

# GIUSEPPE PUCCI

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## RESEARCH EXPERIENCE

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### **Institute of Physics of Rennes, University of Rennes 1**

Rennes, France

*Researcher funded by the program CNRS-Momentum.*

2018–2020

- PI of the project “Self-organization of fluid and solid structures on fluid interfaces at the macroscopic scale”. Supervising a post-doc.
- Experimentally investigating and theoretically rationalizing liquid-on-liquid wetting phenomena driven by surface tension gradients.
- Experimentally characterizing and theoretically rationalizing novel patterns of waves generated by the Faraday instability on the surface of a liquid bath.

### **Brown University, School of Engineering**

Providence (RI), USA

*Post-doctoral Research Associate in the group of Prof. Daniel M. Harris.*

2017–2018

- Experimentally characterized and theoretically rationalized the friction experienced by centimetric objects that slide on water. Under review in *Scientific Reports*.
- Designed a setup based on magnetic force to measure the capillary interaction between centimetric objects resting on water (“Cheerios effect”). Mentored a student who is characterizing these capillary forces.

### **Massachusetts Institute of Technology, Dept. of Mathematics**

Cambridge (MA), USA

*Post-doctoral Research Associate in the group of Prof. John W. M. Bush.*

2015–2017

- Research on hydrodynamic analogs of microscopic systems: walking droplets interacting with boundaries [2,3,4,6]. Active collaboration with applied mathematicians at MIT.
- Rationalized the reflection of a walking droplet from a planar wall; found non-specular reflection [6].
- Characterized through precise experiments the interaction of walking droplets with single and double slits; found non-quantum behavior in this configuration [3].
- Characterized the refraction-like behavior of walking droplets experiencing a reduction in liquid depth; found an effective Snell’s law and other optical analogs. Manuscript *in preparation*.
- Experimentally investigated the diffusion of a droplet bouncing on a field of standing waves. Ongoing collaboration with A. Rahman (Texas Tech Univ.).
- Designed the setup for spin lattices of walking droplets; found anti-ferromagnetic order. Collaboration with Prof. Jörn Dunkel (MIT). Work actively pursued by P. Sáenz at MIT. Manuscript *in preparation*.

### **Massachusetts Institute of Technology, Dept. of Mathematics**

Cambridge (MA), USA

*Post-doctoral Fellow (visiting) in the group of Prof. John W. M. Bush.*

2014

- Experimentally demonstrated and theoretically rationalized the partial coalescence of a soap bubble and a soap film [5,10].
- Designed and set up an experiment for the study of walking droplets interacting with a single slit; found transition to chaos [3].

### **University of Calabria, Dept. of Physics**

Rende (CS), Italy

*Post-doc in the group of Prof. Riccardo Barberi*

2013–2015

- Discovered and characterized curved pattern of electro-convection in nematic samples with planar-periodic alignment [7]. Characterized the topologically non-equivalent textures generated by the nematic electrohydrodynamics [1].

**University of Calabria, Dept. of Physics**  
*Post-doc in the group of Prof. Riccardo Barberi*

Rende (CS), Italy  
2012–2013

- Research on the project: “Innovative nanotechnologic platforms for drugs delivery in Ophthalmology”. Collaboration with Marco Lombardo (Doctor of Medicine, Vision Engineering Italy).
- PI of the group investigating the interaction of ultraviolet light with the human cornea.
- Designed apparatus that mimics the physiological conditions of the eye for the measurement of light absorbance and the detection of clinical solutions inside the human cornea [14].
- Tested a number of trans-epithelial commercial solutions; assessed which solutions were effectively absorbed and could be used for medical treatment [8].

## EDUCATION

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**University of Paris VII Denis Diderot and University of Calabria**  
*Ph.D. in Fluid Dynamics and Science of Mesophases.*

France/Italy  
2008–2011

Mention: *Very Honorable, with Committee Praise.*

Committee composed of: Riccardo Barberi (University of Calabria, co-supervisor); Roberto Bartolino (University of Calabria, examiner); Martine Ben Amar (Ecole Normale Supérieure, examiner); Christophe Clanet (CNRS - Ecole Polytechnique, president); Yves Couder (University of Paris VII Denis Diderot, supervisor); Francesco Mantegazza (University of Milan Bicocca, referee); Marc Rabaud (University of Paris-Sud, referee).

