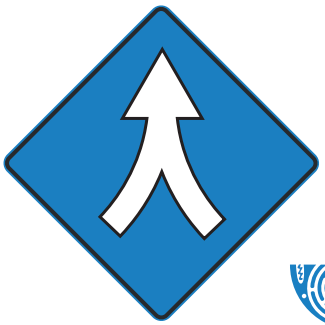
The NSF-Simons National Institute
for Theory and Mathematics in Biology



NITMB MathBio Convergence Conference

National Institute for Theory and Mathematics in Biology
Funded by the U.S. National Science Foundation and the Simons Foundation

Chicago, Illinois

11-14 August 2025

Conference Schedule

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SIMONS FOUNDATION

Monday Schedule

(**boldface** indicates a plenary talk)

07:00-08:30		Breakfast at the Drake
08:30-09:00	Liam O'Brien	Structural causes of pattern formation and loss through model-independent bifurcation theory
09:00-09:30	Amlan Nayak	Unraveling prey evasion mechanisms in zebrafish
09:30-10:30	**Anna-Liisa Laine**	**Uncovering the determinants of disease risk and within host-pathogen diversity in natural systems**
10:30-11:00		Break
11:00-11:30	Haina Wang	Rigidity homeostasis of the actin cortex via tension-sensitive filament and crosslinker dynamics
11:30-12:00	Ryan Robinett	Novel quantification of morphological variation in D. Melanogaster wings using the Wasserstein-Fisher-Rao metric
12:00-12:30	Palash Sashittal	Inferring cell lineage trees and differentiation maps from lineage tracing data
12:30-13:30		Lunch at the Drake
13:30-14:00	Eleanor Degen	Bicoid-nucleosome competition sets a concentration threshold for transcription constrained by genome replication
14:00-14:30	Boya Hou	Multi-network RNA velocity
14:30-15:30	**Michael Hawrylycz**	**Discrete Morse graph construction for high-dimensional transcriptomic data**
15:30-16:00		Break
16:00-16:30		Networking/Meet the Speakers
16:30-18:30		Poster Session/Networking
16:30-20:00		Dinner on your own

Monday Posters

1	Dianzhuo Wang	Integrating biophysics and machine learning to understand viral evolution
2	Robert McDonald	Topological model selection: a case-study in tumour-induced angiogenesis
3	Kathryn Lynch	Gene regulation of toxicity and iron acquisition in Vibrio vulnificus
4	Stephen Cini	Engineering predictive biology: model-based experimentation for digital twin development
5	Idan Sorin	Instability of uniform oscillations in the spatially extended May-Leonard system
6	Angelica Pozzi	Advancing treatments of Tourette syndrome via thalamocortical modelling
7	Maalavika Pillai	Uncovering the hierarchical organization of human multilayer gene regulatory networks
8	Rahnuma Islam	Stochastic modeling of viral reproductive cycle: efficient computation of viral and cell extinction
9	Dwuengchwuan (Tony) Jhwueng	Stochastic modeling of morphological rate evolution: phylogenetic regression with approximate Bayesian computation
10	Idowu Ijaodoro	On generalizing the induced surface charge method to heterogeneous Poisson-Boltzmann models for electrostatic free energy calculation
11	Kayode Oshinubi	Forecasting West Nile virus in Maricopa County using climate factors
12	Alex Kunin	Beyond convex codes: neural rings in boolean matrix factorization
13	Joel Dokmegang	Spectral decomposition unlocks Ascidian morphogenesis
14	Soumyadipta Ray	The role of apical junctional protein NMII in regulating epithelial morphology in mouse villus
15	Nana Ankrah	Metabolic modeling to interrogate microbiome function
16	Alexander Simmons	Characterization of microtubule dynamic instability using artificial intelligence
17	David Nicholas Reynolds	Rayleigh-friction driven models of collective dynamics: flocking, consensus, and synchronization
18	Woody March-Steinman	An ensemble learning method for generic track annotation in live cell imaging
19	Audrey Nash	Decoding oral temperature from gustatory cortex activity in freely licking mice
20	Lianzhang Bao	Vanishing-spreading dichotomy in a two-species chemotaxis competition system with a free boundary
21	Huseyin Ayhan	A topological framework for simultaneously recorded network activity
22	Dilimulati Aierken	Graph analysis of interaction networks within biomolecular condensate reveals distinct distributions of topological hubs and cliques

