 30th–July 3rd 2025, Smolenice, Slovakia
http://ceqip.eu/2025

CEQIP 2025

Number wizards consider this year to be perfect. Universe Nations designated this year to quantum science and technology. And exactly in the middle of this year (plus/minus the standard deviation) in a qute small@nice castle the event of the year will take place. Join us to open Earth's first quantum post-AI biochakra - a device-independent causally-inseparable completely positive entangled superposition of nothing and everything.

CEQIP (Central European Quantum Information Procesing workshop) is traditionally focused on current challenges and paradigms of mathematical and computational aspects of emerging quantum technologies. One of the strengths is the traditionally strong social program creating very friendly and creative atmosphere. Besides traditional wine tasting and a cipher game we plan to visit surrounding natural beauties.

Venue

The workshop will be held in *Smolenice Castle* which history dates back to the 15^{th} century and currently serves as the Congress Center of Slovak Academy of Sciences. It is situated approximately 60 km northeast from Bratislava in the central area of the smallest Slovakian mountains called Malé Karpaty.

Invited speakers

- ⋆ Remigiusz Augusiak
- ⋆ Guillermo Currás-Lorenzo (Vigo)
- ⋆ Nicola Lo Gullo (Arcavacata)
- ⋆ Jan Nöller (Darmstadt)
- ⋆ Martin Plávala (Hannover)
- ⋆ Marco Túlio Quintino (Paris)
- ⋆ Armin Tavakoli (Lund)
- ⋆ Zoltán Zimborás (Helsinki)

Selection Comittee

- ⋆ Leevi Leppäjärvi (chair)
- ⋆ Kieran Flatt
- ⋆ Mariami Gachechiladze
- ⋆ Teiko Heinosaari
- ⋆ Nicola Lo Gullo
- ⋆ Martin Plavála
- ⋆ Marco Túlio Quintino
- ⋆ Daniel Reitzner
- ⋆ Michal Sedlák
- ⋆ Armin Tavakoli
- ⋆ Mário Ziman

Organizing Team

- ⋆ Leevi Leppäjärvi
- ⋆ Michal Sedlák
- ⋆ Mário Ziman
- ⋆ Radka Hovorková
- ⋆ Daniel Reitzner
- ⋆ Jan Bouda

The workshop is organized by Slovak National Center for Quantum Technologies QUTE.sk (Bratislava), Research Center for Quantum Information (Bratislava), and Cyber Security Hub (Brno).

Program

Monday, 30.6.2025

16:00 Arrival and registration (with refreshment)
17:00 Evening session
17:00 ZOLTÁN ZIMBORÁS (I)
17:40 MARTIN PLÁVALA (I)
18:20 REMIGIUSZ AUGUSIAK (I)
19:00 End of session

19:00 Welcome dinner

Tuesday, 1.7.2025

08:00 Breakfast

09:00 Morning session
09:00 MARCO TULIO QUINTINO (T)
10:00 JEF PAUWELS (C)
10:25 MARIUS KRUMM (C)

10:50 Coffee & Refreshment

11:30 GUILLERMO CURRÁS-LORENZO (I)
12:10 MARTIN J. RENNER (C)
12:35 RICARDO RIVERA CARDOSO (C)
13:00 End of session

13:00 Lunch

14:00 Afternoon session
14:00 NICOLA LO GULLO (I)
14:40 MIGUEL NAVASCUÉS (C)
15:05 NIKOLAI WYDERKA (C)
15:30 End of session

15:30 Coffee & Refreshment

16:00 Poster session

18:30 Cipher game registration

18:30 Dinner

19:00 Cipher game

Wednesday, 2.7.2025

08:00 Breakfast

09:00 Morning session
09:00 ARMIN TAVAKOLI (T)
10:00 KONSTANTINOS MANOS (C)
10:25 FELIX HUBER (C)

10:50 Group photo

11:00 Coffee & Refreshment

11:30 PRABHAV JAIN (C)
11:55 LORENZO GIANELLI (C)
12:20 ALASTAIR ABBOTT (C)
12:45 End of session

12:45 Lunch

13:30 Conference hike

19:30 Conference dinner

Thursday, 3.7.2025

08:00 Breakfast

09:00 Morning session
09:00 JAN NÖLLER (I)
09:40 FEI MENG (C)
10:05 LUCAS PORTO (C)

10:30 Coffee & Refreshment

10:50 LIBOR CAHA (C)
11:15 PAULI JOKINEN (C)
11:40 RAPHAEL BRINSTER (C)
12:05 End of session

12:10 Lunch

13:00 Conference bus

(T) Invited tutorial ($55 + 5$ min.)
(I) Invited talk ($35 + 5$ min.)
(C) Contributed talk ($20 + 5$ min.)

Invited Tutorials

1. **Marco Túlio Quintino:** Quantum information processing via higher-order operations
2. **Armin Tavakoli:** Overview of semidefinite programs in quantum information theory

Invited talks

1. **Remigiusz Augusiak:** Certification of quantum states and measurements in quantum networks
2. **Guillermo Currás-Lorenzo:** Security of QKD with device imperfections
3. **Nicola Lo Gullo:** Scaling Measurement Error Mitigation for Noisy Quantum Measurements
4. **Jan Nöller:** Sound and SPAM-robust certification of memory-bounded quantum computers
5. [redacted] **Plávala:** [redacted] !
6. **Zoltán Zimborás:** Who's the most monogamous: fermions, bosons, or the indistinguishables?

Contributed talks

1. **Alastair Abbott:** Self-testing quantum supermaps, with an application to the quantum switch
2. **Raphael Brinster:** Witnesses for non-projectively simulable POVMs
3. **Libor Caha:** Factoring an integer with three oscillators and a qubit
4. **Lorenzo Giannelli:** Information-theoretic derivation of energy, speed bounds, and quantum theory
5. **Felix Huber:** Second order cone relaxations for quantum Max Cut
6. **Prabhav Jain:** Communication Complexity Bounds using Information Causality
7. **Pauli Jokinen:** No-broadcasting characterizes operational contextuality
8. **Marius Krumm:** A Relativistic Variational Quantum Circuit
9. **Konstantinos Manos:** Extrapolation of Quantum Time Series
10. **Fei Meng:** Generalized Cross-Entropy Benchmarking for Random Circuits with Ergodicity
11. **Miguel Navascués:** Tight and self-testing multipartite quantum Bell inequalities from the renormalization group
12. **Jef Pauwels:** Classification of joint quantum measurements based on entanglement cost of localization
13. **Lucas Porto:** Efficient characterisation of qubit measurement incompatibility and quantum steering
14. **Martin J. Renner:** Exact Steering Bound for Two-Qubit Werner States
15. **Ricardo Rivera Cardoso:** Quantum SAT problems with finite sets of projectors are complete for a plethora of classes
16. **Nikolai Wyderka:** No quantum advantage without classical communication: fundamental limitations of quantum networks

