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PREFACE
Xth International Workshop on New Challenges in Quantum Mechanics: Graphene, Supersymmetry and Mathematical Physics

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The *Xth International Workshop on New Challenges in Quantum Mechanics: Graphene, Supersymmetry and Mathematical Physics* (X IWNCQM) was held at the Department of Physics of the Center for Research and Advanced Studies (Cinvestav) in Mexico City from May 20th to 23rd, 2024. This year, the conference paid tribute to the outstanding scientific contributions of Prof. David J. Fernández C., whose work has significantly advanced the fields of quantum mechanics and mathematical physics.

The X IWNCQM was attended by 75 researchers and students from Chile, Czechia, India, Peru, Poland, Spain, Turkey, the United States, and, of course, Mexico. The workshop aimed to bring together researchers of all levels to discuss topics in quantum mechanics and mathematical physics. Each year, the subtitle of the workshop changes to keep it flexible and relevant to current scientific trends. This year, the focus was on graphene, supersymmetry, and mathematical physics. This workshop features studies on coherent states, integrability and superintegrability, algebraic methods, symmetries, quantum optics, quantum many-body systems, exact solutions in physics, and other related topics. It included plenary, contributed, and virtual talks, totaling 36 presentations.

This is the tenth edition of the IWNCQM and the first time it has been held in Mexico. The workshop has been held in different countries including Spain, Canada, and Czechia. It has also honored other distinguished professors working in various areas of quantum mechanics and mathematical physics, such as Profs. Luis Miguel Nieto, Veronique Hussin, Mikhail Plyushchay, and Javier Negro.

This year, 2024, marks the 40th anniversary of the publication of Prof. David J. Fernández's first paper entitled "New hydrogen-like potentials" [1]. To commemorate this milestone, we decided to dedicate this year's workshop to honoring Prof. Fernández.

The Department of Physics of Cinvestav currently employs 45 professors and is one of the main contributors to graduate degrees in physics in Mexico. By the end of 2024, it had granted 386 Ph.D. and 616 M.Sc. degrees, totaling more than 1000 graduates.

Figure 1: Conference photo of the Xth International Workshop on New Challenges in Quantum Mechanics: Graphene, Supersymmetry and Mathematical Physics (X IWNCQM).

These proceedings include 16 contributions from 32 different authors. The manuscripts are organized in four sections: graphene, supersymmetric quantum mechanics (SUSY QM), mathematical physics, and quantum and classical phenomena. The manuscripts published in this volume were accepted by the editors based on the decisions of anonymous referees after a thorough peer-review process. We would like to take this opportunity to acknowledge the anonymous referees for their valuable work.

We, the organizing committee, would like to extend our gratitude to the individuals and institutions that contributed to the organization of this event and provided financial support: Prof. Eduard De La Cruz-Burelo, Head of the Department of Physics; Prof. Abdel Pérez-Lorenzana, Head of Secretaría Académica; and Prof. Alberto Sánchez, Head of Cinvestav. We also acknowledge the financial support provided by Conahcyt project CF-2019-61533. Additionally, we wish to express our appreciation to Miriam Lomelí, Victor Juárez, Gustavo Ávila, and Juan Carlos Sánchez for their invaluable assistance in organizing this workshop.

Brief biography of Prof. David J. Fernández C.

David José Fernández Cabrera was born on December 28th, 1960 in Tezuitlán, Puebla, Mexico. In 1978, he decided to pursue a major in Physics at the University of Puebla. Before completing his undergraduate degreve, in 1982, he traveled to Mexico City with the goal of securing a position as a graduate student at the Department of Physics in Cinvestav.

David received his Master of Science (M.Sc.) degree in 1984, defending a thesis written under the supervision of Prof. Bogdan Mielnik, a brilliant and enthusiastic physicist. In fact, his first scientific publication entitled “New hydrogen-like potentials”, which we celebrate in this workshop, was a direct result of this thesis.