23	Emerald Win	Modeling a chemical signaling network to regulate cellular cytoskeletal components in the cross section of the Drosophila wing disc
24	Kayode Oluwasegun	Theoretical advances in population models with free boundaries: existence results
25	Minki Lee	A mathematical and digital approach to assess real-world dynamics of circadian rhythms, sleep, and psychiatric disorder risks from wearables
26	Jonathan Pachter	Information and optimization in Markov decision process models of drug protocols
27	Tianyong Yao	Spatial pattern formation in eco-evolutionary games with environment-driven motion
28	Feihong Xu	Robust extraction of pneumonia-associated clinical states from electronic health records
29	Sai Bavisetty	Entropy as an upper bound for stability in Boolean networks
30	Shoshana Chipman	Non-perturbative techniques for nonlinear noise in neural networks
31	Samantha Petti	On Gaussian process methods for inferring genotype-phenotype maps
32	Apoorva Singh	Dissecting mechanisms of marginal zone B cell ontogenesis and homeostasis
33	Elizabeth Rubio	A novel mathematical model of Oropouche virus
34	Jen McClure	Model homogenization reveals insights into the spread of chronic wasting disease at large scales
35	Sayandeepa Raha	Modeling microtubule-associated-proteins (maps) driven phase separation
36	Alessandro Maria Selvitella	A mathematical model of hopping with stopping controlled by muscle damping instantaneous change: biological implications and limitations
37	Rose Johnson-Leiva	A multiscale model on hair follicle bulb replenishment and concentric layered differentiation
38	Katalin Anna Olasz	Stochastic agent-based modeling of Salmonella infections
39	Max Hill	Lower bounds on the sample complexity of species tree estimation when substitution rates vary across loci
40	Emily Wang	An unusually low-energy cofactor facilitates efficient energy transduction in the Nfn-1 redox enzyme
41	M.D. Sorique Aziz Momin	Mechanisms controlling the assembly dynamics of cytoskeletal structures in a shared pool
42	Oluwatosin Babasola	H5N1 dynamics and effectiveness of intervention strategies
43	Xiangyi Meng	Revealing the design principles of physical networks through surface optimisation

Tuesday Schedule

(**boldface** indicates a plenary talk)

07:00-08:30		Breakfast at the Drake
08:30-09:00	Juliana Londono Alvarez	Attractor-based models for sequences and pattern generation in neural circuits
09:00-09:30	Hayden Nunley	Division asymmetries and their effects on cell cycles promote Drosophila melanogaster pole cell heterogeneity
09:30-10:30	**Reidun Twarock**	**Viruses under the mathematical microscope: viral geometry as a key to understanding viral infections**
10:30-11:00		Break
11:00-11:30	Ning Wei	The impact of ephaptic coupling and ionic electrodiffusion on arrhythmogenesis in the heart
11:30-12:00	Nonthakorn Olaranont	A cell-based mechanical model captures stress relaxation and flow in proliferating tissues with subcellular elasticity
12:00-12:30	Orlando Arguello Miranda	Biomolecular network discovery through GenAI-driven time series analysis in living cells
12:30-13:30		Lunch at the Drake
13:30-14:00	Andreas Buttenschoen	The dynamical system landscape underlying chirality bias in rotational doublets
14:00-14:30	Jason Kim	Geometric model manifold of space, time, and belief in hippocampal cognitive maps
14:30-15:30	**Lorin Crawford**	**Statistical opportunities in defining, modeling, and targeting cell state in cancer**
15:30-16:00		Break
16:00-16:30		Networking/Meet the Speakers
16:30-18:30		Poster Session/Networking
16:30-20:00		Dinner on your own

