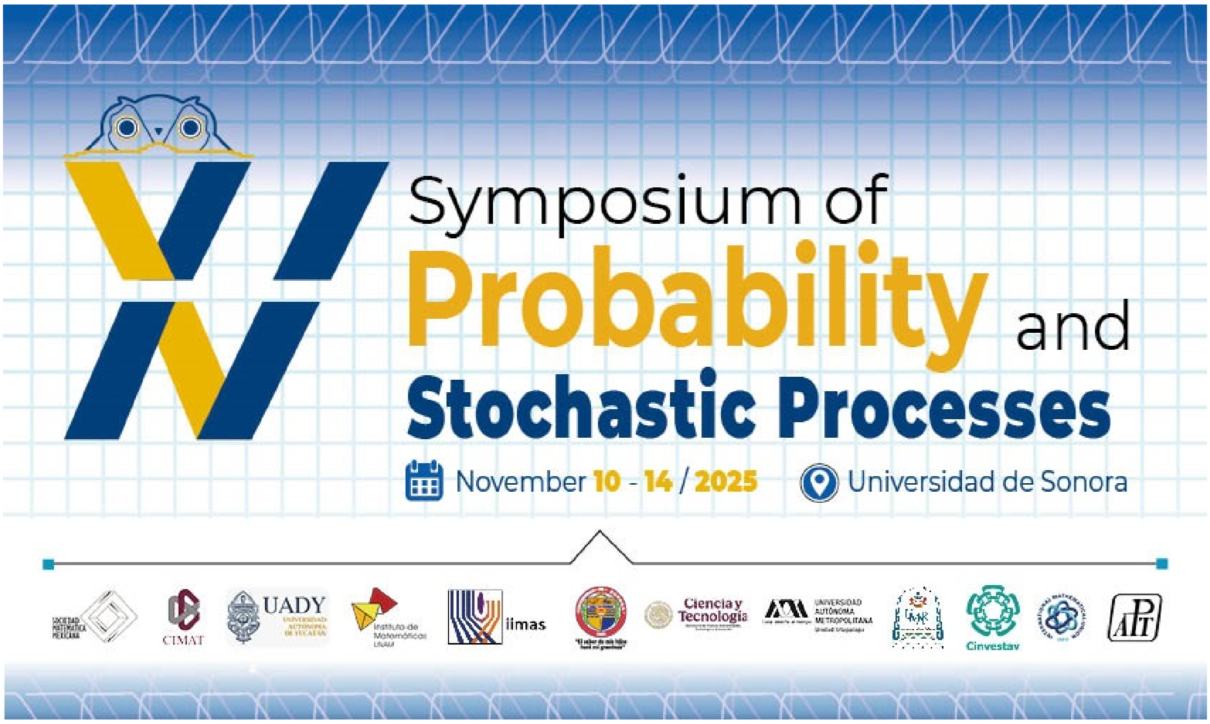

Programme

November 10–14, 2025

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8:15-8:45	Registration				
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9:30-10:00					
10:00-10:30	Sunder Sethuraman - Sesión 1	Jason Schweinsberg		Sunder Sethuraman - Sesión 4	Víctor Rivero
10:30-11:00			Coffee Break		
11:00-11:30	Coffee Break	Coffee Break	Ioana Dimitriu	Coffee Break	Coffee Break
11:30-12:00	Gabriel Nuñez	Gerónimo Uribe - Sesión 2		Session Stochastic Control Theory	Session Information Theory
12:00-12:30			Taller: Síndrome del impostor		
12:30-13:00	Session RM, G & C (Part 1)				
13:00-15:00	Lunch	Lunch *Photo (13:00)	Lunch	Lunch	End of Activities
15:00-15:30	Session Random Matrices, Graphs, and Combinatorics	Session Population Genetics		Mei Yin	
15:30-16:00					
16:00-16:15	Coffee Break			Posters	
16:15-16:30	Session Stochastic Differential Equations				
16:30-16:45		Coffee Break		Coffee Break	
16:45-17:15		Conversatorio: Trayectorias académicas		APT Talk: Natalia Cardona	
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17:45-19:00	Welcome reception	Informal Gathering: Aleatorias y Normales		Get-Together	

