pre-TPS mini-workshop

Report of Contributions

Contribution ID: **1** Type: **not specified**

Intrinsic non-Hermitian topological phases [Prof. Ken Shiozaki, YITP, Kyoto University]

Monday, 12 January 2026 10:00 (45 minutes)

Abstract:
Topological phases specific to non-Hermitian systems are point-gapped topological phases. Their Hamiltonians have no spectrum in the vicinity of a reference energy point and have finite topological invariants defined with respect to that point. A prototypical example is the spectral winding number, whose nontrivial value leads to the non-Hermitian skin effect. However, not all point-gapped topological phases are genuinely non-Hermitian: some can be understood as Hermitian or anti-Hermitian phases. In this talk, we discuss how to systematically extract such Hermitian-extrinsic non-Hermitian phases using a dimensional hierarchy of K-theory. The result was announced in the Supplemental Material of Ref. [1], and the full details are presented in Ref. [2].

[1] Okuma-Kawabata-KS-Sato 1910.02878.

[2] KS 2509.06879.

Contribution ID: **2** Type: **not specified**

Entanglement-only quantum criticality: Dissociation of bulk and entanglement phase transitions in the Haldane phase [Dr. Yu-Chin Tzeng, NYCU]

Monday, 12 January 2026 10:45 (45 minutes)

Abstract:
The entanglement spectrum (ES) of the spin-1/2 ladder in the Haldane phase has long been interpreted as mimicking the gapless des Cloizeaux-Pearson dispersion of physical edge modes, a view established over 15 years ago based on the Li-Haldane correspondence. Here, we demonstrate that this prevailing picture is fundamentally incomplete. Using large-scale exact diagonalization up to 40 spins, we reveal that the entanglement Hamiltonian is not merely a boundary artifact but an autonomous many-body system hosting its own quantum phase transition, disconnected from the bulk physics. By tuning the physical anisotropy parameter, we identify an entanglement-only quantum phase transition associated with spontaneous continuous symmetry breaking, driven by emergent non-locality. This distinct phase structure explicitly violates the standard Lieb-Schultz-Mattis (LSM) and Mermin-Wagner constraints for short-range interacting systems. Our findings overturn the long-held assumption of locality in the entanglement Hamiltonian, establishing entanglement-only quantum criticality as a new frontier beyond the conventional boundary-bulk ES correspondence.

Contribution ID: **3** Type: **not specified**

Magic Entropy in Hybrid Spin-Boson Systems [Ying-Lin Li, NTHU]

Monday, 12 January 2026 11:30 (30 minutes)

Abstract:
Entanglement is widely recognised as a central feature distinguishing quantum and classical correlations, yet it alone does not determine the computational complexity of quantum many-body systems. There exist quantum states that are strongly entangled but still efficiently simulable by classical means, such as stabilizer states generated by Clifford circuits. This observation motivates the study of non-stabilizerness, or quantum magic, as a complementary resource beyond entanglement.

In this work, we extend the stabilizer Renyi entropy to hybrid systems composed of both discrete (spin) and continuous-variable (bosonic) degrees of freedom. The resulting entropic measure captures quantum resources arising from both non-stabilizerness and non-Gaussianity. Within a phase-space quantisation perspective, we further define a hybrid magic entropy and a mutual magic entropy, which characterise how quantum magic is distributed between spin and bosonic subsystems.

In this talk, I will illustrate how these entropic measures can be used to reveal physically relevent phenomena, including the detection of the superradiant phase transition in the Dicke model and the

dynamical behaviour of magic in the Jaynes-Cummings model. I will also discuss a Monte Carlo numerical scheme to practically evaluate these entropic measures in interacting many-body systems

Contribution ID: **4** Type: **not specified**

Lunch break

Monday, 12 January 2026 12:00 (1h 15m)

Contribution ID: **5** Type: **not specified**

Nonreciprocal Transport Induced by Loop Current Order [Prof. Rina Tazai, YITP, Kyoto University]

Monday, 12 January 2026 13:15 (45 minutes)

Abstract:
In recent years, the possibility of a loop current ordered phase, in which spontaneous and spatially nonuniform electric currents circulate within a unit cell, has been proposed in a various materials. Despite growing interest, many aspects of the macroscopic physical consequences of loop current order remain unsolved.
In this talk, we show that the emergence of loop current order leads to an unconventional superconductivity as well as nonreciprocal transport originating from Lorentz force [1,2].
[1] arXiv:2508.04433.
[2] PNAS, 122, e2503645122 (2025).

Contribution ID: **6** Type: **not specified**

Diagnosing topological order: from Chern markers for integer Chern bands to helical entanglement spectroscopy in fractional topological insulators [Dr Gunnar Möller, University of Kent]

Monday, 12 January 2026 14:00 (45 minutes)

Topological phases are characterised by a robustness against perturbations, yet it is instructive to examine how sufficiently strong perturbations can ultimately destroy them. Here, we discuss two representative examples.

First, we study the breakdown of the quantised Hall conductance in the non-interacting Haldane model under disorder and in the presence of a trivial mass term. We find that mass-driven quantum Hall plateau transitions exhibit critical behaviour that is distinct from purely disorder-driven transitions, including continuously varying critical exponents.

Second, motivated by recent evidence for time-reversal symmetry breaking fractional Chern insulators in twisted MoTe2 bilayers, we reexamine the stability of time-reversal invariant fractional topological insulators. Focusing on a model of two interacting fermionic species occupying a time-reversal invariant pair of flat Hofstadter bands with opposite magnetic fields, we map out the ground-state phase diagram using density-matrix renormalisation group methods.

We confirm the stability of the ν=1/3+1/3 fractional topological insulator against inter-species interactions and identify a transition to a topologically trivial phase when inter- and intra-species interactions become comparable. We propose the helical entanglement spectrum as a diagnostic of this phase and show that it reproduces the edge-mode counting of a U(1)×U(1) chiral boson theory.

Finally, we comment on recent progress toward connecting such theoretical diagnostics to experimentally accessible probes. In particular, we highlight work demonstrating that quantum state tomography can, in principle, be reconstructed from neutron scattering correlation functions in quantum spin systems. While not yet directly applicable to itinerant carriers, this establishes a concrete route toward experimentally accessing entanglement- and topology-based diagnostics.