

## **CURRICULUM VITAE ET STUDIORUM**

Name and surname: **Daniel López Díaz**

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Present position: Junior Researcher, Grad Student.

### **General Education:**

- High School Institute of Exact Sciences V. I. Lenin, Havana, 2011-2013.
- Pre-University College of Physics at University of Havana, 2013-2014.

### **Higher and Postgraduate Education:**

-The University of Havana, Faculty of Physics, 2015-2020, Licenciado en Física (Five-year course = Bachelor + Master in Physics, following "Bologna Process" standards).

Thesis: *"Modeling efficient excitonic transport in light-harvesting systems"*, supervised by Dr. Gabriel Gil Pérez and Dr. Augusto González García, ICIMAF.

### **Postgraduate Courses:**

- Theory of Generalized Functions and its applications to Physics.  
Prof: Dr. José M. Marín Antuña, University of Havana, 2017-2018

- Functional Integrals in Quantum Physics.  
Prof: Dr. Carlos Rodríguez Castellanos, University of Havana, 2019

- Data Analysis with Python.  
Prof: Dr. Milton García Borroto, University of Havana, 2021-2022.

- Theory of Particle Physics.

Prof: Dr. Marcus Bleicher (ITP Uni-Frankfurt/ GSI/ NIC Jülich/ HFHF),  
German-Cuban Summer School 2022 (DAAD), ICIMAF, Havana, 2022

- Astrophysics @FAIR.

Prof: Dr. Christian Sturm (GSI), German-Cuban Summer School 2022 (DAAD), ICIMAF,  
Havana, 2022

- Experiments @FAIR.

Prof: Dr. Christoph Blume (IKP Uni-Frankfurt), German-Cuban Summer School 2022  
(DAAD), ICIMAF, Havana, 2022

- Optics and Lasers.

Prof: Dr. María de las M. Sánchez Colina, University of Havana, 2022.  
(Finished but waiting for certificate to be issued)

- Quantum Fields Theory.

Prof: Dr. Daryel Manreza Paret, University of Havana, 2022.  
(Finished but waiting for certificate to be issued)

- Phase Transitions and Disordered Systems.

Prof: Dr. Roberto Mulet Genicio, University of Havana, 2022.  
(Finished but waiting for certificate to be issued)

### **Awards:**

- Best Graduate of the Pre-University College of Physics at University of Havana,  
2014.

-Golden Diploma (*summa cum laude* graduation) in Physics, University of  
Havana, 2020.

### **Scientific Research:**

– Classic and quantum excitonic transport in light-harvesting systems, since  
2019, ICIMAF, supervisors: Dr. Gabriel Gil Pérez and Dr. Augusto González  
García.

My research has focused on energy transport in natural light-harvesting systems,  
mainly the Fenna-Matthews-Olson complex of green sulfur bacteria, to explain  
their efficient excitonic transfer and the possible role of quantum coherence.

### **Teaching Experience** (as an undergraduate student):

– Computational Methods I, 2016/2017, Faculty of Physics, University of  
Havana.

– Experimental Physics I (Mechanics), 2018, Faculty of Physics, University of  
Havana.

– Experimental Physics III (Electromagnetism), 2019, Faculty of Physics,  
University of Havana.

## **Language skills:**

- Spanish (mother tongue)
- English (fluent)

I have taken advanced English courses on reading, writing, listening, and speaking skills. I successfully completed the EF Standard English Test (EF SET) on June 12<sup>th</sup>, 2022, with a total score of 79/100 calculated as an average of my reading and listening skills. This qualification is equivalent to the C2 Proficient level of the Common European Framework of Reference (CEFR). The official certificate URL is <https://www.efset.org/cert/V7N5Wc>.

## **Computer skills:**

I have four years of programming experience in C++ (2015-2018). I developed a C++ program to diagonalize large sparse matrices using a combination of the Lanczos algorithm and implicit-tridiagonal QL transformation, supervised by Dr. Augusto González. I used this program to diagonalize the 1D Hamiltonian of a system composed of N quantum oscillators with M states. It was also applied to diagonalize the Laplacian matrix for the segmentation of gray-scale images.

I have five years of programming experience in Python (2018-2022). In 2018, I developed a program to process gene expression data from The Cancer Genome Atlas. I also performed a Principal Component Analysis on the data, supervised by Dr. Augusto González. Additionally, I tuned a Python program for a Raspberry Pi board in order to control a lab-made auto-balanced mobile robot, supervised by Prof. Gustavo Viera at the University of Havana.

