Schedule week 1

	Monday 18	Tuesday 19	Wednesday 20	Thursday 21	Friday 22
11:00-12:00		Lanzetta	Oshikawa	Putrov	Argurio
12:00-13:00	Welcome	Copetti	Oshikawa	Runkel	Fukaya
14:30-15:30	Bianchi	*Short talks*			
15:30-16:30	Van Vliet	*Short Talks*			

Monday, May 18

Lorenzo Bianchi *(University of Turin)*

Analytic bootstrap for holographic surface defects

In this talk, I will review the recent developments in the application of analytic bootstrap techniques to defect conformal field theories. I will briefly outline some applications and then I will focus on 1/2 BPS surface defects in N=4 SYM theory (the most notable example being Gukov Witten defects). I will show how analytic bootstrap tools can be used to compute the holographic bulk two-point function and possibly some higher-point correlators.

Philine Van Vliet *(LPENS, Paris)*

Sum rules for conformal defect data

Conformal defects break part of the symmetry of a bulk CFT. The broken Ward identities lead to very general sum rules on the defect CFT data as well as on the data of bulk operators in the presence of a defect. We call these sum rules "defect soft theorems", and they hold generally for defects which break conformal symmetry, flavor symmetry, or supersymmetry. In this talk I will focus on line defects for which we can rewrite the constraints in dispersive sum rule form, and show how the defect soft theorems impose constraints on the defect spectrum and OPE coefficients. The new constraints can also be combined with the numerical conformal bootstrap for defects. They allow us to encode information from the bulk by adding integrated correlators of the displacement operator to the crossing equations. These constraints lead to highly improved bounds on CFT data of low-lying defect operators. I will highlight two examples: 1) a flux tube in pure YM in AdS_3, where the bootstrap can be used to test the validity of a smooth interpolation between perturbative models at small and large AdS radius. 2) the ½-BPS Maldacena-Wilson line in N=4 SYM, where an interplay with integrability and supersymmetric localization provides a unique opportunity to obtain exact results.

Tuesday, May 19

Ryan Lanzetta *(Perimeter Institute)*

Unitarity bounds on cusp anomalous dimension

In lattice studies of open surface defects, such as entanglement cuts, monodromy defects, or line defects when viewed as interfaces between trivial surfaces, the geometry of the defect is typically forced to contain sharp corners or cusps. Each cusp contributes to the overall finite size scaling of the observable via its associated cusp anomalous dimension. I will present a simple bound on the cusp anomalous dimension that follows from unitarity and locality constraints obeyed by scale-invariant rectangular surface defects in the continuum. The bound relates the cusp anomalous dimension of a right angle cusp to the universal defect mass, which gives the dominant contribution to the one-point function of the rectangular defect in the quasi-1d limit. The bound complements universal asymptotics of the cusp anomalous dimension that are known when the cusp angle is large or small.

Christian Copetti *(Mathematical Institute, Oxford)*

When symmetries twist: anomaly inflow on monodromy defects

Monodromy defects describe a dynamical termination of topological operators, sourced by a localized background magnetic flux. We study their properties in gapped SPTs phases and, by inflow, in gapless theories with an anomalous symmetry. The background flux acts as a source for the anomaly, implying interesting constraints on their physics, such as the presence of protected chiral defect modes. We test these ideas in the case of a free (3+1)d Dirac fermion.

Short Talks

Jeremias Aguilera-Damia *(University of Barcelona)*

Confining flux tubes in a gapless phase (part 1)

In this short talk I'm going to try to motivate the study of confining flux tubes from a "top-down" approach within a gapless confining phase. After a brief summary of the topic, I'll introduce the model of study, namely the four dimensional CP1 model, which met all the desired requirements and, moreover, has been previously proposed as an effective description of the confining phase in certain strongly coupled gauge theories.

Giovanni Rizi *(IHES, Paris)*

Confining flux tubes in a gapless phase (part 2)

Coffe break

Raquel Izquierdo Garcia *(Perimeter Institute)*

Higher Dimensional Holography

Many physically relevant geometries, such as those dual to heavy operators, are intrinsic to 10d/11d supergravity and are not accessible through the AdS/CFT dictionary. In this talk I will focus on 1/2 BPS surface operators of N=4 super Yang-Mills, and compute their Euler conformal anomaly by adding a counterterm to the 10 dimensional type IIB supergravity action. The talk is based on https://arxiv.org/abs/2512.12696

Riccardo Villa *(INFN, Florence)*

Gauging in superconductors and other electronic systems

Electronic systems obey a spin-charge relation due to their fundamental degree of freedom, namely a unit-charge electron, making fermion parity part of the electromagnetic group. When the spin_c gauge field is dynamical, these systems become bosonic and exhibit a specific 't Hooft anomaly involving the magnetic symmetry. This can be understood from the underlying bosonization process. Superconductors fit naturally into this picture as Higgs phases of the electromagnetic group and the anomaly constrains the allowed topological theories. This should also include higher-charge and topological superconductors.

Stathis Vitouladitis *(Université Libre de Bruxelles)*

The state/defect correspondence

How far can the idea of a state/operator correspondence be pushed beyond conformal field theory? I will explore this question for *p*-form Maxwell theory in arbitrary spacetime dimensions, where the natural objects are extended operators rather than local operators. I will present an exact and constructive correspondence between defects and states, governed by an infinite algebra of conserved charges, rather than conformal symmetry. I will also comment on interactions and possible extensions to gapped theories.

Wednesday, May 20

Masaki Oshikawa *(Ohio State University)*

Conformal boundary conditions of Z_2 orbifold of free bosons in 1+1 dimensions, and their applications to quantum information

In the first part, I will review basic (and very old) subject of conformal boundary conditions of compactified free boson conformal field theory in 1+1 dimensions and their Z_2 orbifolds, which were applied to defect lines in critical Ising model [M.O. and I. Affleck, Nucl.Phys.B495, 533 (1997)]. In the second part, I will discuss their new applications to many-body quantum information problems, such as "quantum magic" (Stabilizer Renyi Entropy) and "entanglement swapping" (measurement-induced entanglement).