Posters

1. **Tim Achenbach, Leevi Leppäjärvi:** Factorization of multimeters: a unified view on nonclassical quantum phenomena
2. **Ieline Ahmed:** Generalized Bell Inequalities via Conjugate Basis and Probe Tensors
3. **Ardra Ajitha Vijayan:** Perfect probabilistic cloning of unitary channels
4. **Nada Ali:** Unsupervised state learning from pairs of states
5. **David Amaro Alcala:** Randomised benchmarking for universal qudit gates
6. **Andreas Bluhm:** Belavkin-Staszewski Quantum Markov Chains
7. **Kai-Siang Chen:** Nonlocality of Quantum States Can be Transitive
8. **Paweł Cieśliński:** How Likely Are You to Observe Non-locality with Imperfect Detection Efficiency and Random Measurement Settings?
9. **Nicola D'Alessandro:** Semidefinite relaxations for high-dimensional entanglement in the steering scenario
10. **Sophie Egelhaaf:** An operational characterisation of statistical signalling in quantum steering
11. **Seyed Arash Ghoreishi:** The future of secure communications: device independence in quantum key distribution
12. **Paulina Janowicz:** Second-Order Cone Relaxations for Spin Hamiltonians
13. **Anna Jenčová:** On the structure of higher order quantum maps
14. **Kartik Kakade:** Spontaneous localization from a coarse-grained deterministic and non-unitary dynamics
15. **Oskari Kerppo:** State Preparation for Computational Fluid Dynamics
16. **Zoltán Kolarovszki:** Anticoncentration and cross-entropy benchmarking of Boson Sampling with linear number of modes
17. **Robin Krebs:** Analytical Methods for High-Dimensional PPT Entanglement
18. **Tamás Kriváchy:** Topologically Robust Quantum Network Nonlocality
19. **Hanwool Lee:** Metainformation in quantum guessing games
20. **Andrés Damián Muñoz Moller:** Random Exclusion Coding
21. **Ekta Panwar:** Self-testing tilted strategies for maximal loophole-free nonlocality
22. **Samgeeth Puliyil:** Applications of communication matrices in quantum information processing
23. **Soham Sau:** Resilience of Correlation Plenoptic Imaging to Atmospheric Turbulence
24. **Sebastian Schlösser:** Bounding the classical cost of simulating quantum systems in the prepare-and-measure scenario
25. **Michal Sedlák:** Storage and retrieval of two unitary channels in experiment
26. **Adrian Solymos:** Extendibility of Brauer states
27. **Abdelmalek Taoutioui:** Towards self-testing the optimal universal quantum-cloning machine
28. **Lucas Tendick:** A hierarchical framework for generalizations of measurement incompatibility
29. **Roope Uola:** Binarisation of multi-outcome measurements in high-dimensional quantum correlation experiments
30. **Gergő Veres:** On the semi-devide independent certification of asymmetry of three-qubit configurations
31. **Lucas Vieira:** Sparse semidefinite programming in quantum information theory
32. **Marco Wiedmann:** Quantum Speed Limits from Symmetries in Quantum Control
33. **Mansur Ziatdinov:** Random projections and quantum fingerprinting for QML
34. **Mário Ziman:** Discriminating and labeling the unlabeled

Invited tutorials

1. **Marco Túlio Quintino:** QUANTUM INFORMATION PROCESSING VIA HIGHER-ORDER OPERATIONS

   Quantum operations form an important pillar of quantum theory and a key point for many applications to quantum technologies. Traditionally, quantum operations were only viewed as devices to transform quantum states, such as quantum communication channels between distant parties or quantum gate elements in a quantum circuit. However, quantum operations themselves may also be submitted to transformations and play the role of a state, or input, of a Higher-Order Quantum Operation (HOQO). In this tutorial, we will present what are HOQOs, basic results from the field, and a few applications of this framework such as: - to design universal quantum circuits to transform unitary operations (e.g., how to invert an arbitrary and unknown quantum gate with finite calls) - to analyse the task of learning, estimating, and storing-and-retrieving quantum operations - to find optimal methods to discriminate quantum channels under different strategies. We will then finish by discussing how fundamental questions about causality naturally emerge from the HOQO formalism.

2. **Armin Tavakoli:** OVERVIEW OF SEMIDEFINITE PROGRAMS IN QUANTUM INFORMATION THEORY

   This tutorial is an introduction to semidefinite programs (SDPs) and their relevance to quantum information science. I discuss SDP on their own merit, why they have become so important in quantum information and I give an overview of some of their applications. Towards the end, I review some more contemporary methods for computing properties of quantum correlations via SDP relaxations. The talk is aimed mainly at non-specialists on SDPs.

Invited talks

1. **Remigiusz Augusiak:** CERTIFICATION OF QUANTUM STATES AND MEASUREMENTS IN QUANTUM NETWORKS

   The emergence of quantum devices has raised a significant issue: how to certify the quantum properties of a device without placing trust in it. To characterise quantum states and measurements in a device-independent way, up to some degree of freedom, we can make use of a technique known as self-testing. While schemes have been proposed to self-test all pure multipartite entangled states and real rank-one projective measurements, little has been done to certify mixed entangled states, composite or nonprojective measurements. In this talk I will show how quantum networks enable device-independent certification of arbitrary quantum states and quantum measurements.

2. **Guillermo Currás-Lorenzo:** SECURITY OF QKD WITH DEVICE IMPERFECTIONS

   In theory, QKD promises unconditional security guaranteed by the fundamental laws of quantum mechanics. However, in practice, QKD implementations suffer from device imperfections that deviate from the idealized theoretical models assumed in standard security analyses, invalidating their security guarantees. This theory-practice gap represents one of QKD's most critical challenges, and has prompted major security agencies to express reservations about QKD adoption. In this talk, I will present recent advances in proving the security of QKD protocols when the sources and detectors used to implement are flawed and only partially characterized.

3. **Nicola Lo Gullo:** SCALING MEASUREMENT ERROR MITIGATION FOR NOISY QUANTUM MEASUREMENTS

   Measurement processes in today's quantum computers are intrinsically noisy. To mitigate these effects, researchers have developed a range of techniques collectively referred to as measurement (or readout) error mitigation. These methods generally follow a common strategy: they begin by accurately characterizing the measurement noise, then apply corrections to reduce its impact on observed outcomes. Traditionally, such techniques have focused on standard projective measurements and addressed only the errors occurring during the final readout stage. However, modern measurement protocols—especially those involving ancillary qubits or multi-qubit operations—introduce greater complexity and demand more advanced tools for both characterization and error mitigation. In this work, we introduce a fully Bayesian pipeline for measurement error mitigation. Our contributions are twofold: - Bayesian Measurement Tomography – We show how Bayesian techniques can be used to precisely characterize noisy measurements, enhancing the fidelity of one- and two-qubit gates. - Bayesian Error Mitigation – We demonstrate how our Bayesian framework suppresses measurement noise effectively while ensuring the physical validity of corrected results by construction. This avoids the risk of producing unphysical outputs and scales efficiently to quantum processor sizes typical of current hardware. Additionally, our approach leverages low-level access to detector data, providing both enhanced performance and deeper insight into the measurement process.