- Research on the Faraday instability in floating drops: a striking example of a hydrodynamic instability in a domain with flexible boundaries [9,13,15,16,17]. Collaboration with Prof. Martine Ben Amar (Ecole Normale Supérieure).
- Experimentally characterized and theoretically rationalized the equilibrium shapes of floating liquid drops deformed by the radiation pressure of surface waves [15,17].
- Experimentally characterized the non-equilibrium behavior of floating drops deformed by radiation pressure; rationalized their self-propulsion [13].
- Research on electrohydrodynamics and topological defects in nematic liquid crystals [1, 11].
- Observed that topologically non-equivalent textures are generated by the transition from turbulence to stochastic regime [1]. Characterized the variation of the transition threshold in nematic mixtures as a function of concentration [11].

**University of Calabria**  
*Master in Physics of Matter. 110/110 cum laude*

Rende (CS), Italy  
2006–2008

- Six-month internship at University Paris VII: Faraday instability in deformable domains.
- Observed and studied the equilibrium shapes of drops deformed by the radiation pressure of surface waves.

**University of Calabria**  
*Bachelor in Physics. 110/110 cum laude*

Rende (CS), Italy  
2003–2006

- Three-month internship at University of Calabria: “A novel method to create probes for atomic force spectroscopy”. Developed a new technique to obtain probes for the Atomic Force Microscope with a typical radius of  $\sim 100$  nm [18].

## SKILLS AND EXPERTISE

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<b>Fluid Dynamics</b>	fluid interfaces, surface waves, surface tension.
<b>Soft Matter</b>	liquid crystals, corneal tissues, AFM, cleanroom techniques.
<b>Non-linear physics</b>	pattern formation, self-organization.
<b>Mechanics</b>	design and construction of setups for mechanical vibrations.
<b>Computer Languages</b>	C/C++, MATLAB.
<b>Software &amp; Tools</b>	Mathematica, Fusion 360 (3D designing), Illustrator.
<b>Languages</b>	Italian (first language), French (fluent), English (fluent).

## GRANTS AND FELLOWSHIPS

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**Grant from the French CNRS** Institute of Physics of Rennes, France  
*French National Center for Scientific Research.* 2018–2020

- CNRS-Momentum: about 180 k€ plus personal salary and two-year salary for a post-doc.
- Within the call CNRS-Momentum 2017, 19 projects were funded over 430 projects presented.

**Grant from the National Science Foundation of U.S.A.** Brown University, USA  
*Condensed Matter Physics program.* 2018

- About 5000 \$ for organizing the workshop “Hydrodynamic Quantum Analogs 8”.

**Post-doctoral Fellowship** University of Haifa, Israel  
*From The Hatter Departement of Marine Technology.* 2015–2016

- To be spent at the Massachusetts Institute of Technology.

**Post-doctoral Fellowship** University of Calabria, Italy  
*From Calabria Region.* 2012–2014

**Grant from Université Franco-Italienne** University of Paris VII, France  
2009–2011

- About 4500 € to be spent for travels during the Ph.D.

**Ph.D. funded by Université Franco-Italienne** University of Paris VII, France  
2008–2011

- To be spent at University of Paris VII (main institution) and University of Calabria (secondary institution). ([link to website](#))

## ORGANIZATION OF MEETINGS

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**Co-organizer of the meeting Hydrodynamic Quantum Analogs 8** Brown University, USA  
July 2018

- About 30 participants from: MIT, University of Liège, IMPA (Rio de Janeiro), New Jersey Institute of Technology, National Autonomous University of Mexico, University of Bath (UK), California Polytechnic State University, Monash University (Australia) and Brown University. ([link to website](#))

**Co-organizer of the meeting Hydrodynamic Quantum Analogs 5** Calabria, Italy  
July 2015

- About 25 participants from: MIT, University of Liège, IMPA (Rio de Janeiro), KAUST (Saudi Arabia), New York University, Max Planck Institute for Dynamics and Self-organization (Göttingen), University of Bath (UK) and University of Calabria.

