

Abstract Booklet

TOGA 2026

Operator Theory on Graphs and its Applications to Physics, Probability and Biology
Joint event with Las Jornadas de Análisis – Department of Mathematics, UAM-Iztapalapa

July 27 - 29, 2026
Casa Rafael Galván, Mexico City

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1 Monday

1.1 Convergence rate of CLT for random matrices

Author: Daniel Muñoz

Affiliation: UnADM

Abstract:

Since the discovery of Wigner's semicircle law, many new notions of Central Limit Theorems (CLTs) for random matrices have emerged. Consequently, investigating their rates of convergence has become a necessity. In this talk, we will discuss the convergence rates of CLTs for adjoint polynomial evaluated in random and deterministic matrices. We will show how convergence results can be deduced by studying higher-order classical cumulants. This is joint work with Zhigang Bao.

1.2 (TBA) (online session)

Author: Luigi Accardi

Affiliation: Università di Roma Tor Vergata

Abstract:

(TBA)

1.3 Fermionic Gaussian States and Channels

Author: Roberto Quezada

Affiliation: UAM-Iztapalapa

Abstract:

(TBA)

1.4 Generalized Comb Product and Operator Valued Monotone Convolution

Author: Octavio Arizmendi

Affiliation: CIMAT

Abstract:

We establish a connection between generalized comb products of rooted graphs and operator-valued monotone convolution. Our results provide a graph-theoretic realization of operator-valued monotone convolution, extending the classical correspondence between comb products and scalar-valued monotone independence.

1.5 Integración mediante sumas de Riemann-Stieltjes

Author: Jorge León

Affiliation: Cinvestav

Abstract:

Estudiaremos diferentes conceptos de integral (resp. estocástica) de una función (resp. aleatoria) con respecto a otra, los cuales son definidos como el límite de sumas de Riemann-Stieltjes. Esto es, usaremos

diferentes normas para analizar la convergencia de dichas sumas y los límites se relacionarán con integrales (resp. estocásticas) que se usan en el estudio y las aplicaciones de las ecuaciones ordinarias (resp. estocásticas).

1.6 Plática en honor al Dr. Roberto Quezada

Author: Franco Fagnola

Affiliation: Politecnico di Milano

Abstract:

Special Session

2 Tuesday

2.1 Spectral Properties of Gaussian Quantum Markov Semigroups

Author: Franco Fagnola

Affiliation: Politecnico di Milano

Abstract:

Gaussian (quasi-free) quantum Markov semigroups (GQMS) describe the evolution of open quantum bosonic systems under the Markovian approximation, generalizing bosonic quadratic Hamiltonian evolutions. In this talk, we consider GQMS with a unique, faithful invariant density and examine their associated semigroups on Hilbert-Schmidt operators via embeddings through the square root of the invariant density. We survey recent results on the spectral gap and the spectrum of generators for these associated semigroups. Crucially, our analysis requires no symmetry (reversibility) assumptions regarding the invariant state, nor any quantum detailed balance conditions.

- [1] F. Fagnola, D. Poletti, E. Sasso, V. Umanit , The Spectral Gap of a Gaussian Quantum Markovian Generator, *J. Funct. Anal.* **289** 10 111119 (2025) <https://doi.org/10.1016/j.jfa.2025.111119>
- [2] F. Fagnola, Zheng Li, Spectral Analysis for Gaussian Quantum Markov Semigroups. arXiv:2504.12162
- [3] Zheng Li, On the existence of the KMS spectral gap in Gaussian quantum Markov semigroups. arXiv:2512.23414
- [4] Melchior Wirth, The KMS and GNS Spectral Gap of Quantum Markov Semigroups. arXiv:2604.21630

2.2 Weak coupling limit on noncommutative graphs (online session)

Author: Alexander Teretenkov

Affiliation: Steklov Mathematical Institute, Mos 

Abstract:

We discuss weak-coupling limit for open quantum systems when the relevant degrees of freedom are described not by a subsystem algebra, but by an operator system, equivalently a noncommutative graph. A state on such a graph is a positive normalized functional on a distinguished space of relevant observables. To derive effective dynamics, we use ansatz extensions: each state on the operator system is extended to a full density matrix consistently with the relevant observables. Combining this construction with projection-operator techniques, in particular generalized Kawasaki–Gunton projectors, leads to time-local master equations for the induced dynamics on the noncommutative graph. The framework includes the usual reduced dynamics of open systems as a special case, but also applies to nonlinear ansatzes, Gaussian approximations for bosonic systems, and thermodynamic ansatzes arising in repeated temperature measurements.

This work was supported by the Russian Science Foundation under grant no. 25-21-00700.

2.3 The role of Kolmogorov’s reversibility criterion in the population inversion phenomena within the framework of MGWLT’s: from interaction graph to cycle matrices

Author: Fernando Guerrero-Poblete

Affiliation: UAM-Iztapalapa

Abstract:

In this talk, within the framework of Markov generators of weak coupling limit type, we introduce the concept of cycle matrix and provide a basis for the sub-space of antisymmetric matrices whose rows sum to zero in terms of them. We prove that this sub-space and the kernel of the incidence matrix of

the interaction graph, are isomorphic; such matrices allow us to condense the currents associated with the equation $\mathcal{L}_*(\rho) = 0$. This approach allows an easy characterization of the non-equilibrium invariant states in some particular regimes. In this non-equilibrium context, we investigate on necessary conditions for the population inversion phenomena arise, we do this in the 1-non equilibrium regime and show the relationship between the necessary conditions and the Kolmogorov's reversibility criterion.

