Recent Progress in Statistical Mechanics
(Org: **Vojkan Jakšić** (McGill) and/et **Renaud Raquépas** (New York University))

NICHOLAS BARNFIELD, McGill University
On the Ziv-Merhav theorem beyond Markovianity

In 1993, Ziv and Merhav proposed a "new notion of empirical informational divergence", or relative-entropy estimator which has met great practical application, yet has seen no significant development in the mathematical literature until recently. In this talk, I will compare their algorithm with more conventional universal entropic estimators and discuss a recent generalization of the Ziv-Merhav Theorem. This extension encompasses a broader class of decoupled measures including the the class of multi-level Markov measures covered by the original result as well as suitably regular g-measures amongst other examples.

Joint work with R. Grondin, G. Pozzoli, and R. Raquépas.

LIA BRONSARD, McMaster University
Boundary defects in liquid crystals/ Défauts aux limites dans les cristaux liquides

We study the effect of "weak" and "strong" boundary conditions on the location and type of defects observed in a Landau de Gennes thin-film model for liquid crystals. We study both the minimizers of the associated Ginzburg-Landau energy as well as the Gamma limit when the correlation length tends to zero. These represent joint works with S. Alama and L. van Brussel, as well as with A. Colinet.

Nous étudions l'effet des conditions aux limites "faibles" et "fortes" sur l'emplacement et le type de défauts observés dans un modèle film mince de Landau de Gennes pour les cristaux liquides. Nous étudions à la fois les minimiseurs de l'énergie de Ginzburg-Landau associée ainsi que la limite Gamma lorsque la longueur de corrélation tend vers zéro. Il s'agit de travaux conjoints avec S. Alama et L. van Brussel, ainsi qu'avec A. Colinet.

ALEXANDER FRIBERGH, Université de Montréal
Biased random walks on supercritical percolation clusters

We will study the existence, and non-existence, of scaling limits for the biased random walks on the supercritical percolation cluster in the zero-speed regime. This is joint work with Alan Hammond.

RAPHAËL GRONDIN, McGill University
A different approach to the Ziv-Merhav Theorem

This talk will present an almost-sure convergence result for a slight modification of the Ziv-Merhav cross-entropy estimator introduced in Nicholas's talk. This result encompasses examples which were not covered by our latest work such as hidden-Markov measures and unraveling of repeated quantum measurements, satisfying some mild decay assumptions. Our approach is based on the study of a rescaled cumulant-generating function called the cross-entropic pressure, which makes an analogy with the study of large deviations in statistical mechanics.

ELIAS HESS-CHILDS, New York University
Propagation of chaos from the perspective of perturbation theory

In this talk, I present my recent work on the mean-field behaviour of diffusions in the torus with bounded pairwise interaction. Using a perturbative expansion of the probability density marginals and iterating inequalities derived from the BBGKY hierarchy, I give sharp higher-order corrections to propagation of chaos. Joint work with Keefer Rowan.

BENJAMIN LANDON, University of Toronto
Tail estimates for stationary KPZ models

The limiting distributions of observables in the KPZ universality class exhibit tail exponents of $\frac{3}{2}$ and 3. In this talk we will review recent work studying the upper tail exponent $\frac{3}{2}$ in the moderate deviations regime of several KPZ models at finite size, including the stochastic six vertex model, the ASEP and a class of non-integrable interacting diffusions.

Joint work with C. Noack and P. Sosoe

GILLES PAREZ, Université de Montréal
The range of entanglement

The investigation of entanglement in quantum many-body systems is a prominent research area, at the intersection of condensed matter, statistical mechanics and quantum information. In particular, quantifying entanglement in quantum critical systems provides us with strong insights regarding universal features of the phase transition. Due to the power-law decay of correlations at quantum critical points, it is generally believed that these systems exhibit long-range entanglement between separated regions. In this talk, I will challenge this basic idea by showing that the long-distance entanglement depends greatly on the bosonic or fermionic nature of the model: bosonic theories lack such entanglement, while theories with fermions are substantially more entangled. I will also discuss the generalization of these results to the important case of multipartite systems.

Joint work with W. Witczak-Krempa (Université de Montréal), based on arXiv:2310.15273.

JACOB SHAPIRO, Princeton University
Classification of disordered insulators in 1D

In this talk I will describe some of the mathematical aspects of disordered topological insulators. These are novel materials which insulate in their bulk but (may) conduct along their edge; the quintessential example is that of the integer quantum Hall effect. What characterizes these materials is the existence of a topological index, experimentally measurable and macroscopically quantized. Mathematically this is explained by applying algebraic topology to the space of appropriate quantum mechanical Hamiltonians; I will survey some recent results mainly concentrating on the classification problem in one dimension, where the problem reduces to studying spaces of unitaries (resp. orthogonal projections) which essentially-commute with a fixed projection.

ISRAEL MICHAEL SIGAL, University of Toronto
Some Rigorous Results on Propagation of Quantum Information

In this talk I present some recent results on evolution of quantum correlations and states, and on quantum messaging in general many-body quantum lattice systems. The proofs are derived from a new type of the Lieb-Robinson bound. The talk based on a joint work with Jérémy Faupin, Marius Lemm and Jingxuan Zhang.

LUC VINET, IVADO/CRM, Université de Montréal
Entanglement of free fermiom systems, signal processing and algebraic combinatorics

Recent advances in the study of the entanglement entropy of free fermions will be presented and their connection with elements of signal processing and algebraic combinatorics will be stressed.

Work done in collaboration with Pierre-Antoine Bernard, Nicolas Crampé, Rafael Nepomechie, Gilles Parez et al.