

Édgar Roldán

Abdus Salam International Centre for
Theoretical Physics (ICTP)
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Date: 7.5.2019



United Nations
Educational, Scientific and
Cultural Organization

Curriculum Vitae

Last Name: Roldán Estébanez
First Name: Édgar
Degree: Ph. D.
Date of birth: 16.07.1985
Place of birth: San Sebastian (Spain)
Nationality: Spanish

PROFESSIONAL EXPERIENCE

- 2018 - current **Associate Research Officer**
ICTP
Quantitative Life Sciences
Trieste, Italy
- 2016 - 2018 **PKS Distinguished Postdoctoral Fellow**
Max-Planck Institute for the Physics of Complex Systems
Biological Physics Division
Dresden, Germany
- 2014 - 2016 **Guest Scientist**
Max-Planck Institute for the Physics of Complex Systems
Biological Physics Division (Frank Jülicher group)
Dresden, Germany
- 2014 **Postdoctoral researcher**
ICFO - The Institute of Photonic Sciences
Optical Tweezers Lab (Dmitry Petrov lab)
Castelldefels (Barcelona), Spain
- 2013 - 2014 **Postdoctoral researcher**
ICMM (CSIC) - Instituto de Ciencia de Materiales de Madrid
Madrid, Spain

2009 - 2013 **PhD student**
Universidad Complutense de Madrid
Departamento de Física Atomica, Molecular y Nuclear
Group of Statistical Mechanics (Juan M.R. Parrondo group)
Madrid, Spain

QUALIFICATIONS

2016 **Assistant Professor**
Spanish National Agency for Assessment and Accreditation (ANECA)

2013 **PhD in Physics**
Title: *Irreversibility and dissipation in microscopic systems*
Date: 29.07.2013
Universidad Complutense de Madrid, Madrid, Spain
Qualification: *Summa cum laude*

2009 **Master in Fundamental Physics**
Universidad Complutense de Madrid, Madrid, Spain

2008 **Bachelor in Physics**
Universidad Complutense de Madrid, Madrid, Spain

PUBLICATIONS

1. **Martingale theory for housekeeping heat**
R. Chetrite, S. Gupta, I. Neri, and **É. Roldán**
EPL **124**, 60006 (2018) - **Editor's choice**
2. **Records of entropy production in an electronic double dot**
S. Singh, **É. Roldán**, I. Neri, I. M. Khaymovich, D. S. Golubev,
V. F. Maisi, J. T. Peltonen, F. Jülicher and J. P. Pekola
Phys. Rev. B **99**, 115422 (2019)
3. **Arcsine Laws in Stochastic Thermodynamics**
A. C. Barato, **É. Roldán**, I. A. Martínez, and S. Pigolotti
Phys. Rev. Lett. **121** (9), 090601 (2018).
4. **Multiplex Decomposition of Non-Markovian Dynamics
and the Hidden Layer Reconstruction Problem**
L. Lacasa, I. P. Mariño, J. Miguez, V. Nicosia,
É. Roldán, A. Lisica, S. W. Grill, and J. Gómez-Gardeñes
Phys. Rev. X **8**, 031038 (2018)