4. **Jan Nöller:** SOUND AND SPAM-ROBUST CERTIFICATION OF MEMORY-BOUNDED QUANTUM COMPUTERS

   The rapid advancement of quantum hardware calls for the development of reliable methods to certify its correct functioning. However, existing certification tests often fall short: they either rely on flawless state preparation and measurement or lack soundness guarantees, meaning that they do not rule out incorrect implementations of the target operations by a quantum device. We introduce an approach, which we call quantum system quizzing, for the certification of quantum gates, where a classical user tests the results of quantum computations performed by a quantum server. Importantly, this approach does not require trusted state preparation and measurement and is thus inherently free from the associated systematic errors. For a wide range of relevant gate sets, including a universal one, we prove our certification protocol to be sound, i.e., it rejects any quantum model other than the targeted one, assuming a bound on the total memory of the quantum computer.

A major challenge that we are first to resolve, is to recover the tensor product structure of multi-qubit systems in such a memory-bounded single-device setup. For the simplest case of a single qubit, we additionally derive an inverse linear relation between the sample complexity of the protocol and the certified average gate infidelity, rendering our method highly relevant for current experimental setups.

5. **[redacted] Plávala: [redacted] !**

   Quantum information [redacted]. [redacted] prime [redacted] entanglement. [redacted] local operations and classical communication (LOCC) [redacted]. Although [redacted], [redacted] scenarios [redacted]. [redacted] facets [redacted]. [redacted], [redacted] quantum information [redacted]. Our insights and methods can light the way to groundbreaking discoveries!

6. **Zoltán Zimborás:** WHO'S THE MOST MONOGAMOUS: FERMIONS, BOSONS, OR THE INDISTINGUISHABLES?

   In this talk, we explore entanglement monogamy through the lens of symmetric extendibility across fermionic, bosonic, and indistinguishable particle systems. We invite the audience to vote on the question posed in the title. After revealing and proving the answer, we examine its deeper implications for many-body quantum physics.

Contributed talks

1. **Alastair Abbott:** SELF-TESTING QUANTUM SUPERMAPS, WITH AN APPLICATION TO THE QUANTUM SWITCH

   Higher order quantum operations, known as "quantum supermaps" or "processes", have numerous applications in computation and information processing. Particular interest has been aroused by supermaps that describe higher order processes incompatible with any well-defined causal structure, such as the quantum switch. In this contribution we discuss how the self-testing of quantum supermaps can be defined and identify two forms of self-testing statements for supermaps in black-box network settings. We apply these approaches to the quantum switch, identifying a procedure exhibiting statistics only compatible with a process implementing the quantum switch, thereby self-testing it. We discuss the operational perspective that this test provides on causally indefinite processes.

2. **Raphael Brinster:** WITNESSES FOR NON-PROJECTIVELY SIMULABLE POVMS

   Quantum measurements are crucial in many quantum information tasks. POVMs are known to outperform projective measurements in tasks like state discrimination. Some POVMs can be simulated using projective measurements with classical resources. The critical visibility t(M) quantifies non-projectiveness of a POVM M by determining the noise needed to make a POVM simulable. We introduce an SDP hierarchy to compute upper bounds on t(M), which are tight in many cases. The decomposition in projective measurements can then be read off from the SDP solution. Applying this to SIC-POVMs in d = 3 we find varying critical visibilities, showing they are physically distinct. Finally, we construct non-simulability witnesses, which can be measured in an experiment.

3. **Libor Caha:** FACTORING AN INTEGER WITH THREE OSCILLATORS AND A QUBIT

   A typical starting point of quantum algorithm design is the notion of a universal quantum computer with a scalable number of qubits. This convenient abstraction mirrors classical computations manipulating bits and allows for a device-independent development of algorithmic primitives. Here we advocate an alternative approach centered on the physical setup. We show that sidestepping the standard approach of reasoning about computation in terms of individual qubits can be leveraged to great benefit. As an example, we consider hybrid qubit-oscillator systems with linear optics operations augmented by qubit-controlled Gaussian unitaries and give a polynomial-time quantum factoring algorithm in this setup that uses single qubit and three oscillators only.

4. **Lorenzo Giannelli:** INFORMATION-THEORETIC DERIVATION OF ENERGY, SPEED BOUNDS, AND QUANTUM THEORY

   We provide an information-theoretic derivation of quantum theory in which the existence of an energy observable that limits the speed of state change follows directly from physical principles. Our first principle is that every reversible dynamics can be implemented through a sequence of fast collisions with an array of identically prepared systems. Combined with four additional principles, known as causality, classical decomposability, purity-preservation, and strong symmetry, the collision model for reversible dynamics pins down the quantum framework, sets up a one-to-one correspondence between observables and the generators of the dynamics, and provides an information-theoretic derivation of the Mandelstam-Tamm bound on the speed of quantum evolutions.

5. **Felix Huber:** SECOND ORDER CONE RELAXATIONS FOR QUANTUM MAX CUT

   Quantum Max Cut (QMC) is a QMA-complete problem relevant to quantum many-body physics and computer science. Semidefinite programming relaxations have been fruitful in designing theoretical approximation algorithms for QMC, but are computationally expensive for systems beyond tens of qubits. We give a second order cone relaxation for QMC, which optimizes over the set of mutually consistent three-qubit reduced density matrices. In combination with Pauli level-1 of the quantum Lasserre hierarchy, the relaxation achieves an approximation ratio of 0.526 to the ground state energy. Our relaxation is solvable on systems with hundreds of qubits and paves the way to computationally efficient bounds on the ground state energy of large-scale quantum spin systems.

6. **Prabhav Jain:** COMMUNICATION COMPLEXITY BOUNDS USING INFORMATION CAUSALITY

   In a distributed computing scenario, two parties aim to compute a given function with as minimum communication as possible. The communication cost or complexity depends not only on the function itself but the shared resources between the two parties. In this work we aim to study communication complexity in theories satisfying the information causality principle. We extend the information causality principle which is valid for any distributed computation scenario and apply it to several well known functions. We show a reduction for some of these problems to known functions and hence derive one-way communication complexity bounds in a theory independent manner. Finally, we prove that the information causality principle is stronger than the principle of non-trivial communication complexity.

7. **Pauli Jokinen:** NO-BROADCASTING CHARACTERIZES OPERATIONAL CONTEXTUALITY

   Operational contextuality forms a rapidly developing subfield of quantum information theory. However, the characterization of the quantum mechanical entities that fuel the phenomenon has remained unknown with many partial results existing. Here, we present a resolution to this problem by connecting operational contextuality one-to-one with the no-broadcasting

theorem. The connection works both on the level of full quantum theory and subtheories thereof. We demonstrate the connection in various relevant cases, showing especially that for quantum states the possibility of demonstrating contextuality is exactly characterized by non-commutativity, and for measurements this is done by a norm-1 property closely related to repeatability.