Plenary Lectures

Plenary 1

Title: From subjective Probability to Bayesian modeling of real phenomena
Speaker: Gabriel Núñez (*UAM, Mexico*)
Time/Room: Mon, Nov 10, 11:30–12:30; *Auditorium*
Abstract. Bayesian modeling of real phenomena is associated with probabilistic and statistical data analysis. From a theoretical point of view, the Bayesian approach to Statistics is an axiomatic paradigm which has its foundations in Statistical Modeling, Decision Theory, Information Theory and, under what is known as Subjective Probability. Although the definition of a probability measure is well known, there are different interpretations or approaches to it.

In this talk I will discuss the different approaches that have been used over the years when a probability measure is used for describing real phenomena. I will show the basic elements for carrying out probabilistic inferences from a Bayesian approach to statistics. In addition, I will present an example in the context of ecology, where the objective is to draw conclusions about an overlap index between certain mammal species. This application will be the pretext to talk, on the one hand, about the correct treatment of random variables/data defined on the unit circle and, on the other hand, about infinite-dimensional probability models, which will lead us to talk about non-parametric mixture models based on the Dirichlet process. Finally, I will present some conclusions about my experience in applying Bayesian probabilistic models in the description of real phenomena.

Plenary 2

Title: Branch lengths for geodesics in the directed landscape and mutation patterns in growing spatially structured populations
Speaker: Jason Schweinsberg (*University of California, San Diego, USA*)
Time/Room: Tue, Nov 11, 10:00–11:00; *Auditorium*
Abstract. Consider a population that is expanding in two-dimensional space. Suppose we collect data from a sample of n individuals taken at random either from the entire population, or from near the outer boundary of the population. A quantity of interest in population genetics is the site frequency spectrum, which is the number of mutations that appear on k of the sampled individuals, for $k = 1, \dots, n-1$. As long as the mutation rate is constant, this number will be roughly proportional to the total length of all branches in the genealogical tree that are on the ancestral line of k sampled individuals. While the rigorous literature has primarily focused on models without any spatial structure, in many natural settings, such as tumors or bacteria colonies, growth is dictated by spatial

constraints. A large number of such two dimensional growth models are expected to fall in the so-called KPZ universality class, exhibiting similar features as the Kardar-Parisi-Zhang equation. For such models, we adopt the perspective that the genealogical tree can be approximated by the tree formed by the infinite upward geodesics in the directed landscape, a universal scaling limit constructed by Dauvergne, Ortmann, and Virag (2022), starting from n randomly chosen points. This leads to the prediction that the number of mutations inherited by k of the sampled individuals should be proportional to $k^{-7/5}$ when the sample comes from the entire population, and proportional to $k^{-1/2}$ when the sample comes from the outer edge of the population. The results verify and extend nonrigorous predictions of Fusco, Gralka, Kayser, Anderson, and Hallatschek (2016) and Eghdami, Paulose, and Fusco (2022). This talk is based on joint work with Shirshendu Ganguly and Yubo Shuai.

Plenary 3

Title: Extremal singular values of sparse rectangular random matrices
Speaker: Ioana Dumitriu (*University of California, San Diego, USA*)
Time/Room: Wed, Nov 12, 11:00–12:00; *Auditorium*

Abstract. We developed a unified approach to study the largest and smallest singular values of sparse rectangular random matrices, both above the critical $log(n)/n$ sparsity regime and at criticality. The approach is based on the non-backtracking operator and the Ihara-Bass formula for general Hermitian matrices with bipartite block structure, as well as on a graph-based approximation scheme developed by Alt, Ducatez, and Knowles (2019). Above criticality, the bounds are given in terms of the maximum and, respectively, minimum ℓ_2 norms of the rows and columns of the variance profile matrix, and they work for the inhomogeneous case. At criticality, we study the centered adjacency matrices of homogeneous Erdős–Rényi random graphs and find outlier thresholds depending on the aspect ratio. This is joint work with Yizhe Zhu, Haixiao Wang, and Zhichao Wang.

