

# Carlos Heredia Pimienta

University of Barcelona

## PERSONAL DETAILS

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*Born:* 28.07.1993

## EDUCATION

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**Ph.D. in Physics** Oct/20 - Mar/23

*University of Barcelona (UB), Barcelona, Spain*

- Category: Mathematical Physics
- Ph.D.'s thesis: Nonlocal Lagrangian formalism
- Supervisor: Prof. Josep Llosa

**Master in Astrophysics, Particle Physics and Cosmology** Sep/16 - Jun/17

*University of Barcelona (UB), Barcelona, Spain*

- Category: Mathematical Physics
- Master's thesis: Hamilton-Jacobi formalism for non-involutive systems
- Supervisor: Prof. Josep M. Pons

**Bachelor's Degree in Physics** Sep/11 - Jan/16

*University of Barcelona (UB), Barcelona, Spain*

## WORK EXPERIENCE

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**Senior Data Scientist at DAMM ([DAMM](#))** Feb/24 - Today

*Barcelona, Spain*

Specialised in: Forecasting with statistical, machine learning and deep learning tools.

**Research Collaborator at NTT Research ([Phi Lab](#))** Dec/23 - Today

*Boston, USA*

Collaboration with Dr. Hidenori Tanaka on researching Lagrangian formulation and symmetries in adaptive optimizers (e.g., Adam, AdamW) for deep learning dynamics.

**Senior AI consultant at Nennisiwok AI Lab ([Nennisiwok](#))** Oct/23 - Feb/24

*Barcelona, Spain*

Specialised in: Forecasting and Anomaly detection with AI tools.

- Research Collaborator at University of Barcelona** (*Group: ICCUB*) Sep/23 - Today  
*Barcelona, Spain*  
Collaborations with Prof. Josep Llosa and Prof. Francesc Salvat in projects based on the study of higher-order Lagrangians and charged particle transport with Penelope/Penhan.
- Assistant Professor at University of Barcelona** (*Department: FQA*) Sep/22 - Sep/23  
*Barcelona, Spain*  
Teaching: Subjects related to mathematics, physics and numerical methods.
- Research Collaborator at University of Barcelona** (*Group: ICCUB*) Jan/18 - Oct/20  
*Barcelona, Spain*  
Collaboration with Prof. Josep Llosa in a project based on the study of nonlocal theories.
- Business Intelligence Consultant at Ernst & Young** (*EY*) Sep/17 - Oct/20  
*Barcelona, Spain*  
Specialised in Machine Learning, Big Data and Data Analytics for the Hospitality industry.
- Research Collaborator at A. University of Barcelona** (*Group: IFAE*) Jan/16 - Oct/16  
*Barcelona, Spain*  
Collaboration with Prof. Oriol Pujolàs and Dr. Matteo Baggioli in a project based on the study of the conductive properties of graphene through holographic methods for condensed matter.

## PUBLICATIONS

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### **Are nonlocal Lagrangian systems fatally unstable?**

*Carlos Heredia and Josep Llosa [arXiv: 2403.19777 (hep-th)]*

### **Electromagnetic interaction models for Monte Carlo simulation of protons and alpha particles**

*Francesc Salvat and Carlos Heredia [Nucl. Instrum. Meth. B 546 165157]*

### **Nonlocal Lagrangian fields and the second Noether theorem. Non-commutative $U(1)$ gauge theory**

*Carlos Heredia and Josep Llosa [J. High Energ. Phys. 04(2024)021 ]*

### **[Ph.D. Thesis] Nonlocal Lagrangian formalism**

*Carlos Heredia [arXiv: 2304.10562 (hep-th)]*

### **Infinite derivatives vs integral operators. The Moeller-Zwiebach paradox**

*Carlos Heredia and Josep Llosa [arXiv: 2302.00684 (hep-th)]*

### **Nonlocal Lagrangian fields: Noether's theorem and Hamiltonian formalism**

*Carlos Heredia and Josep Llosa [Phys. Rev. D 105 126002]*

### **Infinite-derivative linearized gravity in convolutional form**

*Carlos Heredia, Ivan Kolář, Josep Llosa, Francisco José Maldonado Torralba, and Anupam Mazumdar [Class. Quantum Grav. 39 085001]*

### **Nonlocal Lagrangian Mechanics: Noether's theorem and Hamiltonian formalism**

*Carlos Heredia and Josep Llosa [J. Phys. A: Math. Theor. 54 425202]*

**Energy-momentum tensor for the electromagnetic field in a dispersive medium**  
*Carlos Heredia and Josep Llosa [J. Phys. Commun. 5 055003]*