8. **Marius Krumm:** A RELATIVISTIC VARIATIONAL QUANTUM CIRCUIT

   The field of relativistic quantum information seeks to understand the quantum information properties of relativistic quantum systems. A popular approach for this purpose is the Unruh-DeWitt model for qubits interacting with quantum fields on curved spacetime. In my talk, I will present a relativistic variational quantum circuit (VQC) in which the interaction between qubits is mediated by the relativistic quantum field. An important consequence is that the tunable time evolution of the qubits depends on spacetime properties and quantum field propagators. Therefore, our VQC presents first steps in a quantum machine learning approach that seeks to extract quantum properties of spacetime and fields when no hand-crafted protocol is available.

9. **Konstantinos Manos:** EXTRAPOLATION OF QUANTUM TIME SERIES

   We consider the problem of predicting future averages of a collection of quantum observables, given noisy averages at past times. The measured observables, the initial state of the physical system and even the Hilbert space labelling of the latter are unknown; we nonetheless assume a promise on the energy distribution of the state. In this unexplored framework, one can find very surprising phenomena, such as self-testing dataset, aha!-Datasets and fog banks. On the computational side, we prove that the extrapolation problem is efficiently solvable up to arbitrary precision through hierarchies of semidefinite programming relaxations.

10. **Fei Meng:** GENERALIZED CROSS-ENTROPY BENCHMARKING FOR RANDOM CIRCUITS WITH ERGODICITY

    Certifying quantum devices becomes increasingly challenging as they scale up. We introduce the concept of ergodicity to random circuit sampling and establish a rigorous mathematical foundation for cross-entropy benchmarking. We prove that unitary designs satisfy ergodicity for certain classes of functions, meaning the average over bit strings from a single circuit approximates the average over circuit ensembles. This property is violated under strong noise, enabling practical quantum chip certification through a “deviation of ergodicity" metric that directly relates to circuit fidelity. Our framework generalizes linear cross-entropy benchmarking while providing clear conditions for its validity and applications to real experimental data.

11. **Miguel Navascués:** TIGHT AND SELF-TESTING MULTIPARTITE QUANTUM BELL INEQUALITIES FROM THE RENORMALIZATION GROUP

    Connectors are local linear transformations that preserve the quantum set of correlations, but can renormalize the number of parties, inputs or outputs. The contraction of different connectors defines a new connector, each establishing corresponding N-partite quantum Bell inequalities. Here we introduce "tight connectors", which result in tight quantum Bell inequalities. These are saturated by tensor network states whose structure mimics the corresponding network of connectors. Some tight connectors are also "fully self-testing", i.e. the generated inequalities can only be maximized with such a TN-state and specific measurement operators (modulo local isometries). For some such inequalities, the ratio between the maximum quantum and classical values increases exponentially with N.

12. **Jef Pauwels:** CLASSIFICATION OF JOINT QUANTUM MEASUREMENTS BASED ON ENTANGLEMENT COST OF LOCALIZATION

    Joint measurements are crucial for multiparty quantum information processing yet remain poorly understood —especially beyond the well-studied extremes of maximally entangled and product cases. Recent findings show that partially entangled measurements can reveal novel phenomena, such as genuine network nonlocality, exposing a major gap in our knowledge. We propose a classification of joint measurements based on the entanglement cost of performing them locally—without bringing subsystems together or exchanging information. Inspired by how relativistic causality constrains quantum operations, this framework establishes a complexity hierarchy for measurements and opens new avenues to understand and discover joint measurements in multiparty settings.

13. **Lucas Porto:** EFFICIENT CHARACTERISATION OF QUBIT MEASUREMENT INCOMPATIBILITY AND QUANTUM STEERING

    It is well known that not all measurements in quantum theory can be simultaneously performed. Some of the most surprising features exhibited by quantum systems, such as nonlocality or steering, are related to this fact. To decide whether a given set of N measurements is jointly measurable one can use a semidefinite program (SDP). However, the number of variables in such a program grows exponentially with N, which significantly limits its use in practice. In this work, we propose a way to circumvent this problem, by approximating the SDP by a linear program (LP) with a number of variables that grows only linearly with N. The LP can be used for measurements in arbitrary dimensions, but works particularly well for qubits. We also discuss applications of the LP for the study of steering.

14. **Martin J. Renner:** EXACT STEERING BOUND FOR TWO-QUBIT WERNER STATES

    We present a local hidden state model for two-qubit Werner states of visibility $1/2$ that applies to the most general class of measurements, namely positive operator-valued measures (POVMs). This extends Werner's original model that only applies to projective measurements. This determines the exact steering bound for two-qubit Werner states and provides a local hidden variable model that improves on previously known ones. Surprisingly, this shows that POVMs are not more powerful than projective measurements to demonstrate quantum steering for this family of states. Our results have applications to measurement incompatibility. In fact, we determine the critical visibility with respect to white noise such that all qubit measurements, i.e. all POVMs, become jointly measurable.

15. **Ricardo Rivera Cardoso:** QUANTUM SAT PROBLEMS WITH FINITE SETS OF PROJECTORS ARE COMPLETE FOR A PLETHORA OF CLASSES

    Prior to this work, all known variations of the Quantum Satisfiability (QSAT) problem–consisting of determining whether a k-body Hamiltonian is frustration-free–could be classified into 4 complexity classes, where only one refers to tractable problems. Here we demonstrate there are new variations of this problem that are complete for another 9 complexity classes, where six of them are new and two refer to new types of tractable QSAT problems. Our result implies that a complete classification of QSAT problems, analogous to Schaefer's theorem for classical SAT, must either include these 13 classes or otherwsie show that some of them are equal. These feature many interesting relationships, and such a theorem could have deep implications in physics and complexity theory.

16. **Nikolai Wyderka:** NO QUANTUM ADVANTAGE WITHOUT CLASSICAL COMMUNICATION: FUNDAMENTAL LIMITATIONS OF QUANTUM NETWORKS

    Quantum networks connect systems at separate locations via quantum links, enabling a wide range of quantum information tasks between distant parties. Here we show that quantum networks relying on the long-distance distribution of bipartite entanglement, combined with local operations and shared randomness, cannot achieve a relevant quantum advantage. Specifically, we prove that these networks do not help in preparing resourceful quantum states such as Greenberger-Horne-Zeilinger states or cluster states, despite the free availability of long-distance entanglement. At an abstract level, our work points towards a fundamental difference between bipartite and multipartite entanglement.

Posters

1. **Tim Achenbach, Leevi Leppäjärvi:** FACTORIZATION OF MULTIMETERS: A UNIFIED VIEW ON NONCLASSICAL QUANTUM PHENOMENA

   We show that many non-classical features of quantum theory reduce to the same mathematical problem: factorizability. Taking measurement incompatibility, steering, and Bell non-locality as examples, we can thus approach the problems of certification and quantification of non-classical features within a unified mathematical framework. Moreover, it allows us to find witnesses that yield computable criteria to detect these features. Finally, it allows us to find streamlined proofs of known results, pointing out new connections. On a technical level, we view collections of measurements as channels between GPTs, which allows us to use tools from the study of tensor cones. Furthermore, we use the extendability of tensors to approximate the set of separable elements.