Plenary 4

Title: Parking functions: probabilistic and combinatorial
Speaker: Mei Yin (*University of Denver, USA*)
Time/Room: Thu, Nov 13, 15:00–16:00; *Auditorium*

Abstract. A parking function of length n is a sequence $\pi = (\pi_1, \ldots, \pi_n)$ of positive integers such that if $\lambda_1 \leq \cdots \leq \lambda_n$ is the increasing rearrangement of $\pi_1, \ldots, \pi_n$, then $\lambda_i \leq i$ for $1 \leq i \leq n$. We give a survey into parking functions, concentrating in particular on the probabilistic and combinatorial aspects. Joint work with multiple collaborators.

Plenary 5

Title: Critical non-local spatial branching processes with infinite variance conditioned on survival

Speaker: Natalia Cardona (*Universidad Nacional de Colombia, Colombia*)

Time/Room: Thu, Nov 13, 16:45–17:45; *Auditorium*

Session: In this talk, we consider the setting of either a general non-local branching particle process or a general non-local superprocess. Under the assumption that the mean semigroup has a Perron-Frobenious type behaviour in combination with a regularly varying assumption on the reproductive point process, which permits infinite second moments, we consider sufficient conditions that ensure limiting distributional stability when conditioned on survival at criticality. We offer two main results. Under the aforesaid conditions, our first main contribution establishes the polynomial decay in time of the survival probability in the spirit of a classical Kolmogorov limit. The second main contribution pertains to the stability, when conditioning on survival, in the spirit of a Yaglom limit. This is joint work with Andreas E. Kyprianou and Pedro Martín-Chávez (University of Warwick).

Abstract. abs

Plenary 6

Title: Stability of (sub)critical non-local spatial branching processes with and without immigration

Speaker: Víctor Rivero (*CIMAT, Mexico*)

Time/Room: Fri, Nov 14, 10:00–11:00; *Auditorium*

Abstract. In this talk, I will present some recent results for general non-local branching particle process or general non-local superprocess, in both cases, with and without immigration. Under the assumption that the mean semigroup has a Perron-Frobenious type behaviour, for the immigrated mass, as well as the existence of second moments, we consider necessary and sufficient conditions that ensure limiting distributional stability. More precisely, our first main contribution pertains to proving the asymptotic Kolmogorov survival probability and Yaglom limit for critical non-local branching particle systems and superprocesses under a second moment assumption on the offspring distribution. Our results improve on existing literature by removing the requirement of bounded offspring in the particle setting and to include non-local branching mechanisms. Our second main contribution pertains to the stability of both critical and sub-critical non-local branching particle systems and superprocesses with immigration. At criticality, we show that the scaled process converges to a Gamma distribution under a necessary and sufficient integral test. At subcriticality we show stability of the process, also subject to an integral test. In

these cases, our results complement classical results for (continuous-time) Galton–Watson processes with immigration and continuous-state branching processes with immigration.

Short Courses

Course A

Course: On fluctuations in interacting particle systems
Lecturer: Sunder Sethuraman (*Department of Mathematics, University of Arizona*)
Format: 4.5 hours (4 parts) total hours; **Room:** Auditorium
Schedule: Mon, Nov 10, 10:00–11:00; Tue, Nov 11, 9:00–10:00; Wed, Nov 12, 9:00–10:30; Tue, Nov 13, 10:00–11:00.

Abstract. In these talks, we consider a class of interacting particle systems on d dimensional lattices which model 'traffic' broadly understood. We discuss scaled fluctuation limits of local statistics, such as occupation times at sites and the motion of a distinguished, or tagged particle, as well as that of the bulk mass empirical density. A goal is to present some of the ideas in the subject, leading to open problems.