Thursday, May 21

Pavel Putrov *(ICTP, Trieste)*

TQFT from the ground state

In my talk I will consider a gapped theory described by a topological quantum field theory (TQFT) in the IR limit. I will formulate a proposal about how the TQFT data (in particular its partition function on an arbitrary closed manifold) can be recovered from the ground state of the UV theory, in terms of its multi-partite entanglement invariants. I will explain how the proposal can be explicitly verified for 2+1d Levin-Wen string-net model based on an arbitrary unitary fusion category. The talk is based on a joint work with M. Del Zotto and A. Gadde.

Ingo Runkel *(Hamburg University)*

Extensions of topological symmetries

Topological defects play a key role in understanding properties of quantum field theories, such as dualities or renormalisation group flows. One can ask if there is a larger class of defects which share some of the good properties of topological defects, and which can be thought of as an extension of topological symmetries. Two-dimensional conformal field theory is a natural laboratory for such questions, and indeed one finds that translation invariant defects form such a larger class. These contain topological line defects and they still allow for a non-singular fusion operation. Hence they form a tensor category, which, however, is no longer fusion, as it is non-semisimple and possesses infinitely many simple objects. In this talk I want to present some properties of this larger class of defects and give an application to defect renormalisation group flows. This is joint work with Federico Ambrosino, Anatoly Konechny, and Gérard Watts.

Friday, May 22

Riccardo Argurio *(Université Libre de Bruxelles)*

Defects, flat gauging, T-duality: at any radius, in the continuum and on the lattice.

I will discuss non-invertible topological interfaces and defects in the two-dimensional compact boson, focusing on the more exotic ones obtained by gauging on a half-space continuous symmetries with flat connections. These include interfaces between mutually irrational radii and T-duality symmetries at arbitrary boson radius. Using the modified Villain discretization on both a Euclidean two-dimensional square lattice and a quantum one-dimensional chain, I will show that all these topological interfaces survive discretization and give rise to non-compact edge modes localized at the defect sites. Such non-compact edge modes imply an infinite quantum dimension which can be related to a continuous spectrum in presence of the defect.

Hidenori Fukaya *(University of Osaka)*

Curved defects and induced gravity

We consider curved defects between topological phase and trivial phase of matters and discuss induced gravity on the edge-localized fermions.

Schedule week 2

	Monday 25	Tuesday 26	Wednesday 27	Thursday 28	Friday 29
11:00-12:00	Shu-Heng Shao	Fei Yan	Frank Verstraete	Xiao-Gang Wen	Yifan Wang
12:00-13:00	Paul Fendley	Michele Del Zotto	Po-Shen Hsin	Lukas Fidkowski	Luisa Eck
14:30-15:30		*Short talks*			
15:30-16:00		*Coffe break*			
16:00-17:00		*Short talks*			

Monday, May 25

Shu-Heng Shao *(MIT)*

Lattice chiral symmetry from bosons in 3+1d

We present an explicit Hamiltonian that realizes an exact lattice chiral U(1)_V x U(1)_A recently proposed. Nielsen-Ninomiya-type no-go theorems are evaded by using lattice bosons rather than fermions. The continuum limit is a compact boson field theory with an axion-like coupling. While U(1)_V shifts the lattice scalar, U(1)_A acts on short axion string excitations. We demonstrate the chiral anomaly by showing that U(1)_A is broken when U(1)_V is gauged. Finally, gauging either U(1)_V and U(1)_A leads to lattice non-invertible and 2-group symmetries, respectively.

Paul Fendley *(University of Oxford)*

Exact CFT results from the lattice

In classic work spanning decades, exact universal quantities such as critical exponents were obtained by taking the scaling limit of integrable lattice models. I will explain a simpler approach that yields such quantities exactly on the lattice. Namely, one analyses the behaviour of lattice models in the presence of non-trivial topological defects. For example, gluing a defect to a boundary automatically yields a ratio of g-factors, thus constraining strongly any conformal field theory describing the continuum limit. Doing a Dehn twist yields chiral critical exponents, up to a half-integer ambiguity. I will give examples of both.

Tuesday, May 26

Fei Yan *(Brookhaven)*

Integrability and topological defects in (1+1)-d quantum spin chains

This talk explores the interplay between integrability and topological defects in (1+1)-d quantum spin chains. In the first part of this talk, using the three-state Potts model as a playground, I will describe various methods to construct topological defects in this model. In particular, integrability played an important role in the construction of the Fibonacci defect, which seems to be hidden from some other approaches. In the second part of this talk, I will gently break integrability and briefly discuss weak integrability-breaking in the presence of defects, using the prototypical example of transverse-field Ising model enriched with Kramers-Wannier duality defect. This talk is based on various past work with Madhav Sinha, Linnea Grans-Samuelsson, Ananda Roy, Hubert Saleur, Robert Konik, and Aditi Mitra.

Michele Del Zotto *(Uppsala University)*

TQFT from the groundstate (continued)

In the context of gapped quantum systems, ground states are often characterized in terms of TQFTs. In a recent work together with Abhijit Gadde and Pavel Putrov, we have conjectured an explicit formula giving a physical interpretation of the TQFT partition functions in terms of multipartite entaglement of the ground state. In this talk, after a short review of the framework for characterising TQFT in terms of multipartite entanglement that was discussed by Pavel in his seminar in week 1, I will discuss the details of the 2+1 dimensional Levin-Wen lattice models, where our formula can be proved explicitly. We stress that despite its title, this seminar will be self contained.

Short Talks

Andrea Antinucci *(Oxford University)*

Field theories for (non-Abelian) anyon condensation transitions

Gapped phases related by anyon condensation are expected to be connected by a phase transition, but writing down a continuum QFT description for that is very challenging, especially if the anyon is non-Abelian. I will review the subtleties arising already for Abelian anyons, where the problem is much more under control and can be solved in general. I will then illustrate non-Abelian examples where very curious phenomena can show up.