## INVITED SEMINARS

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<b>Soap bubbles, walking drops and sliders at fluid interfaces</b> <i>Laboratories IRPHE and IUSTI, University of Aix-Marseille.</i>	Marseille, France Oct. 2018
<b>Soap bubbles, walking drops and sliders at fluid interfaces</b> <i>Laboratories FAST and LIMSI, University of Paris-Sud.</i>	Orsay, France Sep. 2018
<b>Three experiments with drops and bubbles on fluid interfaces</b> <i>School of Engineering at Brown University.</i>	Providence (RI), USA Nov. 2017
<b>Walking droplets interacting with boundaries</b> <i>Institute of Light and Matter, University Claude Bernard Lyon 1.</i>	Lyon, France Oct. 2017
<b>Hydrodynamic analogs</b> <i>Department of Physics at the University of Massachusetts, Boston.</i>	Boston (MA), USA 2017
<b>Walking droplets interacting with submerged boundaries</b> <i>Institute of Physics of Rennes, University of Rennes 1.</i>	Rennes, France 2016
<b>Three experiments with drops and bubbles on fluid interfaces</b> <i>Marine Technology Research Institute (INSEAN).</i>	Rome, Italy 2015
<b>Faraday instability in deformable domains</b> <i>Physical Mathematics group, Dept. of Mathematics, Massachusetts Institute of Technology.</i>	Cambridge (MA), USA 2014
<b>The Faraday instability in deformable domains</b> <i>Jean le Rond d'Alembert Institute, University Pierre et Marie Curie (UPMC).</i>	Paris, France 2012

## SELECTED CONFERENCE PRESENTATIONS

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<b>Friction on water sliders</b> <i>European Fluid Mechanics Conference</i>	Vienna, Austria Sep. 2018
<b>Spin lattices of walking droplets</b> <i>Condensed Matter Days, French Physical Society.</i>	Grenoble, France Aug. 2018
<b>Partial coalescence of a soap bubble with a soap film</b> <i>March Meeting of the American Physical Society.</i>	Los Angeles (CA), USA March 2018
<b>Droplets bouncing on a standing wave field</b> <i>Meeting of the Division of Fluid Dynamics of the American Physical Society.</i>	Denver (CO), USA Nov. 2017
<b>Walking drops interacting with submerged boundaries</b> <i>Workshop "Waves and particles, novel insights".</i>	Mexico City, Mexico 2017
<b>Diffraction and interference of walking droplets</b> <i>Meeting of the Division of Fluid Dynamics of the American Physical Society.</i>	Portland (OR), USA 2016
<b>Diffraction and interference of walking droplets</b> <b>Invited talk.</b> <i>European Fluid Mechanics Conference.</i>	Sevilla, Spain 2016
<b>Walking droplets interacting with planar boundaries</b> <i>Meeting of the Division of Fluid Dynamics of the American Physical Society.</i>	Boston (MA), USA 2015
<b>Faraday instability in deformable domains</b> <i>Meeting of the Division of Fluid Dynamics of the American Physical Society.</i>	San Francisco (CA), USA 2014

<b>Order reconstruction in turbulent nematics</b> <i>Meeting of the Italian Liquid Crystal Society.</i>	Ravenna, Italy 2014
<b>Faraday instability in deformable domains</b> <i>Meeting of the Italian Physical Society.</i>	Naples, Italy 2012
<b>Turbulence induces change of topology in calamitic nematics</b> <i>Meeting of the Italian Liquid Crystal Society.</i>	Rome, Italy 2012
<b>Mutual adaptation of a Faraday instability pattern with its flexible boundaries</b> <i>Fluid - DTU Summer School.</i>	Denmark 2011
<b>The interplay of an instability pattern with its flexible boundaries</b> <i>Conference “On growth and forms” in honour of Prof. Yves Couder.</i>	Agay, France 2010
<b>The interplay of an instability pattern with its flexible boundaries</b> <i>International Marangoni Association Conference.</i>	Florence, Italy 2010
<b>Faraday instability in deformable domains</b> <i>Fluid - DTU Summer School</i>	Denmark 2009
<b>Force measurements at nanoscale by an atomic force microscope</b> <i>Summer course of Scuola Normale Superiore.</i>	Cortona, Italy 2006

## AWARDS

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<b>Gallery of Fluid Motion Award Winner</b> <i>American Physical Society - Division of Fluid Dynamics</i>	Denver (CO), USA Nov. 2017
· Video “Spin lattices of walking droplets”. ( <a href="#">link to video</a> )	
<b>Milton van Dyke Award Winner</b> <i>American Physical Society - Division of Fluid Dynamics</i>	Boston (MA), USA Nov. 2015
· Video “The merger of a bubble and a soap film”. ( <a href="#">link to video</a> )	
<b>Milton van Dyke Award Winner</b> <i>American Physical Society - Division of Fluid Dynamics</i>	San Francisco (CA), USA Nov. 2014
· Video “Faraday instability in floating drops”. ( <a href="#">link to video</a> )	
<b>Best presentation in Physics of Matter, Italian Physical Society</b> <i>Meeting of the Italian Physical Society.</i>	Naples, Italy 2012

## SUPERVISION AND MENTORING

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### **Supervision of Benjamin Reichert**

*Post-doc within the program CNRS-Momentum.*

Institute of Physics of Rennes, France

2018–2020

- Self-organization at fluid interfaces.