Course B

Course: A Pathwise Approach to the Random Change of Time
Lecturer: Gerónimo Uribe Bravo (*Instituto de Matemáticas, UNAM*)
Format: 4.5 hours (4 parts) total hours; **Room:** Auditorium
Schedule: Mon, Nov 10, 9:00–10:00; Tue, Nov 11, 11:30–13:00; Tue, Nov 13, 9:00–10:00; Fri, Nov 14, 9:00–10:00.

Abstract. Time-change equations are a generalization of ordinary differential equations which are driven by the random and possibly densely discontinuous sample paths of the typical stochastic process.

The weak theory of time-change equations was put forth by Doeblin in a quest to transform Brownian motion into a more general diffusion process. Perhaps the only well known instance of time-change equations (in the strong sense) appears in Volkonskii's or Lamperti's transformation between Markov processes.

Nowadays, time-change equations can lead to deep results on weak existence and uniqueness of stochastic differential equations and posses a robust and strong approximation theory. However, time-change equations are not restricted to Markovian or semimartingale settings.

In this course, we will survey theory and applications of time-change equations. In particular, we will use them to construct, by elementary means, classical stochastic processes of applied relevance, such as squared Continuous State Branching Processes with Immigration (including squared Bessel and CIR processes) and the Wright-Fisher diffusion. We will also look into their connection to other areas such as combinatorics (via discrete trees and forests) and to differential equations.

Thematic Sessions

Random Matrices, Graphs, and Combinatorics

Organizer: Marco Tulio Gaxiola Leyva
Time/Room: Mon, Nov 10, 11:30–13:00; *Auditorium*

Third-order cumulants of products

Sayle Sigarreta Ricardo (*Benemérita Universidad Autónoma de Puebla*) — *12:30–13:00*

Abstract. Free independence, introduced by Voiculescu, extends the classical notion of independence to a broader algebraic framework, with free cumulants serving as multilinear objects that describe this concept. Krawczyk and Speicher addressed the problem of computing cumulants of products in terms of individual cumulants. The theory of higher-order freeness, an extension of Voiculescu's Free Probability Theory, emerged from studying large random matrices, generalizing properties of first order cumulants. Under this line, Mingo, Speicher, and Tan later computed second order cumulants of products. In this work, we extend the previous result to third-order cumulants, including applications.

Infinitesimal distribution of finite free convolutions

Josué Vázquez-Becerra (*CIMAT*) — *13:00–13:30*

Abstract. Introduced independently by Szegö and Walsh in the 1920s, additive and multiplicative finite free convolutions are operations on the set of polynomials with real roots. In recent years, they have regained some interest after being rediscovered in the 2010s by Marcus, Spielman, and Srivastav in connection with Ramanujan bipartite graphs and the Kadison-Singer problem. The term finite free was added due to the fact that these operations converge to the additive and multiplicative convolution of measures from free probability of Voiculescu, so the former can be regarded as finite dimensional versions of the latter. In this talk, we will explaiin how to determine the infinitesimal distributions arising from these two operations, yielding a more precise description of the convergence to their counterparts from free probability. This is joint work with O. Arizmendi and D. Perales.

Polynomial approach to free probability

Katsunori Fujie (*Kyoto University*) — *13:30–15:00*

Abstract. Since the 2010s, when Marcus, Spielman, and Srivastava solved the Kadison–Singer conjecture and found a connection between its solution and free probability theory, this research area has been called finite free probability. Recent progress includes the finite free cumulants introduced by Arizmendi and Perales, which serve as a discrete analogue of the characteristic function in free probability. We will discuss a close connection

between polynomial differentiation and these cumulants, suggesting that the empirical root distributions of iterated derivatives converge to free fractional convolution. This perspective can be understood as the convergence of the finite free S-transform and naturally leads to limit theorems for finite free multiplicative convolution. The talk is based on joint work with O. Arizmendi (CIMAT), D. Perales (University of Notre Dame), and Y. Ueda (Hokkaido University of Education).