5. **Generic properties of stochastic entropy production**
S. Pigolotti, I. Neri, **É. Roldán** and F. Jülicher
Phys. Rev. Lett. **119** (14), 140604 (2017)
6. **Path-integral formalism for stochastic resetting:
Exactly solved examples and shortcuts to confinement**
É. Roldán and S. Gupta
Phys. Rev. E **96** (2) 022130 (2017)
7. **Statistics of infima and stopping times of entropy production
and applications to active molecular processes**
I. Neri, **É. Roldán**, and F. Jülicher
Phys. Rev. X. **7**, 011019 (2017)
8. **Colloidal heat engines: a review**
I. A. Martínez, **É. Roldán**, L. Dinis, and R. A. Rica
Soft Matter **13** (1), 22-36 (2017)
Special Issue Emerging Investigators 2017
9. **Mechanisms of backtrack recovery by RNA polymerases I and II**
A. Lisica, C. Engel, M. Jahnel, **É. Roldán**, E. A. Galburt, P. Cramer and S. W. Grill
PNAS **113** (11), 2946-2951 (2016)
10. **Stochastic resetting in backtrack recovery by RNA polymerases**
É. Roldán, A. Lisica, D. Sanchez-Taltavull and S. W. Grill
Phys. Rev. E **93** (6), 062411 (2016)
11. **Brownian Carnot engine**
I. A. Martínez*, **É. Roldán***, L. Dinis, J. M. R. Parrondo, D. Petrov and R. A. Rica
Nature Phys. **12**, 67-70 (2016)
* equal contribution
12. **Thermodynamics at the microscale: from effective heating to the Brownian
Carnot engine**
L. Dinis , I. A. Martínez, **É. Roldán**, J. M. R. Parrondo, and R. A. Rica
J. Stat. Phys. **5**, 054003 (2016)
Special issue Focus on Stochastic Thermodynamics
13. **Decision Making in the Arrow of Time**
É. Roldán, I. Neri, M. Dörpinghaus, H. Meyr and F. Jülicher
Phys. Rev. Lett. **115**, 2506023 (2015)
14. **Adiabatic processes realized with a trapped Brownian particle**
I. A. Martínez, **É. Roldán**, L. Dinis, D. Petrov and R. A. Rica
Phys. Rev. Lett. **114** (12), 120601 (2015)

15. **Fluctuation theorems between non-equilibrium states in an RC circuit**
L. Granger, J. Mehlis, **É. Roldán**, S. Ciliberto and H. Kantz
New J. Phys. **17**, 065005 (2015)
16. **Universal features in the energetics of symmetry breaking**
É. Roldán*, I. A. Martínez*, J. M. R. Parrondo and D. Petrov
Nature Phys. **10**, 457-461 (2014)
Highlighted article in *News and Views* (Nature Physics)
* equal contribution
17. **Realization of nonequilibrium thermodynamic processes using external colored noise**
P. Mestres, I. A. Martínez, A. Ortiz-Ambriz, R. A. Rica and **É. Roldán**
Phys. Rev. E **90** (3), 032116 (2014)
18. **Measuring kinetic energy changes in the mesoscale with low acquisition rates**
É. Roldán, I. A. Martínez, L. Dinis and R. A. Rica
Appl. Phys. Lett. **104** (23), 234103 (2014)
19. **Effective heating to several thousand kelvin of an optically trapped sphere in a liquid**
I. A. Martínez, **É. Roldán**, J. M. R. Parrondo and D. Petrov
Phys. Rev. E **85** 031129 (2012)
20. **Time series irreversibility: a visibility graph approach**
L. Lacasa, À. Núñez, **É. Roldán**, J. M. R. Parrondo and B. Luque
Eur. Phys. J. B **85** (6), 1-11 (2012)
21. **Entropy production and Kullback-Leibler divergence between stationary trajectories of discrete systems**
É. Roldán and J. M. R. Parrondo
Phys. Rev. E **85** 031129 (2012)
22. **Estimating dissipation from single stationary trajectories**
É. Roldán and J. M. R. Parrondo
Phys. Rev. Lett. **105** 150607 (2010)

Google Scholar Number of Citations: **937**

Google Scholar h-Index: **15**

Google Scholar i10-Index: **18**

Preprints:

1. **Arrow of Time in Active Fluctuations**
É. Roldán, J. Barral, P. Martin, J.M.R. Parrondo and F. Jülicher
arXiv:1801.01574 (2018)

2. **Testing optimality of sequential decision making**
M. Dörpinghaus, I. Neri, **É. Roldán**, H. Meyr and F. Jülicher
arXiv:1801.01574 (2018)
3. **Integral fluctuation relations for entropy production at stopping times**
I. Neri, **É. Roldán**, S. Pigolotti and F. Jülicher
arXiv:1903.08115 (2019)
4. **Quantum martingale theory and entropy production**
G. Manzano, R. Fazio and **É. Roldán**
arXiv:1903.02925 (2019)
5. **Exact distributions of currents and frenesy for Markov bridges**
É. Roldán and P. Vivo
arXiv:1903.08271 (2019)

BOOKS

1. **Irreversibility and dissipation in microscopic systems**
É. Roldán
Springer, ISBN 978-3-319-07079-7 (2014)