### **Mentoring of Ian Ho**

*Bachelor student.*

Brown University, USA

Jan.–July 2018

- Centimetric objects sliding on water and their mutual interaction due to capillary forces.

### **Mentoring of Roy Glavanitz**

*Bachelor student from Munich University of the Federal Armed Force.*

Brown University, USA

May–July 2018

- Design and implementation of a swimmer at intermediate Reynolds number.

### **Mentoring of Alexis Goujon**

*Master student from Ecole Polytechnique.*

MIT, USA

Spring 2017

- Spin lattices of walking droplets.

### **Mentoring of Jean-Baptiste Moiroud**

*Master student from Ecole Polytechnique.*

MIT, USA

Spring 2017

- Walking drops in double and triple cavities. Tunneling of walking drops.

### **Mentoring of Brandon Whitchurch**

*Bachelor student from University of Massachusetts, Amherst.*

MIT, USA

Aug. 2016

- Interaction between promenading pairs of walking droplets.

### **Co-supervisor of Crystal Owen, Andrew M. Fiore and Filip Twarowski**

*Ph.D. and master students, for projects of the course Interfacial Phenomena.*

MIT, USA

Spring 2016

- Vibration of soap bubbles.
- Non-linear phenomena in a liquid-on-liquid wetting system.
- Faraday-wave propelled boat.

### **Mentoring of Benjamin Aubin**

*Master student from Ecole Polytechnique.*

MIT, USA

Apr.–July 2016

- Refraction of walking droplets.

### **Co-supervisor of Pierluigi Bilotto and Giuseppe Di Nardo**

*Bachelor students, final internship.*

University of Calabria, Italy

2014

- Walking droplets interacting with a single slit.
- Analogies between the De Broglie-Bohm pilot-wave theory and walking droplets.

### **Mentoring of Clement Fontaine**

*Bachelor student.*

University Paris VII

May 2010

- Faraday instability in a rotating fluid.

## TEACHING EXPERIENCE

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**Instructor of Fluid Mechanics** University of Rennes 1, France  
*Master in Fundamental Physics.* Fall 2018

**Teaching Assistant (Instructor) of Differential Equations** MIT, USA  
*Bachelor level. Overall rating: 6.2/7.* Spring 2017

**Assistant Instructor of Quantum Mechanics and General Physics** Univ. of Calabria, Italy  
*Bachelor level.* 2012–2013

**Assistant Instructor of Physics and Mathematics.** University of Paris VII, France  
*Bachelor level.* 2008–2011

**Guide of high school students during the Science Week** University of Paris VII, France  
*One-day visit of students from Lycée Charles de Foucault of Paris.* Oct. 2010

**Guide of University students** University of Paris VII, France  
*One-day visit of the Physics Students Association of Perugia, Italy.* Nov. 2010

- Includes a meeting with Prof. Atef Asnacios.

**Elected representative of Ph.D. students** University of Paris VII, France  
*Doctorate School “Condensed Matter and Interfaces”* 2009–2011

**Elected representative of Physics students** Univ. of Calabria, Italy  
*Laurea Course Council, addressing organization of classes and course work.* 2006–2008

## TEACHING QUALIFICATIONS

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**French Qualification for Assistant Professor** France  
*Maître de conférences.* 2017

**Italian Qualification for teaching in high schools** Italy  
*Active Formative Apprenticeship, for teaching Mathematics and Physics.* 2015

- Includes more than 100 hours in a high school. Score 99/100.

