

# David Davalos, Ph.D.



—*Mathematical Physicist (quantum physics)*—

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## About me

I am a physicist with a strong background in Quantum Physics and Mathematics, in particular Quantum Information Theory and Open Quantum Systems. My recent experience focused in investigating the mathematical structures within the convex space of quantum channels and the interplay between quantum channels. In particular I came up with a series of decomposition theorems that have applications in Quantum Computing. Moreover, I have a solid experience leading academic research that culminated in publications in peer reviewed journals and a bachelor thesis. I have experience as lecturer at both undergraduate and graduate levels.

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## Personal Information

- Date of Birth: September 21st of 1990.
- Place of Birth: Guadalajara Jal., México.
- Nationality: Mexican, US citizen.

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## Higher Education

- **Ph. D. Physics**  
*Institute of Physics, UNAM, 2015-2020. Graduated with honors.*
- **Master of Physics**  
*Institute of Physics, UNAM 2013-2015. Graduated with honors.*
- **Bachelor of Physics**  
*Physics department, CUCEI, University of Guadalajara, 2008-2013.*

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## SNI I

- Member of the National Researchers System of Mexico (SNI for its acronym in Spanish), level 1.

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## Publications

- Quantum dynamics is not strictly bidivisible. David Davalos and Mario Ziman. Published: *Phys. Rev. Lett.* **130**, 080801 (2023).
- Pauli component erasing quantum channels. Jose Alfredo de Leon, Alejandro Fonseca, François Leyvraz, David Davalos, and Carlos Pineda. Published: *Phys. Rev. A* **106**, 042604 (2022).
- Fuzzy measurements and coarse graining in quantum many-body systems. Carlos Pineda, David Davalos, Carlos Viviescas, and Antonio Rosado. Published: *Phys. Rev. A* **104**, 042218 (2021).
- Position representation of single-mode Gaussian channels beyond the Gaussian functional form. David Davalos, Camilo Moreno, Juan-Diego Urbina and Carlos Pineda. Published: *J. Phys. A: Math. Theor.* **53** (2020) 425304.

- Divisibility of qubit channels and dynamical maps. David Davalos, Mario Ziman and Carlos Pineda. Published: *Quantum* 3, 144 (2019).
  - Positivity and complete positivity of differentiable quantum processes. Gustavo Montes Cabrera, David Davalos and Thomas Gorin. Published: *Phys. Lett. A* 383, 23 (2019).
  - Quantum non-markovianity and localization. David Davalos and Carlos Pineda. Published: *Phys. Rev. A* 96, 062127 (2017).
  - Measuring and using non-markovianity. Carlos Pineda, Thomas Gorin, David Davalos, Diego A. Wisniacki and Ignacio Garcia-Mata. Published: *Phys. Rev. A* 93, 022117 (2016).
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## Academic experience

- **Institute of Physics Slovak Academy of Sciences (Aug/2021-present )**  
Research fellow with “Schwarz stipend” by the Slovak Academy of Sciences, at Mario Ziman’s group. My duty is the investigation of the algebraic properties of quantum channels, open quantum systems, **quantum communication** and foundations of quantum mechanics. Recently I have found a novel decomposition of quantum channels that immediately leads to a method to reduce the size of the register of a quantum computer when simulating quantum channels.
  - **Institute of Physics the National Autonomous University of Mexico (IF-UNAM)** (Feb/2020-Jun/2021)  
Postdoctoral researcher at the Dr. Carlos Pineda’s group for quantum information and quantum optics. The position was devoted to the exploration of the observable (a.k.a. tomographically accessible) quantum states of many-body quantum systems, when the measurement apparatus is subject to classical noise of permutational nature.
  - **Research Group for Quantum Information and Quantum Optics (GIOC)** (Feb/2013-Feb/2020)  
During my Master and PhD in Physics, I worked in the group as a researcher, and led or co-lead at least 4 projects. Some of them culminated in the publications detailed below. Part of my duties consisted in international collaboration in several countries (see further information below). Furthermore, I gave personal consultancies to other members of the research group, including teaching them the tools of the group (both analytical and programming tools, including C++, Mathematica, Julia and CUDA tools). I was also admin of the Linux servers of the group and organizer of talks and small events.
  - **Faculty of Sciences UNAM** (Feb/2013-Feb/2020)  
During my Master and PhD in Physics, I was lecturer and lecturer assistant of many topics, including computational and mathematical physics. See details below.
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## Thesis direction