CONFERENCE PROCEEDINGS

1. **An information-theoretic analysis of sequential decision making**
M. Dörpinghaus, **É. Roldán**, I. Neri, H. Meyr and F. Jülicher
IEEE International Symposium on Information Theory (ISIT), 3051 (2017)

AWARDS AND HONOURS

- | | |
|------|------------------------------------------------------------------------------------------------------------|
| 2019 | CNRS Chercheur Invite Federation Doebelin
Universite Cote d'Azur, Nice (France) |
| 2019 | CNRS Chair Joliot
ESPCI, Paris (France) |
| 2018 | EPL Distinguished Referee 2017
European Physical Society |
| 2017 | EPS-SNPD Early Career Prize
European Physical Society |
| 2017 | MPIPKS Distinguished Postdoctoral Fellow
Max Planck Institute for the Physics of Complex Systems |

- 2017 **Liquid Art Contest - scientific artwork public outdoor display**
10th Liquid Matter Conference - LIQUIDS 2017
Ljubljana (Slovenia), 17th July
- 2017 **Prize “for excellent poster presentation”**
Gordon Research Conference “Stochastic Physics in Biology”
Ventura, California (United States), 12th January
- 2014 **International Springer Theses Prize**
- 2014 **PhD extraordinary prize**
Universidad Complutense de Madrid, Madrid, Spain
- 2007 **Second Prize of Award “Premio Promoción 60”**
Facultad de Ciencias Físicas
Universidad Complutense de Madrid, Madrid, Spain

ORGANIZATION OF INTERNATIONAL CONFERENCES

- 2018 **Stochastic Thermodynamics: Experiment and Theory (STET’18)**
Scientific organizer
Max Planck Institute for the Physics of Complex Systems
Dresden, Germany
September 10-14

PRESENTATIONS IN INTERNATIONAL CONFERENCES

- 2019 **Workshop “Colloids as a Toolbox for Statistical Mechanics:
Heat Engines, Confinement and Thermodynamics”**
Invited Talk: “Experimental construction of a colloidal Carnot engine”
University of Cambridge, Cambridge March 11
- 2018 **Workshop “Why measure entropy production?”**
Invited Talk: “Arrow of time and entropy production in active fluctuations”
Princeton Center for Theoretical Sciences, Princeton November 5-7
- 2018 **QT60 - Workshop on thermodynamics, thermoelectrics
and transport in quantum devices**
Invited Talk: “Extreme reductions of entropy production in an
electronic double dot”
Hanasaari Cultural Centre, Espoo September 21-23
- 2018 **CONES 2018 - Conference on Non-Equilibrium Systems**
Invited Talk: “Arcsine laws and extreme values in

- stochastic thermodynamics”
King’s College London, London June 25-27
- 2018 **Advanced Workshop on Nonequilibrium Systems in Physics, Geo sciences, and Life Sciences**
Invited Talk: “Arcsine laws and extreme values in stochastic thermodynamics”
ICTP, Trieste May 14-25
- 2018 **DPG Meeting**
Talk: “Records of entropy production in a double quantum dot”
TU Berlin, Berlin March 11-16
- 2017 **30th Smoluchowski Symposium**
Invited Talk: “Generic Properties of Stochastic Entropy Production”
Collegium Novum, Krakow September 3-8
- 2017 **LIQUIDS’17 Liquid Matter Conference**
Talk: “Brownian Carnot engine”
Cankarjev dom Cultural and Congress Centre, Ljubljana July 17-21
- 2017 **FQMT’17 Frontiers of Quantum and Mesoscopic Thermodynamics**
Invited Talk: “Negative records of entropy production: the infimum law”
Orea Hotel Pyramida, Prague, July 10-15
- 2017 **FQMT’17 Frontiers of Quantum and Mesoscopic Thermodynamics**
Poster: “Decision Making in the Arrow of Time”
Orea Hotel Pyramida, Prague, July 10-15
- 2017 **Climate Fluctuations and Non-equilibrium Statistical Mechanics: an interdisciplinary dialogue**
Invited Talk: “Martingale theory for nonequilibrium thermodynamics”
MIPPKS, Dresden, July 10
- 2017 **Dynamics, Thermodynamics and Information Processing in Chemical Networks**
Talk: “Negative records of entropy production: the infimum law”
University of Luxembourg, Luxembourg, June 13-16
- 2017 **DPG Spring Meeting**
Talk: “Extreme values of mesoscopic currents in Physics and Biology”
TU Dresden, Dresden, Germany, March 21-25
- 2017 **DPG Spring Meeting**
Talk: “Brownian Carnot engine”
TU Dresden, Dresden, Germany, March 21-25