Tuesday Posters

1	Yue Liu	Bayesian parameter inference of complex pattern formation in agent-based models using topological data analysis
2	Christopher Ryzowicz	Dynamic homeostasis in relaxation and bursting oscillations
3	Sean Campbell	Distributed delay improves the dynamics of gene regulation
4	Matthew Stahl	Advances in interface-fitted tetrahedral mesh generation for ion channel models: preserving pore topology and enhancing computational efficiency with ICMPv3
5	Colin Klaus	Quantifying the limits of electrophysiological single-cell recordings for estimating photoreceptor kinetics in visual transduction by Bayesian inference
6	Carlos Castañeda Castro	Dynamical motivated analysis of connectome data
7	Suraj Powar	Was lockdown the optimal strategy? insights for devising intervention and control frameworks using compartmental modeling: a case study of COVID-19 transmission in illinois
8	Arnab Dey Sarkar	Emergence of multirhythmicity in cortical networks with two types of inhibition
9	Siwei Wang	Self-supervised learning for discovery of complex patterns in neural time series
10	Garrett Young	Identifying drug targets with a reduced model for competitive inhibitor stimulation
11	Hardik Rajpal	Information-theoretic emergence in biological complex systems
12	Binod Pant	Analyzing human behavior data and modeling the impact of human behavior on SARS-CoV-2 transmission dynamics
13	Maximillian Newman	Correlation of coalescent trees in population genetics
14	Richard Foster	Time-series modeling of human temporal eeg responses to randomly alternating visual stimuli
15	Trong-Thuc Trang	Covering relations in the poset of combinatorial neural codes
16	Nour Khoudari	Topological data analysis of zebrafish skin patterns: a sweeping filtration approach
17	Madi Yerlanov	Investigation of pattern formation in urban crime models with law enforcement
18	Duncan Martinson	Spatial analysis provides robust, precise, and agnostic quantification of zebrafish patterns
19	Sahana Senthilkumar	Artificial intelligence and machine learning approaches investigating metabolomics data for precision medicine
20	Hailey Lynch	Modeling drug perfusion in complex soft matter systems
21	Dominique Hughes	The effect of thresholding on group comparison of graph theory metrics
22	Obinna Ukogu	Immune control of the gut microbiota
23	Bradley Theilman	Decomposing spiking neural networks with graphical neural activity threads

24	Manuela Costantino	Gene-environment interactions partly depend on phenotype scale
25	Zhuojun Yu	How the dynamic interplay of cortico-basal ganglia-thalamic pathways shapes the time course of deliberation and commitment
26	Fathima Nuzla Ismail	Multilayer co-expression networks: mathematical insights into gene expression variability and regulatory interplay
27	Adam O'Regan	A repurposed nonstationary time series heuristic captures domain architecture in synthetic Hi-C matrices
28	Colleen Mitchell	Metabolic kinetic flux profiling
29	Zainab Dere	Optimizing viral interventions to mitigate antibiotic resistance
30	Olenka Jain	The role of cell geometry in cytoplasmic streaming
31	Carles Falco	Modelling adhesion-based interactions in collective cell migration
32	Anne Talkington	Quantifying and perturbing immune activity in the solid tumor microenvironment
33	Rayanne Luke	Probabilistic modeling of antibody kinetics post infection and vaccination
34	Hwai-Ray Tung	Missed an antibiotic dose - what to do?
35	Spencer Gales	Bioreactor model of methane utilization for product synthesis via engineered biofilm
36	Binan Gu	A graph-theoretical network model for nutrient flow in tissue engineering scaffolds
37	Jasmine Kreig	A mathematical model of viral rebound after treatment interruption in HIV infected individuals
38	Priyanka Mondal	Modelling plant-aphid interactions with Holling type-II functional response and adaptive ant-plant cooperative relationships
39	Safaan Sadiq	Modeling bias in decision-making attractor networks
40	Samares Pal	Catastrophic changes in coral reef dynamics under macroalgal toxicity, elevated sea surface temperature (sst), overfishing and invasion of predators
41	Mushal Zia	Persistent directed flag Laplacian (PDFL)-based machine learning for protein-ligand binding affinity prediction

Wednesday Schedule

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07:00-08:30		Breakfast at the Drake
08:30-09:00	Selimzhan Chalyshkan	An ensemble modeling framework to predict synapses from optokinetic stimuli in larval zebrafish
09:00-09:30	Harrison Oatman	Modeling mitotic wave origins in Drosophila Melanogaster
09:30-10:30	**Alexander Aulehla**	Cycles upon cycles - collective rhythms during embryonic development
10:30-11:00		Break
11:00-11:30	Priyom Adhyapok	A biological oscillator controls mineralization of the zebrafish spine
11:30-12:00	Connor Shrader	Modeling genetic drift and selection in spermatogonial stem cell dynamics
12:00-12:30	Paola Malerba	The space-time dynamics of sleep oscillations and its implications for cognition and health.
12:30-13:30		Lunch at the Drake
13:30-14:00	Daniel Cruz	Personalizing agent-based models to construct medical digital twins
14:00-14:30	Sidney Holden	A continuum limit for dense spatial networks
14:30-15:30	**Carina Curto**	**Graphical domination and inhibitory control in recurrent networks**
15:30-16:00		Break
16:00-16:30		Networking/Meet the Speakers
16:30-18:30		Poster Session/Networking
16:30-20:00		Conference Dinner at the Drake