## ACADEMIC RESPONSIBILITIES

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**Elected representative of Ph.D. students** University of Paris VII, France  
*Doctorate School “Condensed Matter and Interfaces”.* 2009–2011

**Elected representative of Physics students** Univ. of Calabria, Italy  
*Laurea Course Council, addressing organization of classes and course work.* 2006–2008

## LIST OF PUBLICATIONS

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1. **G. Pucci**, F. Carbone, G. Lombardo, C. Versace, R. Barberi. Topologically non-equivalent textures generated by the nematic electrohydrodynamics. *Liq. Cryst.* (2019). doi: <https://doi.org/10.1080/02678292.2018.1555649>.
2. P. J. Saenz, **G. Pucci**, A. Gujon, T. Cristea-Platon, J. Dunkel and J. W. M. Bush. Spin lattices of walking droplets. *Phys. Rev. Fluids* **3**, 100508 (2018); winning entry to the Gallery of Fluid Motion of the American Physical Society.
3. **G. Pucci**, D.M. Harris, L. Faria and J. W. M. Bush. Walking droplets interacting with single and double slits. *J. Fluid Mech.* **835**:1136-1156 (2018).
4. N. Sungar, L. Tambasco, **G. Pucci**, P. J. Saenz and J. W. M. Bush. Hydrodynamic analog of particle trapping with the Talbot effect. *Phys. Rev. Fluids* **2**, 103602 (2017).
5. D. M. Harris, **G. Pucci**, V. Prost, J. Quintela and J. W. M. Bush. The merger of a bubble and a soap film, *Phys. Rev. Fluids* **1** (5), 050505 (2016); Milton Van Dyke Award of the Gallery of Fluid Motion of the American Physical Society.
6. **G. Pucci**, P. J. Saenz, L. M. Faria and J. W. M. Bush. Non-specular reflection of walking droplets, *J. Fluid Mech.* **804**, R3 (2016).
7. **G. Pucci**, D. Lysenko, C. Provenzano, Yu. Reznikov, G. Cipparrone and R. Barberi. Patterns of electro-convection in planar-periodic nematic cells. *Liq. Cryst.* **43**:2, 216-221 (2016).
8. M. Lombardo, N. Micali, V. Villari, S. Serrao, **G. Pucci**, R. Barberi, G. Lombardo. Ultraviolet A: Visible spectral absorbance of the human cornea after transepithelial soaking with dextran-enriched and dextran-free riboflavin 0.1% ophthalmic solutions. *J. Cataract Refract. Surg.* **41** (10): 2283 - 2290 (2015).
9. **G. Pucci**, M. Ben Amar and Y. Couder. Faraday instability in floating drops. *Phys. Fluids*. **27**, 091107 (2015); Milton Van Dyke Award of the Gallery of Fluid Motion of the American Physical Society.
10. **G. Pucci**, D. M. Harris and J. W. M. Bush. Partial coalescence of soap bubbles. *Phys. Fluids*. **27**, 061704 (2015).
11. **G. Pucci**, F. Carbone, C. Vena, G. Lombardo, C. Versace and R. Barberi. DSM1-DSM2 Transition Threshold in Turbulent Nematic Mixtures. *Mol. Cryst. Liq. Cryst.* **614**(1), 100-105 (2015).
12. M. P. De Santo, G. Petriashvili, R. Gary, **G. Pucci**, R. Barberi. Anti-counterfeiting and identification solutions using soft matter. *Rend. Fis. Acc. Lincei* **26**(2):S255-S259 (2015).
13. **G. Pucci**. Faraday instability in floating drops out of equilibrium: motion and self-propulsion from wave radiation stress. *Int. J. Non Linear Mech.* **75**: 107-114 (2015).
14. M. Lombardo, **G. Pucci**, R. Barberi, G. Lombardo. Interaction of ultraviolet light with the cornea: Clinical implications for corneal crosslinking. *J. Cataract Refract. Surg.* **41**(2):446-459 (2015).
15. **G. Pucci**, M. Ben Amar and Y. Couder. Faraday instability in floating liquid lenses: the spontaneous mutual adaptation due to radiation pressure. *J. Fluid Mech.* **725**, 402-427 (2013). A figure from this paper has been used for the cover of vol. 725 of the Journal of Fluid Mechanics.
16. **G. Pucci**. Faraday instability in deformable domains. *Il Nuovo Cim.*, **36** C n.4, 61-70. Invited to write a communication after the presentation at the meeting of the Italian Physical Society (2013).



17. **G. Pucci**, E. Fort, M. Ben Amar and Y. Couder. Mutual Adaptation of a Faraday Instability Pattern with its Flexible Boundaries in Floating Fluid Drops. *Phys. Rev. Lett.* **106**, 024503 (2011).
18. **G. Pucci**, M.P. De Santo, G. Carbone and R. Barberi. A novel method to prepare probes for atomic force spectroscopy. *Dig. J. Nanomater. Bios.* **1**(3):99103 (2006).