Federico Ambrosino *(Perimeter Institute)*

Charge conjugation symmetry and Monodromy defects in Chern-Simons theory

In this talk, based on upcoming work with J. Gomis and S. Kannagi, I will discuss an important class of defects in Cern simons theory that implement charge conjugation symmetry. These are monodromy defects and, although some of their properties have been studied in N=4 SYM, we study them for the first time in the context of CS theory. Their quantum dimensions can be computed exactly as twining characters, and are associated with somewhat exotic affine algebras.
If time permits, I will also discuss how the duality between CS theory on S^3 and the topological A model on the resolved conifold geometry also accommodates for these new observables. Being heavy in the ’t Hooft limit, they provide a very non trivial test of the duality, and correspond to some special orientifold projection on the string side.

Rodrigo Arouca *(Rio de Janeiro)*

Hall Conductance in a weakly time-reversal invariant open system

In this talk, I will discuss our recent work [1] on the fate of the Hall conductance and the parity anomaly in open quantum systems. We consider a time-reversal-invariant (2+1)D model of coupled fermions and bosons, where integrating out the bosonic degrees of freedom generates a fermionic self-energy that dynamically breaks time-reversal symmetry. Despite the emergence of a finite Dirac mass, we find that the Hall conductivity vanishes in the zero-frequency limit due to interaction-induced changes in the occupation of fermionic modes. Furthermore, including wavefunction renormalization yields an unquantized Hall conductance, highlighting the nontrivial interplay between dissipation, interactions, and topological response in open quantum systems.

[1] Alexander Fagerlund, Christopher Ekman, Rodrigo Arouca, arXiv:2603.11186

Coffe break

Giovanni Galati *(Université Libre de Bruxelles)*

Scattering off defects, and transmitting what I have understood.

In the presence of extended defects, familiar incoming particles can scatter into exotic out-going states created by twist operators. In this talk I will argue that one possible mechanism driving these processes is the presence of localized ’t Hooft anomalies on the defect’s world volume. After some general arguments, I will present some novel theories where this phenomenon is happening, and I will present an explicit solution of the scattering problem.

Han Ma *(Stony Brook University)*

Z2 gauge structure in the generalized Kitaev honeycomb models

I will discuss the role of 1-form symmetry in higher-spin Kitaev models, including a recently studied quadrupolar Kitaev model. Although these models are not exactly solvable, I will show that they nevertheless possess an exact Z2 gauge structure. The anomaly associated with this 1-form symmetry then imposes strong constrains on the possible phases of these models.

Wednesday, May 27

Frank Verstraete *(DAMPT, Cambridge)*

Perfect Particle Transmission through Duality Defects

We study wavepackets that propagate across (a) topological interfaces in quantum spin systems exhibiting non-invertible symmetries and (b) duality defects coupling dual theories. We demonstrate that the transmission is always perfect, and that a particle traversing the interface is converted into a nonlocal string-like excitation. We give a systematic way of constructing such a defect by identifying its Hilbert space with the virtual bond dimension of the matrix product operator representing defect lines. Our work both gives an operational meaning to topological interfaces, and provides a lattice analogue of recent results solving the monopole paradox in quantum field theory.

Po-Shen Hsin *(King's College London)*

Explore entropic orders in quantum lattice models

I will discuss two analytic methods for constructing quantum lattice models with entropic orders, where the Gibbs states exhibit nontrivial orders at arbitrary high temperatures unlike conventional orders. In particular, I will discuss high temperature continuous symmetry breaking in 1+1d and high temperature chiral anyon theory from p+ip superconductor. The talk is based on https://arxiv.org/abs/2604.18694 with Ryohei Kobayashi (U Tokyo).

Thursday, May 28

Xiao-Gang Wen *(MIT)*

Statistics for Elementary Excitations of Mixed Dimensionalities

There are two kinds of excitations. The first are elementary excitations, described by worldlines, worldsheets, and higher-dimensional worldvolumes, formed by qubits in spacetime. The second are bounding excitations, which arise as boundaries of condensed elementary excitations. In this paper, we study the statistics of elementary excitations with mixed dimensionalities and mixed conservation laws. One class of such conservation laws can be described by a higher group G, so that the excitations may be viewed as symmetry defects of G. Since symmetry defects of a higher group are invertible, this description implies that the corresponding excitations are invertible. Their statistics are therefore Abelian statistics. For invertible excitations in D-dimensional spacetime whose conservation laws are encoded by G, wefind that their Abelian statistics are systematically described by an element omega in H^{D+1}(BG; R/Z). Physically, the dynamics of such excitations, with prescribed conservation laws and Abelian statistics, can be simulated holographically as the boundary of a G higher-group gauge theory in one higher dimension, twisted by omega. More generally, Abelian and non-Abelian statistics of elementary excitations in D-dimensional spacetime are naturally described by fusion (D-1)-categories. In this broader framework, higher groups correspond to pointed fusion higher categories.

Lukas Fidkowski *(University of Washington, Seattle)*

Chiral Lattice gauge theories from symmetry disentanglers

We propose a Hamiltonian framework for constructing chiral gauge theories on the lattice based on symmetry disentanglers: constant-depth circuits of local unitaries that transform not-on-site symmetries into on-site ones. When chiral symmetry can be realized not-on-site and such a disentangler exists, the symmetry can be implemented in a strictly local Hamiltonian and gauged by standard lattice methods. Using lattice rotor models, we realize this idea in 1+1 and 3+1 spacetime dimensions for U (1) symmetries with mixed ’t Hooft anomalies, and show that symmetry disentanglers can be constructed when anomalies cancel. As an example, we present an exactly solvable Hamiltonian lattice model of the (1+1)-dimensional “3450” chiral gauge theory, and we argue that a related construction applies to the U (1) hypercharge symmetry of the Standard Model fermions in 3+1 dimensions. Our results open a new route toward fully local, nonperturbative formulations of chiral gauge theories.

Friday, May 29

Yifan Wang *(New York University)*

Extraordinary Surface Criticalities for Interacting Fermions

Interacting fermions exhibit a rich landscape of surface defects and associated critical phenomena. We investigate novel surface critical behavior in the three-dimensional Gross-Neveu-Yukawa model. For a class of defect renormalization group flows, we obtain exact infrared solutions and show how fermionic anomalies are encoded in the resulting surface dynamics. We further uncover emergent topological and geometric structures in the defect coupling space, and comment on their relation to a defect analogue of the CFT distance conjecture.