2.4 Equilibrium and Non-Equilibrium Invariant States of Weak-Coupling Markov Generators: A Graph Partition Approach

Author: Marco Cruz

Affiliation: UAM-Iztapalapa

Abstract:

In this talk, we study both equilibrium and non-equilibrium invariant states associated with operators acting as Markov generators of the weak coupling limit type.

Given the interaction graph associated to these operators, we propose a partition based on a discrete metric inspired by the metric circle. This geometric and combinatorial approach provides a simpler yet richer description of the structure of their invariant states.

Furthermore, under certain assumptions we demonstrate a topological reduction result: the complete description of the operator's invariant state does not depend on the entire system, but is determined by the dynamics of a specific complete and connected subgraph within the original interaction graph.

2.5 Perturbed G-circulant Quantum Markov Semigroups

Author: Josué Vázquez

Affiliation: CIMAT

Abstract:

We will review past and current developments regarding (perturbed) G-circulant quantum markov semigroups, which are quantum markov semigroups arising from the regular representation of finite groups. The algebraic structure inherited from the underlying groups allows for explicit computations of invariant states, decoherence, and bounds for spectral gaps. This is ongoing work with Roberto Quezada and Jorge Bolaños-Servin.

2.6 Optimización de índices basados en grados en cadenas generales de poliomínos mediante programación dinámica

Author: Sayle Sigarreta

Affiliation: BUAP

Abstract:

En esta plática presentaremos un marco basado en programación dinámica para identificar cadenas generales de poliomínos extremas respecto a índices topológicos dependientes del grado. Como aplicación concreta, resolveremos un problema abierto planteado en 2015, determinando, para cualquier número dado de cuadrados, las cadenas generales de poliomínos que maximizan el índice de Randić generalizado con parámetro $\alpha = -1$. Mostraremos además que las configuraciones extremas dependen explícitamente de la clase residual del número de cuadrados módulo 4. Más allá de este resultado particular, el enfoque propuesto proporciona una metodología constructiva y sistemática para abordar problemas extremos en teoría de grafos.

3 Wednesday

3.1 Asymptotic Eigenvalue Distribution of the Partial Transpose and Left G-Circulant Decomposition

Author: Julián Zazueta

Affiliation: CIMAT, Guanajuato

Abstract:

We will review past and current developments regarding (perturbed) G-circulant quantum markov semi-groups, which are quantum markov semigroups arising from the regular representation of finite groups. The algebraic structure inherited from the underlying groups allows for explicit computations of invariant states, decoherence, and bounds for spectral gaps. This is ongoing work with Roberto Quezada and Jorge Bolaños-Servin.

3.2 Compuertas transversales de códigos estabilizadores

Author: Miryam Mielke

Affiliation: UAM-I

Abstract:

La tolerancia a fallos en computación cuántica exige puertas lógicas que actúen de forma transversal, es decir, qubit a qubit, para evitar que los errores se propaguen dentro de un bloque codificado. El teorema de Eastin–Knill muestra que ningún código admite un conjunto universal de puertas transversales, lo que hace relevante caracterizar, para un código fijo, exactamente qué puertas diagonales sí lo son. En esta charla presento un resultado que da una condición, en términos del peso de Hamming de los generadores del código estabilizador, para que un operador diagonal transversal $U^{\otimes n}$

3.3 El Álgebra de Multiplicadores en Álgebras Topológicas con Involución

Author: Víctor San Martín

Affiliation: UAM-Iztapalapa

Abstract:

La teoría de multiplicadores desempeña un papel fundamental en el estudio de la estructura interna de diversas clases de álgebras y cuenta con aplicaciones importantes en Teoría de Operadores y Análisis Funcional. En esta charla presentaré resultados sobre el álgebra de multiplicadores asociada a álgebras topológicas con involución, con especial énfasis en las álgebras localmente C^* . Utilizaré la descomposición de Arens–Michael, que permite representar estas álgebras como límites proyectivos de álgebras C^* , se analizará cómo extender propiedades clásicas de los multiplicadores al contexto localmente C^* . Finalmente, describiré la estructura del álgebra de multiplicadores y se discutirán algunos ejemplos representativos. Este trabajo forma parte de mi tesis de maestría.

3.4 On maximal ideals in weighted continuous function algebras

Author: Pavel Ramos

Affiliation: UAM-Iztapalapa

Abstract:

Let X be a completely regular Hausdorff space and V a Nachbin family defined on X . We will consider $CV_{(0)}(X, A)$ certain algebras of weighted vector-valued continuous functions with a topology given by the uniform seminorms induced by V , where A is a locally convex algebra. In this talk we give some characterizations of their closed maximal ideals via maximal ideals on A .