Stochastic Differential Equations

Organizer: Liliana Peralta Hernández
Time/Room: Mon, Nov 10, 16:15–17:45; *Auditorium*

The Fourier estimator of spot volatility: Unbounded coefficients and jumps in the price process

Erick Treviño Aguilar (*Unidad Cuernavaca del Instituto de Matemáticas, UNAM*) — *16:15–16:45*

Abstract. We present advances for the Fourier estimator of spot volatility introduced in the seminal papers Malliavin-Mancino 2009 and Malliavin-Mancino 2002. Our setting includes the following aspects. First, the volatility is required to satisfy an integrability condition, but otherwise allowed to be unbounded. Second, we give 'precise' convergence rates to the probability of a large error in the approximation allowing to obtain an almost sure convergence and not just in probability. Third, and last aspect in which we extend the Fourier estimator consists in the inclusion of jumps in the price process. A SDE plus a purely discontinuous local martingale, will show a main validation case.

Stochastic Optimal Control of Vaccine Inventory During Epidemics: Integrating SEIR dynamics with temperature-driven degradation and uncertain replenishment

Saúl Díaz Infante Velasco (*Departamento de Matemáticas, UNISON*) — *16:45–17:15*

Abstract. In this work, we explore how uncertainty shapes vaccine inventory dynamics during an outbreak. We built a stochastic optimal control model that connects a standard SEIR-style epidemic model with a vaccine inventory system — one where both temperature-sensitive degradation and random supply variability are explicitly accounted for. Think of storage losses driven by thermal fluctuations (which we model using a mean-reverting temperature process and Arrhenius kinetics), and unpredictable delivery schedules that can throw off even the best-laid plans. To analyze this messy interplay, we used a nonstandard finite-difference scheme and posed the control challenge as a Markov decision process — one that balances disease outcomes with inventory and logistical costs. Our simulations suggest that even modest thermal noise can quietly deplete stock, while erratic replenishment may shift the timing and scale of outbreaks in ways that deter-

ministic models simply miss. Our simulations suggest there's a risk of overestimating coverage if we ignore temperature-driven losses or assume fixed lead times. While our results are sensitive to assumptions — especially around temperature profiles and delivery uncertainty — they suggest that incorporating uncertainty quantification into both inventory control and epidemic response is less a luxury and more a necessity.

Distributions of Functionals of Brownian Motion and Connections to SPDEs
Eugenio Guerrero Ruiz (*Department of Mathematics, College of Natural Sciences, University of Puerto Rico*) — *17:15–17:45*
Abstract. In this talk we address the problem of deriving, as explicitly as possible, the distributions of integral functionals of Brownian motion of the form

$$\int_0^\infty f(W_s)ds,$$

where $\{W_t\}_{t\geq 0}$ is a standard Brownian motion in R. We will survey known results on the distributions of these functionals and present several results we have obtained using classical potential theory and Laplace transform methods. The talk will conclude by showing how these functionals naturally arise within the construction of upper and lower bounds for the finite-time blow-up of a coupled system of SPDEs with multiplicative noise. This work was in collaboration with José A. López-Mimbela, Ph.D.

Population Genetics

Organizer: Adrian González Casanova
Time/Room: Tue, Nov 11, 15:00–16:30; *Auditorium*

The TMRCA of populations with deterministically varying size
Alejandro Hernandez Wences (*IIMAS, UNAM*) — *15:00–15:30*
Abstract. In this talk I will present a recent work in collaboration with Lizbeth Peñaloza, Arno Siri-Jégousse and Matthias Steinrücken. We study the time to the most recent common ancestor (TMRCA) of a sample of finite size in a wide class of genealogical models for populations with deterministically varying size. This is made possible by recently developed results on inhomogeneous phase-type random variables, allowing us to obtain the density and the moments of the TMRCA of time-dependent coalescent processes in terms of matrix formulas. With these results, the TMRCA provides an explanatory variable to distinguish different evolutionary scenarios, and to infer model parameters.