Luisa Eck *(Caltech)*

Non-invertible symmetry enriched topological orders

Topological orders enriched by group symmetries are well studied in both mathematics and physics, with symmetry twist defects described by G-crossed braided extensions. In this talk, I will outline a generalization to non-invertible symmetries. The starting point is a full inclusion of one fusion category into another, and the resulting twist defects are described by the relative center. I will explain how the symmetry action on anyons can be computed using tube algebra methods, and how it can send a single anyon to a sum of anyons and twist defects. The main example comes from Z2 inside S3, giving a non-invertible symmetry action on toric code anyons. Time permitting, I will also describe extensions of this framework to condensation string-net models and chiral topological orders. The talk is based on upcoming work with Peter Huston, Kyle Kawagoe, and David Penneys.

Schedule week 3

	Monday 1	Tuesday 2	Wednesday 3	Thursday 4	Friday 5
11:00-12:00	Yin-Chen He	*holiday*	Sakura Schafer-Nameki	Ryohei Kobayashi	Ilya Gruzberg
12:00-13:00	Yin-Chen He	*GGI closed*	Sakura Schafer-Nameki	Hubert Saleur	
14:30-15:30			*Short talks*		
15:30-16:30			*Short Talks*		

Monday, June 1

Yin-Chen He *(Perimeter)*

Fuzzy sphere for conformal defects

In this talk, I will introduce the "fuzzy (non-commutative) sphere regularization," a recently proposed non-perturbative approach to 3D CFTs, and explain how it offers a remarkably powerful and efficient tool for studying conformal defects and boundaries. I will first elucidate the basic idea —how the fuzzy sphere realizes 3D CFTs, and how a conformal defect is implemented in this framework. I will then dive into illustrative examples, showing how the scheme grants direct access to a wealth of defect data, including the defect operator spectrum, defect-changing operators, defect-bulk OPE, and the universal defect g-function, with the magnetic line defect of the 3D Ising CFT as the central example. I will then survey further progress, including conformal boundaries and spin impurities in the O(3) Wilson-Fisher CFT.

Wednesday, June 3

Sakura Schafer-Nameki *(Oxford University)*

Pedagogical Introduction to the SymTFT and Applications

By request of this week's organizers, I will give an introduction to the concept of the symmetry topological field theory (SymTFT). This has been a very useful tool to study generalized symmetries, and has allowed to put some order in the classification of phases, gapped and gapless with finite symmetries. Although the main utility of the SymTFT comes in the context of categorical symmetries, I will try to explain the ideas in the context of well-known group symmetries. At the end we may have time for a surprising new result, following from the SymTFT, regarding phase transitions without hidden symmetry breaking.

Short Talks

Lea Bottini *(IHES)*

Topological order enriched by non-invertible symmetry via anyon condensation

In this talk, I will discuss a notion of topological order enriched by a non-invertible symmetry. For invertible symmetry enriched topological order, a well-established formalisation is available in terms of a G-crossed braided fusion category. By considering the condensation of an arbitrary algebra of charges in a quantum double model, a generalisation of this framework naturally emerges. In particular, I will show that the topological order after condensation can be described as a hypergroup-graded extension of the category of deconfined excitations. This has a hypergroup symmetry which acts in a typically non-invertible manner on the confined and deconfined excitations, in a way that is compatible with the grading. I will illustrate the general theory through a simple example.

Nayan Myerson-Jain *(Yale University)*

Rényi defect criticality and entropy and in (2+1)d QCPs

Universal components of entanglement entropies in QCPs capture important information about the IR CFT. Surprisingly, in 2d lattice models with irrelevant anisotropy, numerical evaluation of the 2nd Rényi entropy yields results that differ based on a choice of entangling surface. The entangling surface manifests as a codimension-2 conical defect in the path integral, and under a Weyl transformation, is mapped to the boundary of the n-fold cover of S^1 x AdS_d. We discuss the landscape of Rényi conical defect, or boundary, fixed-points in the O(N) model as a possible resolution to this puzzle.

Coffe break

Pierluigi Niro *(SISSA)*

From QED_3 to the multicritical point of the Fradkin-Shenker model

The Fradkin-Shenker model in 2+1 dimensions, which is equivalent to the toric code deformed by an in-plane magnetic field, is a paradigmatic example of Higgs-confinement continuity. Its phase diagram contains a multicritical point where mutually non-local electric and magnetic excitations, exchanged by a self-duality symmetry, become simultaneously massless. We propose a continuum QFT description in terms of QED_3 with two charge-1 Dirac fermions and a charge-2 Higgs field with Yukawa couplings, deformed by monopole operators. Finally, we conjecture a multicritical duality of the latter theory with a suitable deformation of the easy-plane CP^1 model.

Abhinav Prem *(IAS, Princeton)*

Intrinsically Mixed-State Topological Order

I will discuss progress in classifying and characterizing mixed-state topological phases. In particular, I will introduce the notion of "locally detectable excitations" in the context of 2+1D intrinsically mixed-state topological order.

Thursday, June 4

Ryohei Kobayashi *(IAS, Princeton)*

Automorphism in gauge theory and Clifford-hierarchy stabilizer codes

We study automorphism in twisted gauge theories and discover they can give rise to generalized symmetries such as higher group and/or non-invertible symmetries. In the context of quantum error-correcting codes, the emergent symmetries of stabilizer codes give rise to transversal logical gates. Using the automorphism symmetry, we discover transversal non-Clifford logical gates such as T gate in non-Clifford stabilizer models in 2D as well as transversal CCZ gate in 5D self correcting non-Abelian quantum memory**.**

Hubert Saleur *(IPhT CEA, Saclay)*

O(3) sigma model, XXX spin chains and t'Hooft anomalies

I will discuss the Z_2 (inversion symmetry) t'Hooft anomaly in the O(3) sigma model and in its XXX spin chain lattice regularization. This will involve, among other considerations, a discussion of intriguing features of the spin chain with an odd number of sites, and the role of the Pin groups.