- 2017 **Gordon Research Conference “Stochastic physics in biology”**
 Poster: “Decision Making in the arrow of time”
 Ventura, California, United States. January 8-13
 Awarded with Poster Prize
- 2016 **Principles of biological and robotic navigation**
 Poster: “Experimental construction of a Brownian Carnot engine”
 MPIPKS, Dresden, Germany. August 29-31
- 2016 **Information, Probability and Inference in Systems Biology Conference (IPISB2016)**
 Poster: “Decision Making in the Arrow of Time”
 IST Austria, Klosteneuburg, Austria. May 18-20
- 2016 **DPG Spring Meeting**
 Talk: “Decision Making in the Arrow of Time”
 Universitat Regensburg, Regensburg, Germany. March 6-12
- 2015 **European Biophysics Congress**
 Poster: “Quantifying irreversibility in ear hair bundle spontaneous oscillations”
 International Congress Center Dresden, Germany. July 18-22
- 2015 **DPG Spring Meeting**
 Poster: “Mechanisms of backtrack recovery in RNA polymerases I and II”
 Technische Universität Berlin, Germany. March 20-25
- 2015 **Workshop on recent Developments In Non-Equilibrium Physics “Luxembourg out of Equilibrium”**
 Talk: “Thermodynamics of symmetry breaking”
 Université de Luxembourg, Luxembourg. January 12-15
- 2014 **XI GISC Workshop**
 Talk: “Thermodynamics of symmetry breaking”
 Universidad Complutense de Madrid, Madrid, Spain. February 7
- 2013 **X GISC Workshop**
 Talk: “Detecting active processes from spontaneous oscillations of Ear Hair Bundles”
 Universidad Carlos III, Leganés (Madrid), Spain. February 8
- 2012 **FisEs 2012**
 Talk: “Mimicking high-temperature reservoirs for colloidal particles using noisy electric fields”
 IFISC, Palma de Mallorca, Spain. October 18-20
- 2011 **FisEs 2011**
 Poster: “Irreversibility and dissipation in stochastic processes”
 Universitat de Barcelona, Barcelona, Spain. July 2-4
- 2010 **II Workshop MODELICO**
 Talk: “Relative entropy as a quantitative measure of irreversibility in non-equilibrium stationary states”
 Centro de Astrobiología INTA-CSIC, Madrid, Spain. November 12

- 2010 **International Symposium on Quantum Thermodynamics**
Talk: “Entropy production and time asymmetry in nonequilibrium stationary states”
 Universität Stuttgart, Stuttgart, Germany. September 13-17
- 2010 **Mechanics of Large Molecular Assemblies**
Talk: “Construction of a microscopic Szilard engine”
 IFISC, Mallorca, Spain. April 8-11
- 2010 **VI GISC Workshop**
Talk: “Dissipation and information in stochastic processes”
 Universidad Carlos III, Madrid, Spain. February 19
- 2009 **kTlog2: Computing Matters.**
Talk: “Estimating dissipation with single stationary trajectories”
 Toledo, Spain. October 22-24
- 2008 **I Congreso Complutense de Divulgación de Física Nuclear y de Partículas**
 Poster: “Neutrino mass research: Double Beta Decay and the Nemo Project”
 Madrid, Spain. July 8

RESEARCH STAYS

- 2019 **ESPCI**
 Paris, France
 April 21 - 6 May
- 2018 **Universite Cote d’Azur**
 Nice, France
 December 10-14
- 2018 **The Rockefeller University**
 New York, United States
 November 7-9
- 2018 **King’s College London**
 London, United Kingdom
 June 25-29
- 2018 **Aalto University**
 Aalto, Finland
 May 14-18
- 2017 **ESPCI**
 Paris, France
 December 18-21