After completing his Master’s degree, he decided to continue his studies and pursue a Ph.D. also under the supervision of Prof. Mielnik. This time, his research topic focused on quantum dynamics and quantum control. He successfully defended his thesis in 1988 and received his Ph.D. degree. From 1990 to 1992, he was a postdoctoral fellow at the University of Valladolid in Spain, where he established lifelong scientific collaborations and friendships.

Since 1989, David has been a faculty member in the Department of Physics, currently holding the level of Profesor Titular 3E. He is also recognized as a Level 3 researcher in the National System of Researchers (SNII) of Conahcyt. To date, Prof. Fernández has supervised 17 M.Sc. theses and 14 Ph.D. theses, and has published over 80 scientific articles in international journals. According to Google Scholar, his publications have received more than 3,000 citations. More importantly, David has succeeded in educating and inspiring physicists across the country, teaching them the values and responsibilities defining outstanding educators and great professors. Congratulations to Prof. Fernández!

The organizing committee,
David Bermudez
Alonso Contreras-Astorga
Erik Diaz-Bautista

Mexico City, January 2025

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[1] David J. Fernández C. New hydrogen-like potentials, *Lett. Math. Phys.* **8** 337–343 (1984). doi: 10.1007/BF00400506


XTH INTERNATIONAL WORKSHOP ON NEW CHALLENGES IN QUANTUM MECHANICS:
GRAPHENE, SUPERSYMMETRY, AND MATHEMATICAL PHYSICS
A CONFERENCE IN HONOR OF PROF. DAVID J. FERNÁNDEZ C.
COHERENT STATES, INTEGRABILITY AND SUPERINTEGRABILITY,
QUANTUM OPTICS, ALGEBRAIC METHODS, AND RELATED TOPICS
CINVESTAV, MEXICO CITY. MAY 20-23, 2024
PLENARY SPEAKERS
ROELOF BIJKER (ICN UNAM, MEXICO)
FRANCISCO CORREA (UNIVERSITY OF SANTIAGO, CHILE)
FRANCISCO DELGADO (TEC CEM, MEXICO)
ALINA DOBROGOWSKA (UNIVERSITY OF BIALYSTOK, POLAND)
NICOLÁS FERNÁNDEZ-GARCÍA (UPIITA IPN, MEXICO)
MANUEL GADELLA (UNIVERSITY OF VALLADOLID, SPAIN)
GERARDO GARCÍA NAUMIS (IF UNAM, MEXICO)
JORGE HIRSCH (ICN UNAM, MEXICO)
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List of plenary speakers

- Roelof Bijker (Instituto de Ciencias Nucleares - ICN, Universidad Nacional Autónoma de México - UNAM, Mexico).
- Francisco Correa (University of Santiago, Chile).
- Francisco Delgado (Tecnológico de Monterrey, Campus Estado de México - TEC CEM, Mexico).
- Alina Dobrogowska (University of Bialystok, Poland).
- Nicolás Fernández-García (Unidad Profesional Interdisciplinaria en Ingeniería y Tecnologías Avanzadas - UPIITA, Instituto Politécnico Nacional - IPN, Mexico).
- Manuel Gadella Urquiza (University of Valladolid, Spain).
- Gerardo García Naumis (Instituto de Física - IF, UNAM, Mexico).
- Jorge Hirsch (ICN, UNAM, Mexico).
- Vit Jakubsky (Nuclear Physics Institute, Czechia).
- Piotr Kielanowski (Centro de Investigación y de Estudios Avanzados - Cinvestav, Mexico).
- Hector Moya Cessa (Instituto Nacional de Astrofísica, Óptica y Electrónica - INAOE, Mexico).
- Luis Miguel Nieto (University of Valladolid, Spain).
- Alfredo Raya (Universidad Michoacana de San Nicolás de Hidalgo - UMSNH, Mexico).
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- Yonatan Betancur Ocampo (IF, UNAM, Mexico).
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- Naveed Ahmad Shah (Aligarh Muslim University, India).
- Raúl Valencia Torres (Cinvestav, Mexico).

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