- Bachelor thesis of Adan Castillo, titled *Dinámica efectiva de un sistema de  $N$  qubits* (Effective dynamics of a system of  $N$  qubits). Finished on December of 2022 and grade obtained on January 26 of 2023. The thesis can be downloaded in *tesiunam* ([click here](#)).
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## Teaching experience

At the Research Center for Quantum Information Slovak Academy of Sciences (SAV):

- Lecturer of the minicourse “Toolbox for quantum channels and their decompositions and simulability using dynamical maps”, May of 2022. This was given for PhD students and postdocs.

At the National Autonomous University of Mexico (UNAM):

- Lecturer of “Quantum Mechanics”, first semester of 2020.
- Lecturer assistant of “Introduction to quantum physics”, second semester of 2019.

- Lecturer of “Computational physics”, second semester of 2017.
  - Lecturer assistant of “Selected topics of mathematical and theoretical physics II”, first semester of 2017.
  - Lecturer assistant of “Selected topics of computational physics II”, second semester of 2016.
  - Lecturer assistant of “Selected topics of mathematical and theoretical physics III”, second semester of 2015.
  - Lecturer assistant of “Selected topics of mathematical and theoretical physics I”, first semester of 2015.
  - Lecturer assistant of “Selected topics of mathematical and theoretical physics II”, second semester of 2013.
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## Research interests

- Mathematical Physics.
  - Open Quantum Systems.
  - Quantum Information Theory.
  - Quantum Thermodynamics.
  - Foundations of Quantum Mechanics.
  - Classical and Quantum Probability Theory.
  - Quantum Tensor Networks.
  - Quantum Combs and Causal Structures.
  - Algebraic Quantum Mechanics.
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## Languages

- Spanish (mother language).
  - English (fluent).
  - German (basic).
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## Honors

- Graduated with Honors in the Ph. D. Physics program of UNAM (2020).
  - *Alfonso Caso medal* for being the most distinguished graduated in the year 2015 of the program of “Master on Physical sciences” of UNAM (2017).
  - *Juan Manuel Lozano Mejía Diploma* for distinguished academic performance in the “Master on Physical sciences” program of UNAM (2016).
  - Graduated with Honors in the Master’s degree program of “Master on Physical sciences” of UNAM (2015).
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## Hobbies

- International history: From Romans to XX century in Europe and America.
  - Philosophy of mathematics and natural sciences. Zermelo-Fraenkel+Choice set theory and model theory; heuristics and the path from metaphysics to physics.
  - Linux gaming: I enjoy enhancing my experience experimenting with different drivers and WINE (and Proton) versions. I play grand strategy (eu4, ck3), simulation (x-plane 11, F1), fighting (db fighter z) and shooting games (insurgency, verdun, CoD).
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## Graduate Research experience

