Jonathan Lozano

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Institute of physics, UNAM

Education

2015 – 2020 **BSc.Physics**, National Autonomous University of México - Coyoacan, Mexico City, Mexico

GPA: 9.39/10.0, Graduated with Highest Honors.

Advisor Dr. Manuel Torres Labansat

Four and a half year long bachelor involving general physics courses and including selected topics in advanced physics from which I took two graduate courses in **quantum field theory** and a course in **differential geometry and topology for physicists** among others.

Thesis In my BSc thesis titled "*Spontaneous symmetry breaking and extended configurations in a scalar theory subject to a potential with two families of vacuum states*" I studied the spontaneous symmetry breaking in a scalar field theory with two families of vacuum states, a generalization the ϕ^4 theory. Besides, I studied the non-perturbative extended configurations that arise when the fully non-linear field equations of the generalized theory are considered. Furthermore, the possibility of vacuum decay when the two vacua have different energy was studied.

Awards and distinctions

2022 **DPG/IAPS-PLANCKS Munich Travel Grant**

Awarded a travel grant to attend to the PLANCKS competition in Munich at the LMU

2022 **Winner of the PLANCKS 2022 mexican preliminary**

Placed **1st** out of 30 in the mexican tournament of physics.

2021 **Awarded the 2021 *Juan Manuel Lozano Mejia* Diploma**

Given by the Institute of Physics of the National Autonomous University of Mexico to the students with the most outstanding achievements during their thesis research.

2021 **Excellence track scholarship (Johannes Gutenberg Universität Mainz)**

Couldn't attend due to a family emergency.

2021 **Top 10 in the international theoretical physics competition PLANCKS Porto**

Placed **7th** out of 50 participant teams

2021 **Winner of the PLANCKS 2021 mexican preliminary**

Selected as member of the **first mexican team** to attend to the PLANCKS competition after winning the preliminary. `https://www.iaps.info/plancks/what-is-plancks/`

2020-2021 **Winner of the national TMF**

Placed **1st** in the mexican tournament of physics for bachelor's and master's students (Torneo Mexicano de Física)

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2021 **"Honorific mention", BSc. Physics Thesis defense (UNAM)**

Achieved the highest honor after succesfully defending my BSc thesis. *Note: I finished my thesis in January 2020, however, due to the pandemic the university took a whole year to allow me to defend my thesis in March 2021.*

2019 **IF-UNAM research assistant**

Enrollment as research assistant at the Physics Institute of the National Autonomous University of Mexico.

2018 **IF-UNAM associate student**

Enrollment as associate student at the Physics Institute of the National Autonomous University of Mexico.

2018 **AMC-Scholarship**

Mexican Academy of Sciences scholarship to attend to the XXVIII Scientific research summer.

2018 **ICF-UNAM Scholarship**

Physical Sciences Institute of the National Autonomous University of Mexico scholarship to attend to the VII Experimental Physics School.

2017 **IF-UNAM Scholarship**

Physics Institute of the National Autonomous University of Mexico scholarship to attend to the XXV Physics School.

Publications

2021 **J. L. Mayo** and M. Torres, (2021) J. Phys. Commun. https://doi.org/10.1088/2399-6528/abdd83

2022 **J. L. Mayo** and M. Torres, (2022). *Multi-kinks in scalar field theories with non-degenerate vacua: the modulated double Sine-Gordon model*. **(In revision)**

Professional Presentations

October 2021 **J. L. Mayo**.*Multi-solitones en teorías escalares de campo con vacíos no-degenerados: el modelo doble de Sine-Gordon* LXVI National Physics Congress. Mexican Physical Society

Research Experience

2021-2022 **Multi-kinks in scalar field theories with non-degenerate vacua**

Advisor: Dr. Manuel Torres Labansat

We studied the phenomenology of the formation of static structures with n kinks in models with deformed potentials. In order to study the binding forces between kinks I performed numerical simulations in the programming language Julia, additionally, I found an analytical relation for the energy of the static multikink. There's an article in preparation reporting our findings and we're planning to extend our study to higher dimensional topological structures in the future.

2020-2021 **One-loop quantum renormalization of the kink masses, forces between kinks and virial relations**

I studied the emergent phenomena in the behavior of the kink configurations arising from the topology of a generalized ϕ^4 potential. During this project I used perturbation techniques in order to renormalize the quantum mass correction of a kink configuration. By using asymptotic analysis we proved the existence of static multikink configurations and developed the framework to understand the stability of such fields.

2018-2019 **Photon wave function**

I studied the possibility of having a well-defined photon wave function starting from the photon's dispersion relation and then letting the theory go checking for consistency. The appropriate quantum operators and Lorentz transformations were constructed by using **elements of group theory** to find the representations acting on the proposed 6-component wave function. After obtaining the lagrangian density the expected symmetries of the theory were examined. I worked under the tutelage of Dr.Manuel Torres Labansat at the Physics Institute of the National Autonomous University of Mexico.

2019 **Mass spectrometry**

A collision between protons and air particles was produced using a Low-Energy linear collider. The products of the reaction were analyzed using the time of flight mass spectrometry technique under the tutelage of Dr.Juan Lopez Patiño at the Science Faculty of the National Autonomous University of Mexico.

Academic Experience

2022 **Reviewer**

Reviewed an article for the *Journal of physics G: Nuclear and Particle physics*. https://orcid.org/0000-0002-9638-5173

2022 **Teaching assistant: Statistical Mechanics**

Undergraduate-level thermodynamics course, taught by Dr.Juan Valentin Escobar Sotomayor and Dr.Gerardo García Naumis.

I mentored students, held problem solving sessions, created and graded homeworks and exams.

2019 **Teaching assistant: Nuclear and sub-nuclear physics**

Undergraduate level Nuclear and subnuclear physics course taught by Prof. Manuel Torres Labansat

I mentored students, graded homeworks and exams.

2022 **Teaching assistant: Thermodynamics**

Undergraduate-level thermodynamics course, taught by Prof. Juan Valentin Escobar Sotomayor and MSc. Ivan Hernandez Garibay.

I mentored students, held problem solving sessions, created and graded homeworks and exams.

Volunteer Work

2017 **Teacher**

Physics and mathematics teacher in an undergraduate preparation course at the Humanities and Sciences School of the National Autonomous University of Mexico.

Research Interests

- Particle physics, Physics beyond the standard model
- Dark matter, Axion Physics
- Flavor physics
- Quantum Field Theory, Effective field theory
- Extended field configurations (Kinks, Vortex, Domain walls)

Additional Training

2021 **Bad Honnef Physics School - DPG**

Methods of Effective Field Theory and Lattice Field Theory

2021 **VII Mexican School on String Theory and supersymmetry (MSSS)**

2021 **Mexican Astro-Particle School (MAPS)**

Technical Skills

Data analysis and Programing: Julia, Python, Mathematica, QtiPlot, Origin, Tracker, Latex, basic html

Languages

C1 **English**

Native **Spanish**

A2 **German**