

# Workshop Schedule

Events for:  
**Monday, January 6th - Wednesday, January 8th**

## Monday, January 6th

10:30am **Coffee Break - SCGP Cafe**

11:00am **Shiu - SCGP 102**

**Speaker:** Gary Shiu

**Title:** TBA

11:45am **Hashimoto - SCGP 102**

**Speaker:** Koji Hashimoto

**Title:** Deep learning and AdS/CFT

12:30pm **Lunch Break - SCGP Cafe**

2:00pm **Erbin - SCGP 102**

**Speaker:** Harold Erbin

**Title:** Casimir effect and 3d QED from machine learning

**Abstract:** The last years has seen efforts towards bringing the tools of machinelearning to lattice QFT. I will present two recent results on lattice QFT: 1) computing the Casimir energy for a 3d QFT with arbitrary Dirichlet boundary conditions, 2) predicting the critical temperature of the confinement phase transition in 2+1 QED at different lattice sizes.

2:45pm **Lukas - SCGP 102**

**Speaker:** Andre Lukas

**Title:** String Data and Machine Learning.

**Abstract:** The talk will discuss two applications of machine learning techniques to problems which arise in the context of string model building. In the first part I will show how machine learning can help understand line bundle cohomology of complex manifolds. In the second part, I apply machine learning to a data set of string standard models.

3:30pm **Coffee Break - SCGP Cafe**

4:00pm **Discussion - SCGP 102**

**Title:** Discussion

**Tuesday, January 7th**

9:45am **Sulkowski - SCGP 102**

**Speaker:** Piotr Sulkowski

**Title:** Knots and data science?

10:30am **Coffee Break - SCGP Cafe**

11:00am **Hughes - SCGP 102**

**Speaker:** Mark Hughes

**Title:** Machine and reinforcement learning for constructive proofs in topology

11:45am **Berman - SCGP 102**

**Speaker:** David Berman

**Title:** Strings and Restricted Boltzman Machines?

12:30pm **Lunch Break - SCGP Cafe**

2:00pm **Cheng - SCGP 102**

**Speaker:** Miranda Cheng

2:45pm **Gong Show - SCGP 102**

**Title:** Gong Show

3:30pm **Coffee Break - SCGP Cafe**

4:00pm **Wang - SCGP 102**

**Speaker:** Jin Wang

**Title:** Landscape-flux of nonequilibrium multiverse and time arrow

### Wednesday, January 8th

9:45am **Vaudrevange - SCGP 102**

**Speaker:** Patrick Vaudrevange

**Title:** Machine Learning towards particle physics from strings

**Abstract:** The landscape of four-dimensional string models is of enormous size and, hence, still widely undiscovered. Therefore, it is reasonable to assume that there are many islands of MSSM-like string models to be found in this landscape. In this talk, we give an overview of recent progress in the case of the heterotic orbifold landscape using various techniques from machine learning. In more detail, we present i) an autoencoder neural network to identify structures in this landscape, ii) contrast patterns to construct new MSSM-like string models in special corners of the landscape and, finally, iii) neural networks to predict the stringy origin of the MSSM.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Han - SCGP 102**

**Speaker:** Xizhi Han

**Title:** Deep learning quantum geometry in matrix models

**Abstract:** We employ machine learning techniques to provide accurate variational wavefunctions for matrix quantum mechanics, with multiple bosonic and fermionic matrices. Variational quantum Monte Carlo is implemented with deep generative flows to search for gauge invariant low energy states. The ground state, and also long-lived metastable states, of an  $SU(N)$  matrix quantum mechanics with three bosonic matrices, as well as its supersymmetric 'mini-BMN' extension, are studied as a function of coupling and  $N$ . Known semiclassical fuzzy sphere states are recovered, and the collapse of these geometries in more strongly quantum regimes is probed using the variational wavefunction. We then describe a factorization of the quantum mechanical Hilbert space that corresponds to a spatial partition of the emergent geometry. Under this partition, the fuzzy sphere states show a boundary-law entanglement entropy in the large  $N$  limit.

11:45am **Vishnu Jejjala - SCGP 102**

**Speaker:** Vishnu Jejjala

12:30pm **Lunch Break - SCGP Cafe**

2:00pm **Westphal - SCGP 102**

**Speaker:** Alexander Westphal

**Title:** Inflation as an information bottleneck

2:45pm **Rudelius - SCGP 102**

**Speaker:** Tom Rudelius

**Title:** Learning to Inflate

**Abstract:** Motivated by machine learning, we introduce a novel method for randomly generating inflationary potentials, treating the Taylor coefficients of the potential as weights in a single-layer neural network and using gradient ascent to maximize the number of e-folds of inflation. We study the phenomenology of the models along the gradient ascent trajectory, finding substantial agreement with experiment for large-field local maximum models and small-field inflection point models. We speculate on possible uses for machine learning in model-building.

3:30pm **Coffee Break - SCGP Cafe**

4:00pm **Raghuram - SCGP 102**

**Speaker:** Nikhil Raghuram

**Title:** On Calabi-Yau Metrics and Neural Networks

**Abstract:** Metrics on compactification spaces such as Calabi-Yau manifolds are important for determining physical properties of string models. Yet there are few analytic expressions for these metrics. In this talk, I will describe an approach for numerically calculating the metrics on compactification spaces with neural networks. Our method is based on previous work that uses neural networks to solve partial differential equations. In addition to providing details about our approach, I will present some early, preliminary results.

5:00pm **Outlook by Mike Douglas - SCGP 102**

**Speaker:** Mike Douglas

**Title:** Outlook