2. **Ieline Ahmed:** GENERALIZED BELL INEQUALITIES VIA CONJUGATE BASIS AND PROBE TENSORS

   A novel family of Bell inequalities emerges from the set of complete Bell inequalities given by Werner and Wolf in Ref. [10.1103/PhysRevA.64.032112] and, equivalently by Zukowski and Brukner in Ref. [10.1103/PhysRevLett.88.210401] for the two-dimensional case. Our construction applies to the n sites, the same k possible observables per site, where each observable admits d outcomes. The Bell functionals obtained, for any local and realistic theory, as well as for a theory that enables quantum correlations, test the facets of the respective complex polytope with a probe tensor based on the notion of conjugate basis. As a testbed, we deploy such a promising construction for the veiled scenario $(N, k, d) = (2, 3, 3)$, and $(N, k, d) = (3, 2, 3)$ and for the known inequalities.

3. **Ardra Ajitha Vijayan:** PERFECT PROBABILISTIC CLONING OF UNITARY CHANNELS

   We investigate the problem of optimal perfect probabilistic cloning of unitary channels from a single use to two copies in qubit systems. Focusing on the scenario where the unknown unitary is selected from a set of two unitaries with equal prior probabilities, we derive upper and lower bounds on the success probability of the cloning strategy. Notably, when the success probability is plotted as a function of the angular spread of the relative unitary, the bounds coincide in the interval $[\pi/4, \pi/2]$, indicating that the optimal strategy in this regime is the measure-and-prepare approach. We also explore numerical methods to estimate the optimal success probability across the entire interval.

4. **Nada Ali:** UNSUPERVISED STATE LEARNING FROM PAIRS OF STATES

   Suppose you receive a sequence of qubits, each in one of two unknown pure states. You must either determine these states or construct a POVM (Positive Operator-Valued Measure) to discriminate them—a quantum analog of unsupervised learning. Without further information, only the density matrix of the sequence can be found, and it can generally be decomposed in multiple ways. However, providing an additional copy of each qubit, i.e. pairs of identical qubits, resolves this ambiguity. We simulate measurements on qubit pairs and show that the states and their respective occurrence probabilities can be identified with high accuracy.

5. **David Amaro Alcala:** RANDOMISED BENCHMARKING FOR UNIVERSAL QUDIT GATES

   Schemes to characterise universal qudit operations, as opposed to Clifford gates, are scarce. I present a method to characterise universal (non-Clifford) gates using a new randomised benchmarking approach. This method relies on phase gates and permutation gates, making it practical for experiments. The results are supported by a combinatorial identity and by the representation theory of a wreath product of the symmetric and cyclic groups, where the structure depends on the specific non-Clifford gate used. The scheme is also applicable to multiqudit systems.

6. **Andreas Bluhm:** BELAVKIN-STASZEWSKI QUANTUM MARKOV CHAINS

   The conditional mutual information (CMI) of a quantum state is zero if, and only if, the quantum state is a quantum Markov chain (QMC). Replacing the Umegaki relative entropy in the definition of the CMI by the Belavkin-Staszewski (BS) relative entropy, we obtain the BS-CMI, and we call the states with zero BS-CMI BS-QMCs. In this article, we establish a correspondence which relates QMCs and BS-QMCs. This correspondence allows us to find a recovery map for the BS-relative entropy, prove a structural decomposition of the BS-QMCs and also study states for which the BS-CMI is only approximately zero. We also present an application in the spin chain setting, showing supperexponential decay of the CMI of an associated state of the Gibbs state under some usual constraints.

7. **Kai-Siang Chen:** NONLOCALITY OF QUANTUM STATES CAN BE TRANSITIVE

   In a three-party Bell test, nonlocality in two bipartite subsystems can force nonlocality in the third, a phenomenon known as nonlocality transitivity. While post-quantum example was found in 2011, its existence in quantum theory remained unresolved—until now. We provide the first quantum example of nonlocality transitivity at the state level. We construct a tripartite system where two nonlocal bipartite states necessarily make the third nonlocal. We also prove that multiple copies of W-state marginals uniquely determine the global state. Additionally, we show that quantum steering exhibits transitivity in a three-qubit system, unlike Bell nonlocality, highlighting a key distinction. Finally, we explore connections between nonlocality transitivity and the polygamous nature of nonlocality.

8. **Paweł Cieśliński:** How Likely Are You to Observe Non-locality with Imperfect Detection Efficiency and Random Measurement Settings?

   Imperfect detection efficiency and establishing a common reference frame are major challenges in loophole-free Bell tests over long distances. This work addresses both of these problems by studying how limited detection efficiency affects the probability of Bell inequality violation with Haar random measurement settings. We derive tight analytical lower bounds for two-qubit maximally entangled states and extend the analysis numerically for more qubits and settings using two detection efficiency models and an original linear programming method. We also show that the so-called typicality of Bell violation holds under limited efficiency. Additionally, we find new, lower critical detection efficiencies for two- and three-setting three-party scenarios in the binning and extra outcome models.

9. **Nicola D'Alessandro:** Semidefinite relaxations for high-dimensional entanglement in the steering scenario

   We introduce semidefinite programming hierarchies to benchmark relevant entanglement properties in the steering scenario. Firstly, we provide a method to certify the entanglement dimension through certification of the Schmidt number. Being the computational cost of the method independent on the Schmidt number, it proves to be highly scalable. Secondly, we provide a method to estimate the fidelity of the source with any maximally entangled state. Thus, we are able to characterise experiment when the fidelity of the source with the maximally entangled state is restricted. We demonstrate the usefulness of these methods via case study known in the literature, using only basic computational resources and providing sharper bounds for future experimental applications.

10. **Sophie Egelhaaf:** An operational characterisation of statistical signalling in quantum steering

    Many scenarios which are considered in quantum information require non-signalling correlations. However, statistical signalling occurs in every data set, meaning that it violates the non-signalling constraint. There are a variety of causes for statistical signalling beyond the locality loophole, e.g. the heating of the measurement device and finite statistics. In this work, we propose an operationally motivated approach to treating statistical signalling. Specifically, the connection between the signalling acting on a state assemblage and the guessing probability of the assemblages' total states is exploited. Furthermore, it is shown how to adjust linear steering witnesses to account for statistical signalling.

11. **Seyed Arash Ghoreishi:** The future of secure communications: device independence in quantum key distribution

    Device-independent quantum key distribution (DI-QKD) offers ultimate security by removing trust assumptions about quantum devices. This poster presents a structured overview of DI-QKD, covering core principles like Bell nonlocality, key protocols, advanced security proofs, and recent experimental progress. We also discuss semi-device-independent variants and the roadmap toward practical DI-QKD networks.