Friday, June 5

Ilya Gruzberg *(Ohio State University)*

Multifractals at Anderson transitions and the Coulomb gas: a (b)CFT perspective.

Anderson (and quantum Hall) transitions are quantum critical points in disordered electronic systems. A common feature of these transitions is the multifractal (MF) nature of critical wave functions and their correlations encoded in continuous spectra of scaling dimensions. These so-called MF spectra are different in the bulk and near a boundary of the system. The precise nature of the critical theories for Anderson transitions is mostly unknown. However, assuming that MF observables are primaries in a conformal field theory (CFT) satisfying simple (Abelian) fusion rules, one can derive strong constraints on the MF spectra. In two dimensions, this reasoning leads to the unique description of MF observables as vertex operators in a Coulomb gas CFT with simple modifications near boundaries. We discuss possible extensions of this circle of ideas to higher dimensions.

Schedule week 4

	Monday 8	Tuesday 9	Wednesday 10	Thursday 11	Friday 12
11:00-12:00	Cenke Xu	Anton Kapustin	Nat Tantivasadakarn	Sara Murciano	Xinping Yang
12:00-13:00	Yunqin Zheng	Sergej Moroz	Nat Tantivasadakarn	Ibrahima Bah	Salvatore Pace
14:30-15:30		*Short talks*			
15:30-16:30		*Short Talks*			

Monday, June 8

Cenke Xu *(UCSB)*

Symmetry origin of the quantum-classical transition, hydrodynamics, and decodability.

We discuss the following question: when a quantum system evolves into classical one, is there a sharp transition? We will show that the "strong-to-weak" spontaneous symmetry breaking (SW-SSB) provides a sharp onset of classical physics. We present the theoretical framework and summarize recent experimental progress toward observing SW-SSB. We will also discuss the consequence of the SW-SSB, including the emergence of hydrodynamics, and also its information aspect, such as the transition of decodability and distinguishability. Much of the theoretical analysis maps to a problem of defect in the Euclidean spacetime.

Yunqin Zheng *(KITS, UCAS, Beijing)*

On the absence of symmetric conformal boundary conditions

There is a common piece of lore that given a CFT, there is a simple conformal boundary condition preserving any anomaly free subsymmetry. We will discuss counterexamples where this lore is violated. These include certain minimal models and c=1 compact boson. We also comment on an improved lore which can be promoted to be correct subjected to an assumption.

Tuesday, June 9

Anton Kapustin *(Caltech)*

Higher symmetries and homotopy theory in quantum lattice models

It is generally accepted that the interplay of symmetry and locality in Quantum Field Theory leads one to introduce higher or generalized symmetries. While ordinary (0-form) symmetries form a group, incorporating invertible higher symmetries requires one to replace groups with higher groups, that is, finite connected homotopy types. It is far from obvious how to attach such a gadget to a local QFT. In this talk I discuss this problem in the context of quantum lattice models. I will show how to attach a connected homotopy (d+1)-type to lattice models in d spatial dimensions by exploiting a construction which is a non-abelian analog of the Cech homology of a precosheaf. This homotopy type encodes all higher symmetries as well as all 't Hooft anomalies. A key ingredient in the construction is the equivalence between connected homotopy (d+1)-types and crossed d-cubes of groups due to Loday and Ellis-Steiner.

Sergej Moroz *(University of Karlstad)*

Spontaneously Broken Non-Invertible Symmetries in Transverse-Field Ising Qudit Chains

I will discuss one-dimensional chains of group-valued qudits, whose local Hilbert spaces are spanned by elements of a finite non-Abelian group G. For these systems, I will construct Ising-type transverse-field Hamiltonians possessing non-invertible Rep(G) symmetry. I will describe the resulting pattern of spontaneous symmetry breaking and the associated quantum phase transition. Finally, I will argue that at a fine-tuned point with enhanced symmetry, the model admits a Kramers–Wannier-type duality, and I will explore some of its consequences.

Short Talks

Giuseppe Policastro *(ENS, Paris)*

Holographic generalized conformal junctions

I will discuss the construction of gravitational junctions in 3-dimensional AdS, that describe holographically a generalization of the usual conformal interface in a 2d CFT. The generalization involves turning on a sector of fluctuating modes on the interface, which are solutions of the Nambu-Goto equations at linearized level in the string tension. The construction can be extended to multi-way junctions. Talk based on work in collaboration with A. Mukhopadhyay, T. Kibe, A. Chakraborty and M. Molina.

Arkya Chatterjee *(YITP, Stony Brook)*

More (about) non-invertible symmetries in the 4-state Potts model

The 1+1d 4-state Potts model is a one-parameter family of Z_4 clock models distinguished by an enhanced S_4 global symmetry. Its paramagnet-ferromagnet phase transition is described at low energies by the compact boson CFT at a certain rational point on the orbifold branch. Many of the topological defect lines of the CFT are realized as non-invertible symmetries of the lattice model tuned to its critical point. In this talk, we show that the 4-state Potts model enjoys non-invertible symmetries even away from criticality. The simplest of these are coset symmetries arising from gauging Z_4 subgroups of S_4. The fusion of these operators reveals a rich symmetry structure for the 4-state Potts model at any coupling.

Apoorv Tiwari *(University of Odense)*

Universal quantum computation with group surface codes

In this talk, I will introduce group surface codes, a natural generalization of the Z2 surface code that can be understood as Kitaev quantum double models of finite groups with suitable boundary conditions. Logical gate protocols in this framework decompose into a finite set of elementary operations which involve merging, splitting, preparing and reading out group surface codes. In the language of TQFT, these correspond to elementary spacetime blocks in 2+1-dimensional topological gauge theories. I will present a systematic construction of these TQFT building blocks and analyze the fault tolerance of the associated elementary operations. In this framework a group can be constructively designed to implement a target non-Clifford gate on qubits encoded in the Z2 surface code, yielding new routes toward universal quantum computation without anyon braiding. As an application, I will describe how arbitrary reversible classical gates can be implemented transversally in the group surface code.