A general mother-dependent neutral mutation model conditioned on late extinction

María Clara Fittipaldi (*Facultad de Ciencias, UNAM*) — *15:30–16:00*

Abstract. We are interested in studying the genealogical structure of alleles in a Bienaymé–Galton–Watson (BGW) process with neutral mutation and finitely many alleles conditioned on late extinction. Our focus is on the general mother-dependent mutation model, where each mutant child acquires a type different from that of its mother, chosen according to a given mutation matrix. In particular, we study the multitype-mutant chain conditioned on late extinction. We describe the mutant process in an explicit way, using its relationship with the mutant chain studied by Bertoin for the infinite-alleles case. Based on joint work in progress with Airam Blancas (ITAM) and Saraí Hernández-Torres (IM–UNAM).

Spatial stochastic models for population dynamics

Johnny Yang (*Arizona State University*) — *16:00–16:30*

Abstract. How do randomness and spatial structure shape population dynamics? We first demonstrate, via a simple example, how stochasticity can affect spatial patterns in evolving populations. We then explore the long-time behaviors of the stochastic Fisher–Kolmogorov–Petrovsky–Piskunov (FKPP) equation and demonstrate that it approximates many discrete models in population genetics.

Stochastic Control Theory

Organizer: Óscar Vega-Amaya

Time/Room: Thu, Nov 13, 11:30–13:00; *Auditorium*

A necessary condition for distribution steering in discrete time.

David Sánchez-González (*Departamento de Matemáticas, CINVESTAV-IPN*) — *11:30–12:00*

Abstract. A class of distribution-steering problems is studied from a variational perspective. Under suitable differentiability assumptions, necessary conditions for optimal Markov policies are derived in the spirit of the Lagrange-multiplier approach. In addition, a heuristic gradient-based method is introduced.

Optimal allocation of resources via optimal transport

Wincy Alejandro Guerra Polania (*Universidad EIA Medellín-Colombia*) — *12:00–12:30*

Abstract. In this talk, we propose a Stackelberg-like model for a resource allocation problem over an urban region. The model incorporates transportation costs, distribution costs, and utility functions. A social planner aims to minimize the total cost while maximizing the welfare of the population that receives the resource. The resulting for-

mulation is a bilevel optimization problem—-also known as a Stackelberg game in game theory. The existence of the best-response function is established via results from optimal transport theory.

Discrete-Time Hybrid Control Problems with Risk-Sensitive Discounted Costs: An Approach

Rubén Blancas-Rivera (*Departamento de Actuaría, Física y Matemáticas, UDLAP*) — *12:30–13:00*

Abstract. This talk studies discrete-time hybrid control problems under a risk-sensitive discounted cost criterion. The discount factor may depend on both state and action variables and can even take values of zero or one. Within a dynamic programming framework, we establish the existence of optimal control policies and characterize the minimal cost through the associated dynamic programming equations. Illustrative examples in inventory management and environmental regulation highlight the model's relevance for decision-making under uncertainty.

Information Theory

Organizer: James Melbourne

Time/Room: Fri, Nov 14, 11:30–13:00; *Auditorium*

Discrete diffusion models: theory and practical challenges

Lalitha Sankar (*ASU*) — *11:30–12:00*

Abstract. Diffusion models have achieved impressive performance in generating high-quality and diverse synthetic data. This talk will briefly review the underlying theory of discrete diffusion models and their relationships to SDEs. We will then focus on an emerging challenge for these models: the training paradigm typically assumes a class-balanced training distribution. In real-world settings, multi-class data often follow a long-tailed distribution, where standard diffusion models struggle – producing low-diversity and lower-quality samples for tail classes. While this degradation is well-documented, its underlying cause remains poorly understood. In this talk, we will highlight the behavior of diffusion models trained on long-tailed datasets and identify a key issue: the latent representations (from the bottleneck layer of the U-Net) for tail class subspaces exhibit significant overlap with those of head classes, leading to feature borrowing and poor generation quality. We will present a solution to this via COntrastive Regularization for Aligning Latents (CORAL), a contrastive latent alignment framework that leverages supervised contrastive losses to encourage well-separated latent class representations. Our results will demonstrate that CORAL significantly improves both the diversity and visual quality of samples generated for tail classes relative to state-of-the-art methods.