- **Research Center for Quantum Information (RCQI), Slovak Academy of Sciences, Bratislava, Slovakia**  
Six visits from 2015 to 2019.  
Collaboration with Dr. Mario Ziman. Currently (and few time ago in the framework of a research fellow position) it is being devoted to the investigation of structural questions on quantum channels and to quantum networks.
  - **Institute für Theoretische Physik, Regensburg, Germany**  
September of 2016, April of 2017 and March of 2018.  
Collaboration with Dr. Juan Diego Urbina. It was devoted for the research on continuous variable quantum systems.
  - **Departamento de Física “J. J. Giambiagi”, University of Buenos Aires, Argentina; Instituto de Investigaciones Físicas de Mar del Plata, Mar del Plata, Argentina**  
April of 2015.  
Collaboration with Dr. Diego Wisniacki and Dr. Ignacio García Mata. It was devoted to research new and meaningful ways to measure quantum information flux from the environment of quantum systems to the central system.
  - **Moscow Institute of Physics and Technology (State University), Moscow region, Russia**  
November of 2018.  
Research visit and talk for collaboration with the Dr. Sergey Filippov. Given the talk titled ‘Divisibility of quantum channels and entanglement breaking’.
  - **Universität Wien, Vienna, Austria**  
February of 2018.  
Research visit under the supervision of Carlos Pineda.
  - **Physikalisches Institut, Albert-Ludwigs Universität Freiburg, freiburg im breisgau, Germany.**  
October of 2015.  
Research visit and talk under the supervision of Prof. Dr. Andreas Buchleitner. Given the talk titled “Measuring and using non-markovianity”.
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## Organization of scientific activities

- *Classical and Quantum Dynamics of Complex Systems and Applications*, (via zoom) March 22nd - April 1st, 2021. [Click to jump to the webpage.](#)
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## Incursion into the private sector

- **Austin AI** (March/2023-August/2023)  
I am working as specialist consultant and developer in Machine Learning, implementing state-of-art modified transformer-based architectures for several tasks of **Natural Language Processing** (NLP). Also in custom word embeddings for semantic search and context trackers.
  - **TechIsland** (May/2022-Nov/2022)  
I worked as Machine Learning Specialist and backend developer, in particular developing algorithms using **Natural Language Processing** (NLP). I used Python and AWS, with the help of GitHub for version control and other tools such as Jira and Confluence for collaboration and documentation construction. Part of my duty was to develop and document workflows for train, retrain, maintain, organize, certify and deploy backends using Machine Learning models.
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## Programming Skills

- Advanced knowledge of **Python**, **Julia** and **Mathematica**.

- Intermediate knowledge of **C++** and **MatLab**.
  - Advanced use of **L<sup>A</sup>T<sub>E</sub>X**.
  - Extensive use of **GNU/Linux** as user and administrator.
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## Attendance to conferences, given talks and posters