Coffe break

Anatoly Konechny *(Heriot-Watt University)*

RG flows of chiral defects from fusing relations

We discuss topological defects in 2D CFTs perturbed by chiral defect operators. Such defects flow under RG transformations to topological defects. As chiral defects commute with the bulk conformal Hamiltonian there is a well defined operation of fusing two such defects. In rational CFTs this fusion can be calculated explicitly using the CFT fusing matrices. We look at the fusion of perturbed chiral defects with the coupling constants being complex. For some values of the couplings the fused defect may break up into a direct sum of chiral defects. This gives rise to fusing relations that for some well known perturbations give rise to T-system equations linked to the Bethe ansatz. We show how the fusing relations along with some analyticity assumptions can be used to directly determine the end-point of the defect RG flow without using any Bethe ansatz machinery. We look at the explicit examples of defect flows in Lee-Yang, Ising and tricritical Ising models. The talk is based on a joint work with Federico Ambrosino, Ingo Runkel and Gerard Watts.

Luigi Tizzano *(CERN)*

Soft Theorems and Null Cusps from Line Defects

I will discuss universal structures that appear in soft and large-boost limits of QFT. First, I will explain how emergent electric and magnetic one-form symmetries in the soft sector of QED reproduce asymptotic charges and the leading soft photon theorem. I will then discuss work to appear on the null limit of the cusp anomalous dimension, which gives rise to logarithmic scaling in gauge theories, and how this phenomenon is generalized for conformal line defects in CFT.

Rajath Radhakrishnan *(ICTP, Trieste)*

Dimensional reduction of topological operators

While a generic quantum field theory may admit infinitely many topological operators, their topological nature imposes strong consistency conditions on their structure. In this talk, I will introduce the notion of dimensional reduction of topological operators and discuss some constraints it imposes in various spacetime dimensions. I will explain how these constraints severely restrict the possible non-invertible symmetries of QFTs in spacetime dimension greater than two.

Wednesday, June 10

Nat Tantivasadakarn *(YITP, Stony Brook)*

Symmetries on the lattice

Much progress of generalized symmetries has been formulated in the continuum. However, on the lattice, symmetries can behave quite differently, and its fundamental organizing principles are still in development. I will give an overview of our understanding of symmetries on the lattice and subtleties in matching them to those in the continuum.

Thursday, June 11

Sara Murciano *(University of Paris Saclay)*

Measurement-altered criticality beyond forced outcomes

Quantum critical systems provide a natural platform to explore novel measurement-induced phenomena, due to their strong sensitivity to perturbations. In this talk, I will review how measurements affect critical states and show that, in certain post-selected cases, they can drive the system toward new fixed points described by boundary conformal field theory. Building on this idea, I will focus on Luttinger liquids and show that, upon averaging over measurement outcomes, the system can exhibit a new universal behavior characterized by multifractal scaling and logarithmic corrections to power-law correlation functions.

Ibrahima Bah *(Johns Hopkins University)*

Aspects of locality, unitarity, and symmetries

*I*n this talk, I will explore some aspects of the apparent tension between locality and unitarity for symmetries in quantum field theory. I will then discuss how locality can impose regularity conditions on the Hilbert space, and use this to define an observable that measures the non-locality of symmetry operators. In examples, this observable encodes data about the fusion algebra of the symmetries.

Friday, June 12

Xinping Yang *(Perimeter)*

Microscopic structure of categorical duality operators

We systematically study the microscopic features of fusion category symmetries implemented via categorical duality operators acting on tensor product quasi-local algebras, with respect to an internal fusion category symmetry $\mathcal{C}$. We parameterize duality operators on the quasi-local algebra in terms of data dependent on the associated quantum cellular automata (QCA) on the symmetric subalgebra B. Using the technical tool of DHR bimodules, we consider the structure of external symmetries generated by a family of duality operators, and show that the UV symmetry structure is a free group F_n-graded extension of the integral fusion category. If the UV models are all defined on tensor product Hilbert spaces, these categories necessarily flow to weakly integral fusion categories in the IR.

Salvatore Pace *(MIT)*

Comments on Clifford QCA symmetries

I will discuss how, while QCAs are natural and basic symmetry operators in quantum lattice systems, they nevertheless defy many of the symmetry intuitions we have from QFT. I will motivate the discussion with a particularly simple example: a finite-depth quantum circuit on a qubit chain. Afterward, I will discuss some more general features based on the classification of Clifford QCAs.

Schedule week 5

	Monday 15	Tuesday 16	Wednesday 17	Thursday 18	Friday 19
11:00-12:00	Charlotte Kristjansen	Chris Herzog	Francesco Benini	Marco Meineri	Fiona Burnell
12:00-13:00	Fabio Apruzzi	Francesco Parisen Toldin	Inaki Garcia-Etxebarria	Alessandro Vichi	Erik Tonni
14:30-15:30		*Short talks*			
15:30-16:30		*Short Talks*			

Monday, June 15

Charlotte Kristjansen

Black Holes and Integrable Boundary States in Quantum Spin Chains

Black hole states in quantum spin chains are particular boundary states introduced to encode thermal one-point functions of the AdS/CFT correspondence. We demonstrate that these states exhibit many intriguing features such as logarithmic growth of entanglement entropy with subsystem size and thermalization at infinite temperature. We contrast the black hole states with the integrable boundary states which describe one-point functions in the presence of D-branes giving rise to domain wall, surface or line defects in AdS/CFT.

Fabio Apruzzi

Holographic Defects: From Strings to Punctures

Defects are important ingredients in a quantum systems, and the supersymmetric ones provide controlled probes of protected sectors of strongly coupled theories. In this talk I will discuss two related holographic constructions of superconformal defects in six-dimensional N=(1,0) SCFTs and their compactifications. The first describes string defects in 6d using probe D4-branes, whose Weyl anomalies, entanglement data, and anomaly inflow can be computed and matched against field-theoretic expectations. The second class of defects uses related probe-brane configurations, which describe punctures in four-dimensional theories when the 6d theory is compactified on Riemann surfaces. This reproduces known class S results in suitable limits and predicts new large-N punctures beyond class S together with their defect anomaly data.