12. **Paulina Janowicz:** Second-Order Cone Relaxations for Spin Hamiltonians

    In most cases, the ground state energy of a Hamiltonian cannot be determined analytically, and exact numerical methods are limited to systems of moderate size. This study proposes numerically efficient relaxations formulated as a second-order cone program (SOCP) to provide a lower bound on the ground state energy of multi-qubit spin systems. The spin Hamiltonian is defined on a graph, where vertices correspond to spin sites and edges to interactions. A heuristic algorithm is employed to enumerate local system subgraphs and generate constraints based on cliques, cycles, and interaction graphs of certain size. These constraints take the form of inequalities involving sums of squared expectation values of observables, bounded by known or efficiently computable Lovász theta numbers. This formulation enables the treatment of larger systems and offers improved computational performance compared to semidefinite programs. The method was benchmarked against known results, with relative errors ranging from 1% to 20%.

13. **Anna Jenčová:** On the structure of higher order quantum maps

    The hierarchy of higher order quantum maps (HOM) covers all admissible quantum objects and transformations between them. This hierarchy contains maps that have a definite causal order but also ones that have indefinite causal structure, e.g. process matrices or quantum switch. The aim of the present contribution is to propose a new characterization of general HOM. For this, we combine the theory of types (Bisio and Perinotti, 2019) and their combinatorial characterization, with some ideas in (Hoffreumon and Oreshkov, 2022) using a projective characterization of the related Choi matrices. We show that type structures are determined by certain binary functions (the type functions) and investigate relations between properties of these functions and the causal structure of HOM.

14. **Kartik Kakade:** Spontaneous localization from a coarse-grained deterministic and non-unitary dynamics

    Collapse of the wave function appears to violate the quantum superposition principle as well as deterministic evolution. Objective collapse models propose a dynamical explanation for this phenomenon, by making a stochastic non-unitary and norm-preserving modification to the Schrödinger equation. In the present article we ask how a quantum system evolves under a deterministic and non-unitary but norm-preserving evolution? We show using a simple two-qubit model that

under suitable conditions, quantum linear superposition is broken, with the system predictably driven to one or the other eigenstates. If this deterministic dynamics is coarse-grained and observed over a lower time resolution, the outcomes appear random while obeying the Born probability rule. Our analysis hence throws light on the distinct roles of non-unitarity and of stochasticity in objective collapse models.

15. **Oskari Kerppo:** STATE PREPARATION FOR COMPUTATIONAL FLUID DYNAMICS

    Quanscient focuses on scaling up industrial multiphysics simulations to bring value to our customers. We believe quantum computing will play a key role in this field and we are developing lattice-based methods to natively simulate fluid dynamics on quantum computers. In this poster I will present some of the research we do at Quanscient Quantum Labs, focusing on the problem of state preparation in quantum algorithm development. Specifically, I will present results from utilizing matrix product state based state preparation techniques as part of a larger Quantum Lattice Boltzmann Method algorithm.

16. **Zoltán Kolarovszki:** ANTICONCENTRATION AND CROSS-ENTROPY BENCHMARKING OF BOSON SAMPLING WITH LINEAR NUMBER OF MODES

    Our work provides evidence for the anticoncentration conjecture in the Boson Sampling scheme in the linear regime, where the number of modes (m) grows linearly with the number of particles. Together with earlier findings, this result provides a strong hardness guarantee for the computational advantage of Boson Sampling over classical computers in this regime. To reach this conclusion, we carefully analyze the representation of $SU(m)$ on two copies of bosonic subspace. Beside anticoncentration, we also use our findings to give an efficient algorithm for computation of averaged linear cross-entropy benchmarking score for Boson Sampling in the linear regime.

17. **Robin Krebs:** ANALYTICAL METHODS FOR HIGH-DIMENSIONAL PPT ENTANGLEMENT

    Quantifying high-dimensional entanglement is crucial for many problems in quantum information processing. The number of entangled degrees of freedom are quantified by the Schmidt number (SN). A particular mathematical and computational challenge is determining the SN in states positive under partial transpose (PPT). We present a novel sufficient and necessary criterion to determine the SN of extreme points of the PPT set, generalizing the range criterion. Further, we generalize the projection property, which constitutes a versatile tool in the construction and analysis of highly entangled PPT states. With these tools, we present an instance of SN 3 PPT entanglement with the lowest known local dimensions 4×5, improving on our previously published results attaining 5x5.

18. **Tamás Kriváchy:** TOPOLOGICALLY ROBUST QUANTUM NETWORK NONLOCALITY

    We discuss network Bell nonlocality in a setting where the network structure is not fully known. Concretely, an honest user may trust their local network topology, but not the structure of the rest of the network, involving distant (and potentially dishonest) parties. We show that in a large ring network, the knowledge of only a small part of the network structure (only 2 or 3 neighbouring parties) is enough to guarantee nonlocality over the entire network. This shows that quantum network nonlocality can be extremely robust to changes in the network topology. We also show that applications of quantum nonlocality, such as the black-box certification of randomness and entanglement, are also possible.

19. **Hanwool Lee:** METAINFORMATION IN QUANTUM GUESSING GAMES

    We investigate quantum state discrimination with classical side information. Depending on which phase Bob gets the side information, it is either pre-measurement or post-measurement information. Our main focus is to recognize the role of an additional layer of information, which we call metainformation. Namely, Bob knows that he will get post-measurement information and he also knows the form of that information. In this work, we consider two state discrimination strategies, minimum-error discrimination and maximum-confidence discrimination and show that metainformation can be useful. Our results discover a new nonclassical feature of quantum theory which can potentially be applied to classical-quantum hybrid approach to communication or computation.

20. **Andrés Damián Muñoz Moller:** RANDOM EXCLUSION CODING

    An important goal in quantum information theory is to find communication tasks in which quantum systems can outperform classical ones. State exclusion is a distinctly quantum phenomenon in which a receiver can unambiguously determine that some subset of possible messages were not the one they received. Quantum advantage can also be demonstrated in random access codes, a task in which a receiver can choose which subset of some information they wish to learn. This work presents the first analysis of random exclusion coding, which utilises features of both exclusion and random access coding. We show that random exclusion codes can be performed with greater success if the communicating system is quantum rather than classical and study the resources required for perfect implementation.

21. **Ekta Panwar:** SELF-TESTING TILTED STRATEGIES FOR MAXIMAL LOOPHOLE-FREE NONLOCALITY

    We address an experimentally motivated question: Which quantum strategies attain the maximal loophole-free nonlocality in the presence of inefficient detectors? In the simplest scenario, we demonstrate that the quantum strategies that maximally violate the doubly-tilted versions of Clauser-Horne-Shimony-Holt inequality are unique up to local isometries. We utilize a Jordan's lemma and Gröbner basis-based proof technique to analytically derive self-testing statements for the entire family of doubly-tilted CHSH inequalities and numerically demonstrate their robustness. These results enable us to reveal the

insufficiency of even high levels of the Navascúes–Pironio–Acín hierarchy to saturate the maximum quantum violation of these inequalities.