- Conference *Quantum Information and Probability: from Foundations to Engineering (QIP22)* at Linnaeus University, Växjö, Sweden. June 14th-17th of 2022. Presented the talk titled “Quantum dynamics is not strictly bidivisible”.
- Conference/Meeting of the *Division of Quantum Information of the Mexican Academy of Sciences (DICU)* at Puebla, Puebla, Mexico, September 4th-6th of 2019. Presented the talk titled “Divisibility of qubit channels and dynamical maps”.
- Conference/Meeting *QMath2019* at Aarhus, Denmark, August 12th-16th 2019. Presented the poster titled “Divisibility of quantum channels”.
- Conference/poster: *Quantum Optics IX* at Cartagena, Colombia, October 21th-27th of 2018. Presented the poster titled “Characterization of singular Gaussian quantum channels”.
- Conference/Talk: *Statistical techniques for correlation analysis: Quantum Many-Body Systems and more* at Cuernavaca, Mexico, July 8th to August 4th of 2018. Presented the talk titled “Divisibilidad de canales cuánticos, markovianidad y entrelazamiento”.
- Conference/Meeting of the *Division of Quantum Information of the Mexican Academy of Sciences (DICU)* at San Luis Potosí, SLP, Mexico, September 27th-29th of 2017. Presented the poster titled “Divisibility of quantum dynamical maps vs. divisibility of quantum channels”.
- Conference/Talk: *Latin American School of Physics: Quantum Correlations* at Mexico City, Mexico, July 24th to August 4th of 2017. Presented a poster titled “Divisibility of quantum dynamical maps vs. divisibility of quantum channels”.
- Conference/Talk: *Gathering: Correlations in Time Series and Many-Body Systems* at Cuernavaca, Mexico, June 18th to July 8th of 2017. Presented the talk titled “Divisibility of quantum channels versus divisibility of dynamical maps: Verifying Lindbladian divisibility”.
- Conference/Talk: *UDG-UNAM-BUAP meeting on quantum information, open systems, time series and correlations* at Cuernavaca, Mexico, January 9th-20th of 2017. Presented the talk titled “Open systems and non-markovianity”.
- Conference/Meeting of the *Division of Quantum Information of the Mexican Academy of Sciences (DICU)* at Monterrey, NL, Mexico, October 26th-28th of 2016. Presented the poster titled “Quantum non-Markovianity and localization”.
- Conference/Talk: *Topics in Quantum Optics* at Cuernavaca, Mexico, February 14th-20th of 2016. Presented the talk titled “This year and prospects to the next: Non-Markovianity and random density matrices”.
- Conference/Talk: *ICF nonlinear physics group’s meeting* at Cuernavaca, Mexico, December 8th-9th of 2015. Presented the talk titled “This year and prospects to the next one: Non-Markovianity and random density matrices”.
- Talk at the *Students seminar of the Instituto de Física UNAM*: “Bóvedas cuánticas y No Markovianidad” (quantum vaults and non-Markovianity), Mexico City, September 7th of 2015 .
- Conference/Meeting of the *Division of Quantum Information of the Mexican Academy of Sciences (DICU)* at Ensenada, Mexico, September 23th-25th of 2015. Given a poster presentation titled “Quantum vaults and non-Markovianity”.
- Summer School: *QUTE-Europe Summer School* at Smolenice, Slovakia, August 18th-28th of 2014. Given a poster presentation titled “Non-Markovianity and dynamical regimes” .
- Student Conference: *11th Canadian Quantum Information Student Conference*. At Guelph, Ontario, Canada, June 23th-27th of 2014. Presented the poster titled “Non-Markovianity and spin chains” .

- Summer School: *14th Canadian Quantum Information Summer School* at Guelph, Ontario, Canada, June 16-20/2014.
  - Conference: *VII Reunión Anual de la División de Información Cuántica de la Sociedad Mexicana de Física*. At Cocoyoc, Morelos, Mexico, May 7th-9th of 2014. Presented the poster titled “Non-Markovianity and spin chains”.
  - Summer School: *XLIII Latin American School of Physics: ELAF 2013* at Mexico City, Mexico, from July 22th to August 2th of 2013.
  - Summer School: *Applications of Quantum Mechanics III* at Guadalajara Jalisco, Mexico, July 8th-19th of 2013.
  - Summer School: *Applications of Quantum Mechanics II* at Cuernavaca, Morelos, Mexico, July 16th-27th of 2012.
  - Summer School: *Tercer Verano de las Matemáticas y Matemáticas Aplicadas* at CIMAT, Guanajuato, Gto. Mexico. July 2th-13th of 2012.
  - Summer School: *XX Escuela de Verano en Física* at UNAM, Mexico city and Cuernavaca, Mexico, July 18th-29th of 2012.
  - Summer school: *Advanced Summer School 2011* at The Physics Department of CINVESTAV-IPN, Mexico city, Mexico, July 25th-29th of 2011.
  - Summer School: *Applications of Quantum Mechanics: Optics, Chaos, Random Matrices and Quantum Information* at Cuernavaca, Morelos, Mexico, July 11-22/2011.
  - Congress: *LIII Congreso Nacional de Física* at Boca del Rio, Veracruz, Mexico, October 25-29/2010.
  - Congress: *XV Congreso de la investigación científica y tecnológica del pacífico* at Puerto Vallarta, Mexico, August 25-28/2010.
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## Academic references

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