Tuesday, June 16

Chris Herzog

Scattering Off Chamblin-Reall Branes

I will discuss recent work with Dongsheng Ge describing scattering dilaton-graviton waves off of thin branes in a three dimensional space-time. The gravity problem has some novel aspects I have not seen in the general relativity literature before and is reminiscent of the optics problem of scattering light off of a rough, translucent window. The motivation for our study was that the process has a dual holographic realization as scattering in a family of strongly interacting (non-conformal) 1+1 dimensional quantum field theories.

Francesco Parisen Toldin

Extraordinary transition at the edge of a correlated topological insulator

The interplay of topology and correlations defines a new playground to study boundary criticality in quantum systems. In this context, a prominent model is provided by the Kane-Mele-Hubbard model on the honeycomb lattice, which hosts protected edge modes. In this talk I will introduce the model, and discuss our recent large scale auxiliary field quantum Monte Carlo simulations on a lattice with zig-zag edges, where the Hubbard interaction is tuned to the three-dimensional XY bulk critical point. Upon varying the Hubbard-U term on the edge we observe a boundary phase transition from an ordinary phase with a helical Luttinger liquid edge decoupled from the critical bulk to an extraordinary-log phase characterized by a logarithmically diverging spin stiffness. We find that the spectral functions exhibit distinct features in the two phases giving potential experimental signatures. [FPT, F. F. Assaad, M. A. Metlitski, arXiv:2508.00999]

Short Talks

Bernardo Zan

Quantum group symmetry and non-local operators

I will discuss systems where the global symmetry is described by a quantum group. The operators transforming under the quantum group are necessarily mutually non-local. I’ll consider a lattice model with this symmetry and construct these non-local scaling operators, and check that for a critical system they give the correct power law correlation functions. Finally, I will comment on some consequence of quantum group symmetry on local operators

Alison Warman

Twin Phases: Phase Transitions Without Hidden Symmetry Breaking

We introduce the concept of twin phases for a symmetry S, defined as inequivalent phases, whose order parameters are part of the same generalized charge under S. Stable, direct transitions between such twin phases are never spontaneous-symmetry-breaking transitions, even after (partially) gauging the initial symmetry S: they are phase transitions without hidden symmetry breaking. We illustrate this with an (anomalous) finite group symmetry in 1+1d, which exhibits such intrinsically beyond Landau transitions. [Based on 2605.3160 and 2605.31602 with Yuhan Gai and Sakura Schäfer-Nameki]

Giuseppe Di Giulio

Local Quench from a Krylov Perspective

A local quench is a protocol in which a localized impurity is suddenly removed from the initial state, inducing an out-of-equilibrium quantum dynamics. In this talk, I will study this process from the perspective of the Krylov-space approach, which projects the evolution of a quantum state onto an effective one-dimensional dynamics. This framework has found applications in quantum information, many-body physics, and quantum gravity. Within this approach, the spread complexity quantifies the size of the space of states explored during the evolution. I will discuss its behavior after a local quantum quench in conformal field theories, showing in particular its dependence on the central charge of the theory. I will also show that, to isolate the universal features of the leading-time behavior, it is useful to consider another Krylov-space quantity: the K-entropy.

Coffe break

Francesco Galvagno

Exact results for bulk integrated correlators with line defects

In this talk, I will review recent developments on integrated correlators in 4d N=4 SYM in the presence of a half-BPS Wilson line. In particular, the two-point function of bulk operators belonging to the stress-tensor multiplet, integrated against a special measure, can be computed exactly in terms of a matrix model. This exact result can be used as a constraint in the bootstrap analysis of the bulk two-point function in the presence of a line defect and, from a holographic perspective, of the scattering process on a long string. Finally, we argue that similar results can be obtained for other classes of defects and extended branes.

Matthew Roberts

Magnetic defects and new RG monotones

We study conformal magnetic defects corresponding to an infinitely long and thin magnetic solenoid in the context of supersymmetric quantum field theory. In four dimensions this co-dimension two defect has one new A-type trace anomaly coefficient b, which is monotonic under defect RG flows and depends nontrivially on the magnetic flux. We study these defects in a UV and IR fixed point of a bulk RG flow to strong coupling and demonstrate that b is no longer monotonic. However, we find that a particular combination of anomaly coefficients, 12 a - b, is monotonic, and conjecture that this is true for general 4d/2d defects. We also study the 3d/1d system, which has no trace anomaly, though we can still define a ``defect free energy", which also appears to be monotonic.

Zimo Sun

Extraordinary Surface Criticalities for Interacting Fermions II

This is the second of two talks on this topic. I focus on the large N derivation of the extraordinary surface defect of the 3d Gross-Neveu-Yukawa CFT. I will explain in detail the emergence of a defect conformal manifold in the strict large N limit, which is lifted to an isolated fixed point by 1/N corrections. At this fixed point, N chiral Majorana fermions emerge as localized surface degrees of freedom.

Wednesday, June 17

Francesco Benini

Quantum-information methods to quantify symmetry breaking

Entanglement asymmetry is a measure of symmetry breaking in quantum subsystems, inspired by quantum information theory, particularly suited to study out-of-equilibrium states. I will overview this observable, highlighting some of the key phenomena it captures, such as a quantum Mpemba effect. I will present computations in topological and conformal field theories, commenting on relations with the Coleman-Mermin-Wagner theorem. In the second part of the talk I will describe how to define and compute the asymmetry for higher and noninvertible (or categorical) symmetries, and the role played by anomalies and boundary conditions.

Inaki Garcia-Etxebarria

TBA

Thursday, June 18

Marco Meineri

Defects and protected operators at the boundary of AdS

I will present a mechanism that ensures that conformal defects placed at the boundary of Anti-de Sitter spacetime support operators whose dimension is protected. Some consequences of this fact on the physics of confinement in AdS and on the moduli of theories of quantum gravity will be discussed as well.