Wednesday Posters

1	Srivarshini Ganesan	Deep generative protein design using multimodal sequence-structure-text conditioning
2	Chen Cheng	Quantifying population-level robustness for distribution shift
3	Alexander Diefes	Spatiotemporal modeling of extracellular DNA (eDNA) dynamics in biofilms
4	Thi Quynh Nga Nguyen	A control strategy for the sterile insect technique using exponentially decreasing releases to avoid the hair-trigger effect
5	Brandon Lukas	TFSage: compendium-powered search engine for transcription factor binding and gene regulatory network inference
6	Kemal Keseroglu	Tissue self-organization tunes the period of somite segmentation
7	Willem Nielsen	Towards computational foundations of medicine
8	Savannah Williams	Mathematical models of ovulation: a parameter sensitivity analysis
9	Farshad Shirani	Infinite-dimensional dynamics, spatiotemporal gamma oscillations, and balance of excitation and inhibition in cortical networks
10	Liam Jemison	A nonlocal size-modified Poisson-Boltzmann model for VDAC
11	Bharadwaj Vemparala	Preservation of functional memory CD8 T cells with early treatment initiation underlies sustained post-treatment control of HIV infection
12	Yifan Zhang	The flywheel effect in the Pdu metabolic pathway
13	Claire Christian	Modeling the Mhrt gene regulatory network
14	Siddarth Achar	Gentlest ascent dynamics for rapid exploration of energy landscapes
15	Yi-Chun Hung	Neural population code adaptation under changing metabolic constraints
16	Alyssa Wenzel	Topologically informed model selection of agent-based models for collective cell motion
17	Rholee Xu	Impact of spatial cell wall elastic moduli on modeling of tip growth and morphogenesis
18	Cameron Watt	Analysis of colon motor patterns in the proximal colon
19	Joseph Nasser	A calculus for transcription
20	Sayandeepa Raha	Understanding nonequilibrium steady state(s) in dynamical systems of microtubules
21	Carli Peterson	A SIMPL model of phage-bacteria interactions accounting for mutation and competition
22	Yuta Hozumi	Topological insights into viral evolution via k-mer topology
23	Mehrdad Zandigohar	Variational inference of transcription factors
24	Xin Cao	Geometric methods for constrained molecular structure refinement

25	Marium Yousuf	Causality in replay: detecting effective connectivity from spike trains
26	Arjun Sohur	How rainfall variability impacts vegetation pattern formation in drylands
27	Thomas Fai	Nuclear size control by osmotic forces in S. pombe
28	Purba Biswas	Graph theoretic analyses of tessellations of aperiodic polykite unitiles
29	Anh Nguyen	Auditory encoding modeling using neural networks
30	Amanda Alexander	Plasmid loss in spatially constrained microbial populations
31	Ethan Nowaski	Computational model of eversion of Drosophila wing
32	Thuy Linh Do	Changepoint detection problems and application on particle tracking in live cells
33	Kitrick Fynaardt	A delay differential equation interpretation of the Leinheiser et al. mitochondrial fission model
34	Taylor Kennedy	Accurate reconstruction of cellular time series using linear, Gaussian, and deep learning models
35	Zelong Li	Attractor degeneracy in threshold-linear networks
36	Ted Galanthay	Evolution of aggression in consumer-resource models
37	Anna Leinheiser	A dynamical systems model for the total fission rate in Drp1-dependent mitochondrial fission
38	Skylar Sargent Walters	Vyriad: a deep learning framework to catalyze viral discovery and identification from metagenomic datasets
39	Youssof Abdullah	Stability analysis of Markov models of voltage-gated ion channels mediated action potential generation
40	Veronika Koren	An efficient multilayer spiking network as a model of ascending sensory pathways
41	Nizhum Rahman	Tug-of-war in axonal transport: a model of large vesicle transport driven by kinesins and dynein
42	Connor Olson	Multiple rational behaviors during an epidemic with reservoir infection
43	Chirantha Piyamal Bandara	Immunological and epidemiological modeling of HIV/AIDS: a nutritional perspective

Thursday Schedule

07:00-08:30	Breakfast at the Drake
08:30-10:00	Open House at NITMB
10:00-11:30	Career Development Workshop at NITMB (more details to follow)
10:00-11:30	Return to the Drake
12:00-13:00	Lunch
13:00	Conference Ends