22. **Samgeeth Puliyil:** APPLICATIONS OF COMMUNICATION MATRICES IN QUANTUM INFORMATION PROCESSING

    We use communication matrices, a mathematical tool obtained from certain communication tasks in operational theories, in the context of quantum theory, to try to characterize quantum channels. Furthermore, we try to understand the necessary and sufficient conditions on the communication tasks in order for the communication matrices to be capable of completely characterizing the channels. Specific cases of qubits are discussed in detail. We also design a prepare-and-measure scenario using bipartite systems and local measurements, and compare the communication matrices obtained from separable and entangled states to probe the existence of communication matrices that necessitate entangled states for their construction, the answer to which can help us understand entanglement as a resource.

23. **Soham Sau:** RESILIENCE OF CORRELATION PLENOPTIC IMAGING TO ATMOSPHERIC TURBULENCE

    Correlation Plenoptic Imaging (CPI) captures both spatial and directional light information via intensity correlations, enabling high-resolution, refocusable 3D imaging. Originating from Glauber's optical coherence theory, it has been shown that CPI works with thermal or entangled photons and surpasses traditional imaging. We show that CPI remains robust across weak to extreme atmospheric turbulence by relying on second-order correlations rather than wavefront integrity. The result makes CPI highly suitable for biological imaging, remote sensing, and long-range applications.

24. **Sebastian Schlösser:** BOUNDING THE CLASSICAL COST OF SIMULATING QUANTUM SYSTEMS IN THE PREPARE-AND-MEASURE SCENARIO

    We study a scenario in which Alice transmits a quantum state to Bob, who then performs a quantum measurement. While recent results establish that two bits are necessary and sufficient to classically simulate all qubit behaviors, the advantage of higher dimensional quantum systems is an open problem. We show that a classical simulation of the qutrit requires a classical alphabet with a minimum length of 5. Furthermore, we construct classicality witnesses that allow to discriminate between a qubit and a trit. Additionally, we show that if the real qubit is trit-simulable, an analytical formulation of the protocol is intricate.

25. **Michal Sedlák:** STORAGE AND RETRIEVAL OF TWO UNITARY CHANNELS IN EXPERIMENT

    We address the fundamental task of converting n uses of an unknown unitary transformation into a quantum state (i.e., storage) and later retrieval of the transformation. Specifically, we consider the case where the unknown unitary is selected with equal prior probability from two options. First, we prove that the optimal storage strategy involves the sequential application of the n uses of the unknown unitary, and it produces the optimal state for discrimination between the two possible unitaries. Next, we show that incoherent "measure-and-prepare" retrieval achieves the maximum fidelity between the retrieved operation and the original (qubit) unitary. We then identify the retrieval strategy that maximizes the probability of successfully and perfectly retrieving the unknown transformation. In the regime in which the fidelity between the two possible unitaries is large, the probability of success scales as $P_{\text{succ}} = 1 - \mathcal{O}(n^{-2})$, which is a quadratic improvement with respect to the case in which the unitaries are drawn from the entire unitary group $U(d)$ with uniform prior probability. Finally, we present an optical experiment for this approach and assess the storage and retrieval quality using quantum tomography of states and processes. The results are discussed in relation to non-optimal measure-and-prepare strategy, highlighting the advantages of our protocol.

26. **Adrian Solymos:** EXTENDIBILITY OF BRAUER STATES

    Entangled states cannot necessarily be extended to arbitrary many parties in such a way that the two-particle reduced states are all identical. The so-called extendibility numbers describe to how many parties a given state can be extended to, and they act as a good entanglement measure. This contribution investigates the symmetric two-sided and the de Finetti extendibility problem for Brauer states (states invariant to local orthogonal transformations). We provide a general recipe for finding the (n, m)-extendible and n-de Finetti-extendible set. We explicitly determine the set of $(1, 2)$-, $(1, 3)$- and $(2, 2)$-extendible Brauer states, along with the n-de Finetti-extendible ones in dimensions 2,3 and 4. Finally, we determine the limiting shape for n-de Finetti-extendibility, when $n \to \infty$.

27. **Abdelmalek Taoutioui:** TOWARDS SELF-TESTING THE OPTIMAL UNIVERSAL QUANTUM-CLONING MACHINE

    We propose an original protocol for self-testing the Buzek-Hillery quantum cloning machine (QCM) which produces the best possible two approximate copies of an unknown qubit state. In our protocol, Alice randomly chooses a qubit state out of six states and transmits it to a remote station where the qubit undergoes an unknown operation. The resulting qubit state is then sent to the QCM to be self-tested, modelled by a CPTP map, that takes the input qubit and outputs two qubits. These approximate clones are sent to Bob and Charlie, who measure them from a set of three possible measurements. Based on the input-output statistics of this protocol, we have constructed a linear witness whose maximum qubit value provides a self-testing evidenced by numerics on the optimal quantum cloning machine.

28. **Lucas Tendick:** A HIERARCHICAL FRAMEWORK FOR GENERALIZATIONS OF MEASUREMENT INCOMPATIBILITY

The incompatibility of quantum measurements—i.e., the fact that certain observable quantities cannot be measured jointly—is widely regarded as a distinctive quantum feature with important implications for both the foundations and applications of quantum theory. While the standard notion of measurement incompatibility has been a focus of attention since the inception of quantum theory, its generalizations—such as measurement simulability, n-wise incompatibility, and multi-copy incompatibility—have only recently been proposed. Here, we point out that all these generalizations reflect different ways of addressing the question: how many measurements are genuinely contained in a given set of measurements? We show that these notions differ not only in their operational meaning but also mathematically, in terms of the sets of measurement assemblages they characterize. We then fully resolve the relationships between these different generalizations by establishing a strict hierarchy among them. Thus, we provide a comprehensive framework for generalized measurement incompatibility. Finally, we discuss the implications of our results for recent works that employ these various notions.

29. **Roope Uola:** BINARISATION OF MULTI-OUTCOME MEASUREMENTS IN HIGH-DIMENSIONAL QUANTUM CORRELATION EXPERIMENTS

    High-dimensional systems are an important frontier for photonic quantum correlation experiments. These correlation tests commonly prescribe measurements with many possible outcomes but they are often implemented through many individual binary measurements. In this poster, the effect of the binarisation procedure is shown to be prone to false positives, and an accurate analysis for binarised data is given to reveal its quantum features. We quantitatively analyse the effect of binarisation for various correlation experiments, finding that binarisation may incur a sizable cost in the quantum advantage. This emphasizes the importance of both accurate data analysis and implementing genuinely multi-outcome measurements in high-dimensional correlation experiments.