- 2017 **Institut Curie - Laboratoire de Physico Chimie**
Paris, France
February 23 - March 3
- 2012 **ICFO - The institute of photonic sciences**
Castelldefels (Barcelona), Spain
November 9-24
- 2012 **Max Planck Institute for the Physics of Complex Systems**
Dresden, Germany
July 1 - September 1
- 2012 **ICFO - The institute of photonic sciences**
Castelldefels (Barcelona), Spain
March 28 - April 14
- 2012 **ICFO - The institute of photonic sciences**
Castelldefels (Barcelona), Spain
February 6-21
- 2011 **ICFO - The institute of photonic sciences**
Castelldefels (Barcelona), Spain
August 20 - September 6
- 2010 **Max Planck Institute for Molecular Cell Biology and Genetics**
Dresden, Germany
February 22 - April 8
- 2009 **Max Planck Institute for the Physics of Complex Systems**
Dresden, Germany
July 1 - August 10
- 2008 **Max Planck Institute for the Physics of Complex Systems**
Dresden, Germany
July 18 - August 18

INVITED SEMINARS IN EXTERNAL INSTITUTIONS

- 2019 **“Martingale theory for nonequilibrium thermodynamics”**
Laboratoire Gulliver, ESPCI
Paris, France. May 2
- 2019 **“Arrow of Time and Entropy Production in Active Fluctuations**
Disordered System Group, Department of Mathematics, Kings college
London, United Kingdom. March 14
- 2019 **“Arrow of Time and Entropy Production in Active Fluctuations”**
Soft Matter Group, University of Cambridge

Cambridge, United Kingdom. March 13

- 2018 **“Martingale theory for nonequilibrium thermodynamics”**
Laboratoire Dieudonne, Universite Cote d’Azur
Nice, France. December 11
- 2018 **“Arrow of Time and Entropy Production in Active Fluctuations”**
Hudspeth Lab, The Rockefeller University
New York, United States. November 8
- 2018 **“Heat engines and Carnot efficiency at the nanoscale”**
University of Southampton, Faculty of Engineering and Environment
Southampton, England. June 29
- 2018 **“Arcsine laws and extreme values in stochastic thermodynamics”**
PICO group, Aalto University
Aalto, Finland. May 21
- 2018 **“Records of entropy production at the nanoscale”**
QLS Seminar. Abdus Salam International Centre
for Theoretical Physics (ICTP)
Trieste, Italy. January 9
- 2017 **“Heat engines and Carnot efficiency at the nanoscale”**
Theoretical Physics Colloquium. Universität Oldenburg
Oldenburg, Germany. November 16
- 2017 **“Martingale Theory for Nonequilibrium Thermodynamics”**
Theoretical Physics Colloquium. Institute for Theoretical Physics Cologne
Cologne, Germany. May 26
- 2017 **“Decision Making and Infima in Physics and Biology”**
Seminar in Laboratoire de Physico Chimie
Institut Curie. Paris, France. February 28
- 2015 **“Decision Making in the Arrow of Time”**
Seminario de Fisica Estadística GISC-UCM. Departamento de Fisica
Atomica, Molecular y Nuclear. Universidad Complutense de Madrid
Madrid, Spain. December 18
- 2015 **“Brownian Carnot engine”**
Origin of Life seminar. Max-Planck Institute for Molecular Cell Biology and
Genetics. Dresden, Germany. October 1
- 2015 **“To cleave or not to cleave: the choice of recovery pathway in RNA
polymerase backtracking”**

Polymerase day

Deutsches Hygiene-Museum Dresden, Germany. August 25

- 2014 **“Mechanisms of backtrack recovery in RNA polymerases I and II”**
Universidad Politecnica de Madrid, Madrid, Spain. December 18th
- 2014 **“Thermodynamics of symmetry breaking”**
Universidad de Granada, Granada, Spain. April 22
- 2014 **“Thermodynamics of symmetry breaking”**
Centre de Recerca Matematica
Bellaterra (Barcelona), Spain. March 12
- 2012 **“Irreversibility and dissipation in the nonequilibrium stationary state (NESS)”**
Grill Lab group meeting
Max-Planck Institute for Molecular Cell Biology and Genetics (MPI- CBG),
Dresden, Germany. July 14
- 2012 **“Increase of Effective temperature in a colloidal particle up to 3000K” (Joint seminar with Ignacio A. Martínez)**
Petrov Lab, ICFO- The Institute Of Photonic Sciences
Castelldefels (Barcelona), Spain. November 15

