

## Édgar Roldán

Abdus Salam International Centre for  
Theoretical Physics (ICTP)  
Strada Costiera, 11  
34151 Trieste, Italy

Tel: +39 0402240136  
Email: [edgar@ictp.it](mailto:edgar@ictp.it)  
Website: [www.edgarroldan.com](http://www.edgarroldan.com)  
Date: 8.1.2019



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.    **Arcsine Laws in Stochastic Thermodynamics**  
A. C. Barato, **É. Roldán**, I. A. Martínez, and S. Pigolotti  
Phys. Rev. Lett. **121** (9), 090601 (2018).
3.    **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)
4.    **Generic properties of stochastic entropy production**  
S. Pigolotti, I. Neri, **É. Roldán** and F. Jülicher  
Phys. Rev. Lett. **119** (14), 140604 (2017)

5. **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)
6. **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)
7. **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
8. **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)
9. **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)
10. **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
11. **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
12. **Decision Making in the Arrow of Time**  
É. Roldán, I. Neri, M. Dörpinghaus, H. Meyr and F. Jülicher  
Phys. Rev. Lett. **115**, 2506023 (2015)
13. **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)
14. **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)

15. **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
  
16. **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)
  
17. **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)
  
18. **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)
  
19. **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)
  
20. **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)
  
21. **Estimating dissipation from single stationary trajectories**  
**É. Roldán** and J. M. R. Parrondo  
 Phys. Rev. Lett. **105** 150607 (2010)

Google Scholar Number of Citations: **828**

Google Scholar h-Index: **14**

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. **Universal First-Passage-Time Distribution of Non-Gaussian Currents**  
S. Singh, P. Menczel, D. S. Golubev, I. M. Khaymovich, J. T. Peltonen, C. Flindt, K. Saito, **É. Roldán**, and J. P. Pekola  
arXiv:1809.06870 (2018)
4. **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  
arXiv:1712.01693 (2017)

## 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

---

- |      |   |
|------|---|
| 2018 | <b>EPL Distinguished Referee 2017</b><br>European Physical Society  |
| 2017 | <b>EPS-SNPD Early Career Prize</b><br>European Physical Society   |
| 2017 | <b>MPIPKS Distinguished Postdoctoral Fellow</b><br>Max Planck Institute for the Physics of Complex Systems  |
| 2017 | <b>Liquid Art Contest - scientific artwork public outdoor display</b><br>10th Liquid Matter Conference - LIQUIDS 2017<br>Ljubljana (Slovenia), 17th July            |
| 2017 | <b>Prize “for excellent poster presentation”</b><br>Gordon Research Conference “Stochastic Physics in Biology”<br>Ventura, California (United States), 12th January |
| 2014 | <b>International Springer Theses Prize</b>  |

- 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  
(Sergio Ciliberto, John Bechhoefer, Simone Pigolotti and **Edgar Roldan**)  
Max Planck Institute for the Physics of Complex Systems  
Dresden, Germany  
September 10-14

## PRESENTATIONS IN INTERNATIONAL CONFERENCES

---

- 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”  
MPIPKS, 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

---

- 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

---

- 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

---

- 2018      Vice-chair of the PhD Thesis Committee  
 Candidate: Ryan Cubero  
 PhD in Statistical Physics, SISSA  
 Trieste, Italy, October 2019
- 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

---

2017 **Alexandre Guillet “Stochastic thermodynamics of living systems”**  
 Visiting Master Student  
 Max Planck Institute for the Physics of Complex Systems  
 Dresden, Germany  
 June-August

## 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      **"Il 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 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