30. **Gergő Veres:** ON THE SEMI-DEVIDE INDEPENDENT CERTIFICATION OF ASYMMETRY OF THREE-QUBIT CONFIGURATIONS

    We use an SDI framework to certify the asymmetry of three-qubit configurations with a linear witness in a PM scenario. We consider a witness constructed for self-testing an asymmetric configuration and checking whether evaluating the witness for a configuration in question surpasses the maximum witness value accessible by any symmetric configuration; the difference of the latter from the ideal value defines a gap. After numerically finding the gap to be the largest for a coplanar ideal configuration, we plot the gap in that plane, then analytically prove the existence of zero lines and the equivalence of optima. While larger gaps make asymmetry certification easier, the gap is not an asymmetry quantifier due to witness construction and triangle size dependence.

31. **Lucas Vieira:** SPARSE SEMIDEFINITE PROGRAMMING IN QUANTUM INFORMATION THEORY

    Large-scale semidefinite programming (SDP) problems arise frequently from relaxations in quantum information theory. In this work, we present a heuristic method for obtaining sparse representations of arbitrary semidefinite programs. Our method works by finding the effective sparsity implicit in a problem, not directly apparent from its full definition, but which emerges naturally from its structure. We present two different methods based on this heuristic. The first is capable of providing an exact sparse representation, while the second can be used to obtain a hierarchy of sparse relaxations for any problem. Our method is problem-agnostic and can be integrated with many existing techniques.

32. **Marco Wiedmann:** QUANTUM SPEED LIMITS FROM SYMMETRIES IN QUANTUM CONTROL

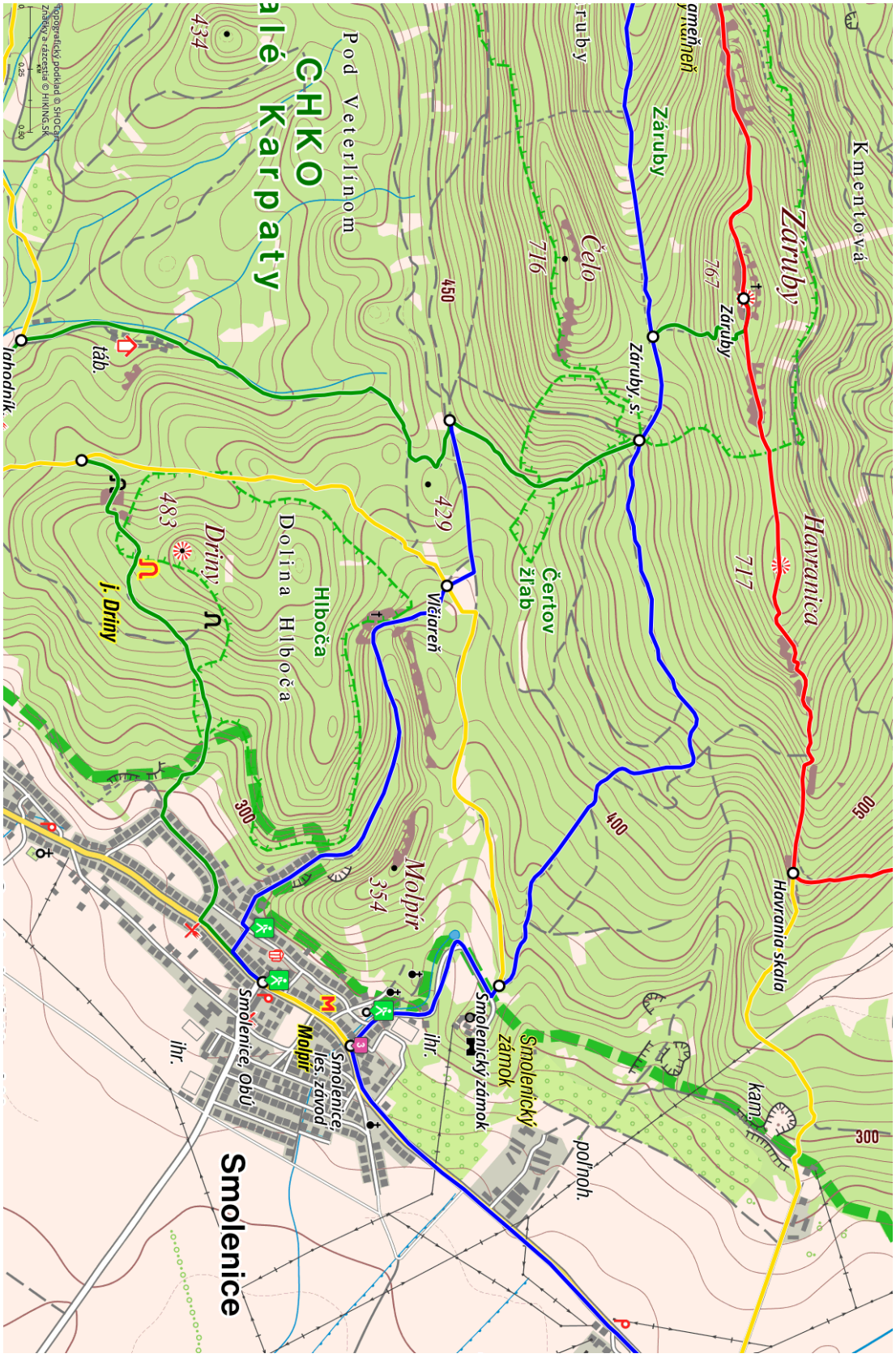
    Quantum speed limits provide a fundamental lower bound on how fast quantum systems can evolve towards a given target. This is particularly interesting for applications in quantum control, where decoherence limits the time available to the experimentalist. We present lower bounds on the time needed to implement any given unitary operation in a given control system. The bound crucially depends on the size of the minimal perturbation to the control system that renders the target operation unreachable and the symmetries of the control Hamiltonians. Further, we extend the result to the use case of quantum simulation by bounding the minimal time needed to implement an arbitrary time evolution in the orbit of a target Hamiltonian.

33. **Mansur Ziatdinov:** RANDOM PROJECTIONS AND QUANTUM FINGERPRINTING FOR QML

    QML promises speedups for various ML tasks, but faces challenges related to data encoding, while classical ML suffers from the "curse of dimensionality" in high-dimensional feature spaces. This study introduces a quantum-classical data encoding technique that combines the best of both worlds: Random Projections (RP) with Quantum Fingerprinting (QFP). RP is used to reduce the dimensionality of classical data before encoding it into a quantum state. QFP, a quantum technique for building efficient bounded-error algorithms, is then applied as a data encoding. The mathematical foundations of this combination are explored by showing that it preserves the properties of QFP. This approach provides a way to implement QML algorithms by mitigating the challenges posed by high-dimensional data.

34. **Mário Ziman:** DISCRIMINATING AND LABELING THE UNLABELED.

    We will compare the discrimination of measurements when their outcomes are labeled and unlabeled. Specifically, the problem of measurement labeling will be introduced and studied. It is a special type of discrimination problem aiming to distinguish observables with different permutations of outcomes. The obtained results for single-shot and multiple-shot scenarios will be described.



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