Alessandro Vichi

TBA

Friday, June 19

Fiona Burnell

TBA

Erik Tonni

Entanglement Hamiltonians in the presence of a boundary

The reduced density matrix of a spatial subsystem can be written as the exponential of the entanglement (modular) Hamiltonian, hence this operator contains a lot of information about the entanglement of the corresponding spatial bipartition. For some particular models, states and bipartitions, this operator is local, but in general it is expected to be non-local. We discuss the entanglement Hamiltonians of an interval for three different free quantum field theories in one spatial dimension, in their ground state: the massless Dirac field either on the half line or on the strip with an inhomogeneous background (the rainbow model), and the massive scalar field on the half line with Robin boundary conditions.

Monday, June 1

Yin-Chen He *(Perimeter)*

Fuzzy sphere for conformal defects

In this talk, I will introduce the "fuzzy (non-commutative) sphere regularization," a recently proposed non-perturbative approach to 3D CFTs, and explain how it offers a remarkably powerful and efficient tool for studying conformal defects and boundaries. I will first elucidate the basic idea —how the fuzzy sphere realizes 3D CFTs, and how a conformal defect is implemented in this framework. I will then dive into illustrative examples, showing how the scheme grants direct access to a wealth of defect data, including the defect operator spectrum, defect-changing operators, defect-bulk OPE, and the universal defect g-function, with the magnetic line defect of the 3D Ising CFT as the central example. I will then survey further progress, including conformal boundaries and spin impurities in the O(3) Wilson-Fisher CFT.

Wednesday, June 3

Sakura Schafer-Nameki *(Oxford University)*

Pedagogical Introduction to the SymTFT and Applications

By request of this week's organizers, I will give an introduction to the concept of the symmetry topological field theory (SymTFT). This has been a very useful tool to study generalized symmetries, and has allowed to put some order in the classification of phases, gapped and gapless with finite symmetries. Although the main utility of the SymTFT comes in the context of categorical symmetries, I will try to explain the ideas in the context of well-known group symmetries. At the end we may have time for a surprising new result, following from the SymTFT, regarding phase transitions without hidden symmetry breaking.

Short Talks

Lea Bottini *(IHES)*

Topological order enriched by non-invertible symmetry via anyon condensation

In this talk, I will discuss a notion of topological order enriched by a non-invertible symmetry. For invertible symmetry enriched topological order, a well-established formalisation is available in terms of a G-crossed braided fusion category. By considering the condensation of an arbitrary algebra of charges in a quantum double model, a generalisation of this framework naturally emerges. In particular, I will show that the topological order after condensation can be described as a hypergroup-graded extension of the category of deconfined excitations. This has a hypergroup symmetry which acts in a typically non-invertible manner on the confined and deconfined excitations, in a way that is compatible with the grading. I will illustrate the general theory through a simple example.

Nayan Myerson-Jain *(Yale University)*

Rényi defect criticality and entropy and in (2+1)d QCPs

Universal components of entanglement entropies in QCPs capture important information about the IR CFT. Surprisingly, in 2d lattice models with irrelevant anisotropy, numerical evaluation of the 2nd Rényi entropy yields results that differ based on a choice of entangling surface. The entangling surface manifests as a codimension-2 conical defect in the path integral, and under a Weyl transformation, is mapped to the boundary of the n-fold cover of S^1 x AdS_d. We discuss the landscape of Rényi conical defect, or boundary, fixed-points in the O(N) model as a possible resolution to this puzzle.

Coffe break

Pierluigi Niro *(SISSA)*

From QED_3 to the multicritical point of the Fradkin-Shenker model

The Fradkin-Shenker model in 2+1 dimensions, which is equivalent to the toric code deformed by an in-plane magnetic field, is a paradigmatic example of Higgs-confinement continuity. Its phase diagram contains a multicritical point where mutually non-local electric and magnetic excitations, exchanged by a self-duality symmetry, become simultaneously massless. We propose a continuum QFT description in terms of QED_3 with two charge-1 Dirac fermions and a charge-2 Higgs field with Yukawa couplings, deformed by monopole operators. Finally, we conjecture a multicritical duality of the latter theory with a suitable deformation of the easy-plane CP^1 model.

Abhinav Prem *(IAS, Princeton)*

Intrinsically Mixed-State Topological Order

I will discuss progress in classifying and characterizing mixed-state topological phases. In particular, I will introduce the notion of "locally detectable excitations" in the context of 2+1D intrinsically mixed-state topological order.

Thursday, June 4

Ryohei Kobayashi *(IAS, Princeton)*

Automorphism in gauge theory and Clifford-hierarchy stabilizer codes

We study automorphism in twisted gauge theories and discover they can give rise to generalized symmetries such as higher group and/or non-invertible symmetries. In the context of quantum error-correcting codes, the emergent symmetries of stabilizer codes give rise to transversal logical gates. Using the automorphism symmetry, we discover transversal non-Clifford logical gates such as T gate in non-Clifford stabilizer models in 2D as well as transversal CCZ gate in 5D self correcting non-Abelian quantum memory.

Hubert Saleur *(IPhT CEA, Saclay)*

O(3) sigma model, XXX spin chains and t'Hooft anomalies

I will discuss the Z_2 (inversion symmetry) t'Hooft anomaly in the O(3) sigma model and in its XXX spin chain lattice regularization. This will involve, among other considerations, a discussion of intriguing features of the spin chain with an odd number of sites, and the role of the Pin groups.

Friday, June 5

Ilya Gruzberg *(Ohio State University)*

Multifractals at Anderson transitions and the Coulomb gas: a (b)CFT perspective.

Anderson (and quantum Hall) transitions are quantum critical points in disordered electronic systems. A common feature of these transitions is the multifractal (MF) nature of critical wave functions and their correlations encoded in continuous spectra of scaling dimensions. These so-called MF spectra are different in the bulk and near a boundary of the system. The precise nature of the critical theories for Anderson transitions is mostly unknown. However, assuming that MF observables are primaries in a conformal field theory (CFT) satisfying simple (Abelian) fusion rules, one can derive strong constraints on the MF spectra. In two dimensions, this reasoning leads to the unique description of MF observables as vertex operators in a Coulomb gas CFT with simple modifications near boundaries. We discuss possible extensions of this circle of ideas to higher dimensions.