TEACHING

- 2018 **Lectures “Probability Theory” - Master Physics of Complex Systems**
SISSA - Scuola Internazionale di Studi Avanzati Trieste
Joint course with Matteo Marsili
Trieste, Italy
- 2017 **Lectures “Theoretical Biophysics”**
Technische Universität Dresden
Joint course with Frank Jülicher and Stephan W. Grill
Dresden, Germany
- 2016 **Practicals for PhD students, Dresden International PhD Program**
Max Planck Institute for the Physics of Complex Systems
Dresden, Germany
- 2012-2013 **Lectures “Physics applied to biology”**
Faculty of Biology and Geology
Joint course with Luis Dinis
Universidad Complutense de Madrid, Madrid, Spain
- 2011-2012 **Lectures “Physics applied to biology”**
Faculty of Biology and Geology
Joint course with Luis Dinis
Universidad Complutense de Madrid, Madrid, Spain

- 2007-2008 **Tutorships “Differential Equations I”**
With J. I. Aranda Iriarte
Universidad Complutense de Madrid, Madrid, Spain
- 2006-2007 **Tutorships “Calculus I”**
With J. M. R. Parrondo
Universidad Complutense de Madrid, Madrid, Spain

THESIS COMMITTEES

- 2019 Vice-chair of the PhD Thesis Committee
Candidate: Nicolas Tizon Escamilla
PhD in Physics, Universidad de Granada
Granada, Spain, January 2019
- 2018 Vice-chair of the PhD Thesis Committee
Candidate: Ryan Cubero
PhD in Statistical Physics, SISSA
Trieste, Italy, October 2018
- 2018 External evaluator of the PhD Thesis
Candidate: Priyo S. Pal
PhD in Physics, Homi Bhabha National Institute
Bhubaneswar, India, December 2019
- 2014 Vice-chair of the PhD Thesis Committee
Candidate: Ángel M. Núñez
PhD in Physics, Universidad Politecnica de Madrid
Madrid, Spain, December 19

SUPERVISION

- **Alexandre Guillet** (France, Master student) June 2017 - August 2017
- **Roman Belousov** (Russia, Postdoc) Jan 2019 - current
- **Ashwin Gopal** (India, Master student) May 2019 - current

FUNDING

- 2018 **Application ERC starting grant: Step 2 Interview**
Final panel score: A
(Ranking range 50%, not selected for funding)
- 2009-2013 **PhD grant "Beca de Formación de Profesorado Universitario (FPU)"**
Ministerio de Educación y Ciencia, Spanish Government (national)

- 2008-2009 **Master grant “Beca para estudios de master”**
Obra Social La Caixa, Barcelona, Spain (private)
- 2007-2008 **Bachelor grant “Beca de Colaboración en la investigación”**
Ministerio de Educación y Ciencia, Spanish Government (national)
- 2005-2006 **Bachelor grant “Beca de Excelencia”**
Comunidad de Madrid, Madrid, Spain (regional)
- 2004-2005 **Bachelor grant “Beca de Excelencia”**
Comunidad de Madrid, Madrid, Spain (regional)

SCIENTIFIC DIVULGATION

- 2017 **Article “Termodinàmica Estocàstica: un camp científic emergent”**
Notices per a Químics”
Col·legi de Químics de Catalunya

SUMMER SCHOOLS

- 2012 **“II Gefenol Summer School on Statistical Physics of Complex and Small Systems”**
Centro de Ciencias de Benasque Pedro Pascual
Benasque (Huesca), Spain
September 3rd-14th
- 2011 **“Summer School on Statistical Physics of Complex and Small Systems”**
IFISC, Palma de Mallorca, Spain
September 12th-23rd

OTHERS

Referee for the American Physical Society (APS) since 2015

Scientific referee for: Physical Review X, Physical Review Letters, Physical Review E, New Journal of Physics, Journal of Chemical Physics, EPL (Distinguished Referee 2017), European Physical Journal B, Physica A, Entropy

Spoken languages: English (fluent oral and written), Spanish (native), French (intermediate level), German (beginner level), Italian (beginner level), Basque (intermediate level)

Programming: C, C++, Python, MATLAB, Mathematica