Since 2019, I have developed a Python software for excitonic transport calculations (*ExciTraC*) and used it to simulate energy transfer in natural light-harvesting systems, supervised by Dr. Gabriel Gil Pérez. The code *ExciTraC* includes some traditional transport mechanisms, such as the Förster Resonant Energy Transfer (FRET) and the wave-like transfer (in both Schrödinger and Von Neumann formalism). Additionally, I developed a code with a non-trivial hybrid mechanism based on the interplay between FRET and quantum coherence. More recently, I extended the code for the treatment of open quantum systems by adding the Lindblad mechanism. Some features of the program are the direct use of experimental Hamiltonians, the construction of Hamiltonians from fixed or randomly sampled structural-spectral data, and the application of a genetic algorithm to simulate biological evolution, among others.

Assessment of computer proficiencies:

- Python (developer)
- C++ (developer)
- FORTRAN (beginner)
- LaTeX (advanced)
- gnuplot (advanced)
- Origin Graphing & Analysis Software (advanced)
- Wolfram Mathematica Symbolic Package (advanced)
- GitHub Version Control (advanced)
- Raspberry Pi OS (beginner)

- Arduino Language (beginner)
- Protein Data Bank [database] (beginner)
- The Cancer Genome Atlas [database] (beginner)

### **Publications:**

- D. López Díaz, G. Gil and A. Gonzalez, "Modeling efficient excitonic transport in light-harvesting systems", Diploma Thesis in Physics, defended on October 15<sup>th</sup>, 2020, written originally in Spanish (Submitted to arXiv).
- D. López Díaz, G. Gil and A. Gonzalez, "A new channel for excitonic transport in the Fenna-Matthews-Olson complex", in peer review from Physical Review E. (eprint: [arXiv:2112.10667v2](https://arxiv.org/abs/2112.10667v2))
- D. López Díaz, G. Gil and A. Gonzalez, "Exciton transport mechanisms in FMO: a cross-species analysis", in preparation.

### **Scientific Meetings:**

- Theoretical Physics Commission of the Student Scientific Conference, University of Havana, Cuba, May 16<sup>th</sup>, 2018. Oral Presentation: "Exact diagonalization of N quantum oscillators in one dimension" (originally in Spanish).
- Electronic and Computing Commission of the Student Scientific Conference, University of Havana, Cuba, May 17<sup>th</sup>, 2018. Oral Presentation: "Theoretical model and development of a self-balancing mobile robot" (originally in Spanish).
- Theoretical Physics Commission of the Student Scientific Conference, University of Havana, Cuba, May 17<sup>th</sup>, 2019. Oral Presentation: "Effective dimension reduction in cancer gene expression by PCA" (originally in Spanish).
- XV Symposium of Cuban Physical Society, University of Havana, Cuba, March 11<sup>th</sup>, 2020. (Poster: "Revisiting design principles for optimal transport in light-harvesting systems").
- FT-45 Meeting, Online (from Cuba and other countries), March 15<sup>th</sup>, 2021. (Oral presentation: "Quantum mechanics in photosynthesis?").
- Biomolecules and Nanoparticle Modeling Group Meetings (UNIPD/CNR-NANO), Online (from Italy and Cuba), May 12<sup>th</sup>, 2021. (Oral Presentation: "Efficient transport mechanism in FMO").
- German-Cuban Summer School 2022 (DAAD), ICIMAF, Havana, Cuba, January 18<sup>th</sup>, 2022 (Oral presentation: "A new channel for excitonic transport in FMO").
- Canadian – Cuban – American – Mexican Graduate Student Conference (C<sup>2</sup>AM), Online, August 2-3, 2022 (Oral presentation: *A new channel for excitonic transport in*

*the Fenna-Matthews-Olson complex)*

**Seminars:**

- “Excitonic transport channels in FMO: a cross-species analysis”, Theoretical and Computational Biophysics Seminars, ICIMAF, Havana, Cuba, March 22<sup>th</sup>, 2022.
- “Review of Quantum Biology”, Theoretical and Computational Biophysics Seminars, ICIMAF, Havana, Cuba, April 5<sup>th</sup>, 2022.
- “Excitonic transport in photosynthetic systems: dipole resonance and quantum coherence, Seminars on MSc thesis advancement, University of Havana, Cuba, June 20<sup>th</sup>, 2022.