## POSTERS & TALKS

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### **Decoding Non-Locality**

*Center for Theoretical Physics of the Universe (Prof. Masahide Yamaguchi), Korea*

### **Navegando en la No Localidad**

*I Congreso Trujillano de Gravitación y Cosmología, Perú*

### **Extending Noether's Theorem to Nonlocal Theories**

*Machine Learning in Mathematics and Theoretical Physics 2023, University of Oxford*

### **Noether's Theorem for Nonlocal Lagrangians**

*Symmetry 2023 - The 4th International Conference on Symmetry, Barcelona, Spain*

### **Noether's theorem for non-local theories**

*Van Swinderen Institute (Anupam Mazumdar's group), University of Groningen*

### **Noether's theorem for non-local Lagrangian mechanics**

*Cosmology Journal Club, University of Barcelona*

### **Energy-momentum tensor for the electromagnetic field in a dispersive medium**

*HSE Study Center Voronovo, Moscow*

## TEACHING

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### **S23: Practical sessions of principles of Laboratory Practice - #363980**

*Electronic Engineering and Telecommunications, University of Barcelona*

### **S23: Problems of Multivariable Calculus - #360570**

*Physics, University of Barcelona*

### **F22: Problems of Calculus 1 - #366693**

*Biomedical engineering, University of Barcelona*

### **F22: Problems of Calculus 1 - #360569**

*Physics, University of Barcelona*

### **F22: Problems of Fundamentals of Mechanics - #360563**

*Physics, University of Barcelona*

## SUMMER/WINTER SCHOOLS & CONFERENCES

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**Machine Learning in Mathematics and Theoretical Physics** ([Link](#))

*University of Oxford, United Kingdom*

Jul/23

**Sym. 2023 - The 4th International Conference on Symmetry** ([Link](#))

*The AXA Convention Center, Barcelona, Spain*

Jun/23

<b>Moscow International School of Physics 2020</b> ( <a href="#">Link</a> ) <i>HSE Study Center Voronovo, Moscow, Russia</i>	Mar/20
<b>XIII Tonale Winter School in Cosmology</b> ( <a href="#">Link</a> ) <i>University of Heidelberg, Passo del Tonale, Italy</i>	Dec/19
<b>TAE 2019 - COST Training School in High Energy Physics</b> ( <a href="#">Link</a> ) <i>Centro de Ciencias de Benasque Pedro Pascual, Huesca, Spain</i>	Sep/19

## SKILLS

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### Programming skills

- *Fortran 95 // Mathematica 10 // ABAP // R // Python // SQL*

### Simulation

- *Penelope // Penhan*

### AI tools

- *Azure // DataBricks // Pytorch // LSTM // RNN // Prophet // Git*

## COURSES

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<b>Complete Python Bootcamp: From Zero to Hero in Python</b> ( <a href="#">Link</a> ) <i>Udemy, Spain</i>	Oct/20
<b>Complete Guide to Tensorflow for Deep Learning with Python</b> ( <a href="#">Link</a> ) <i>Udemy, Spain</i>	Oct/20
<b>Machine Learning A-Z: Hands-On Python &amp; R In Data Science</b> ( <a href="#">Link</a> ) <i>Udemy, Spain</i>	Oct/20
<b>The Complete SQL Bootcamp 2020: Go from Zero to Hero</b> ( <a href="#">Link</a> ) <i>Udemy, Spain</i>	Oct/20
<b>Data Science and Machine Learning Bootcamp with R</b> ( <a href="#">Link</a> ) <i>Udemy, Spain</i>	May/20

## DISSEMINATION

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**Nit de la Recerca - Intel·ligència artificial i humanitat. Perills i avantatges**  
[UB Divulga](#)

**The beauty of symmetries**  
*Severo Ochoa Coffee Talk, CIMNE, Polytechnic University of Catalonia*

## **ACADEMIC REFEREE**

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Classical and Quantum Gravity journal, ISSN: 1361-6382  
*IOP Publishing, Journal*

Selectivitat PAU 2023 - Member of the examining board and proofreader  
*Catalonia, Spain*

## **LANGUAGES**

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Spanish (*mother tongue*), Catalan (*mother tongue*), English (*C1*)

## **FUNDINGS**

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COST - TAE2019 HEP *Cost - Funding*

2019