Joint work with Esther Rodriguez, Monica Welfert, Samuel McDowell, Nathan Stromberg, and Julian Antolin Camarena

A min-entropy inequality for log-concave variables on the real line

Emma Pollard (*CIMAT*) — *12:00–12:30*

Abstract. We prove a Renyi entropic inequality for real log-concave random variables. Our approach is elementary and uses majorization techniques to recover and extend results of Hensley (1980) on convex bodies, Bobkov and Chistyakov (2015) on anti-concentration of sums of independent random variables, as well as discrete analogs considered in Bobkov, Marsiglietti and Melbourne (2022), and Jakimiuk, Murawski, Nayar, and Slobodianiuk (2024).

This talk is based on joint work with Tulio Gaxiola (Universidad Autónoma de Sinaloa), James Melbourne (CIMAT), and Vincent Pigno (CSU Sacramento)

Fourier Transforms from Classical to Quantum Information

Eliseo Sarmiento Rosales (*ESFM-IPN*) — *12:30–13:00*

Abstract. Fourier analysis is a natural language for symmetry, periodicity, and correlation in both classical and quantum information. We revisit the Discrete Fourier Transform (DFT) as a bridge from linear convolution to the spectral diagonalization of circulant and Toeplitz operators, emphasizing algorithmic efficiency via the Fast Fourier Transform (FFT).

We then connect to the Quantum Fourier Transform (QFT)—central to period-finding at the core of Shor's algorithm—and to the Number-Theoretic Transform (NTT), a key component of post-quantum cryptography in lattice-based schemes such as the standard CRYSTALS-Kyber.

Across these settings, convolution becomes pointwise multiplication in the Fourier basis, revealing common structure with direct implications for probability, stochastic processes, and information theory.

Poster Session

Random Walks on the Symmetric Group and Hecke Algebras
Ana Saraí Dávila Martínez (*UNAM*)

Convergence analysis for heuristic algorithms for the Knapsack problem
Amilcar Escobedo (*IIMAS*)

Microscopic Weak Selection Principle for the Logistic Branching Brownian Motion
Frank Eduardo Bravo Lozano (*UNAM*)

Modelo probabilístico del riesgo de deforestación de manglares
Hassim Olvera Castillo (*CIMAT*)

Modeling a Class of Partially Exchangeable Sequences of Markov Chains via Dice Processes
Imanol Nuñez Morales (*CIMAT*)

Markov Switching Models
Iztel Abigail Ramirez Gonzalez (*UNAM*)

Critical thresholds in stochastic rumors on trees
John Franklin Puerres Tipas (*Universidad Federal de Pernambuco*)

Bayesian inference on intensity parameter of a mixed Poisson process: Stacy distribution case
Luis Gustavo Perez Reyes (*UADY*)

Robust SGD via coordinate-wise median
Mario Alejandro Molina (*IIMAS*)

Statistical method to predict chicken meat chemical composition
Salvador Diaz Serrano (*UADY*)

Modelos de feedback no lineales para la evaluación del impacto del cambio climático en el ciclo hidrológico de cuencas
Jesus Ramírez Morales (*UNAM*)

Bounds on the Energy of Graphs and Some Applications in Random Graphs
Samuel Gurrola Viramontes (*CIMAT*)

On the blowup behavior of semilinear stochastic parabolic equations with a gradient-dependent noise
Alejandro Sierra Conde (*CIMAT*)

Bayesian Inference in Diffusion Processes using Wiener Chaos Expansion
Gabriel A. Salcedo Varela (*Secihti-UNAM*)

Duality and Coming Down from Infinity in Exchangeable Fast Fragmentation Coalescence Processes
José Chacón (*Arizona State University*)

G-Circulant Decomposition of Random Matrices
Julián Zazueta (*CIMAT*)

Existence of solutions to coagulation-transport equation arising from a coalescent process
Edwin Anzures (*IIMAS*)

Penalization and Conditioning for Lévy process
Kohki Iba (*CIMAT*)