

UNIVERSITÀ DEGLI STUDI DI MILANO

selezione pubblica per n.1 posto/i di Ricercatore a tempo determinato ai sensi dell'art.24, comma 3, lettera b) della Legge 240/2010 per il settore concorsuale 02/D1 - FISICA APPLICATA, DIDATTICA E STORIA DELLA FISICA, settore scientifico-disciplinare FIS/07 - FISICA APPLICATA (A BENI CULTURALI, AMBIENTALI, BIOLOGIA E MEDICINA), presso il Dipartimento di Biotecnologie Mediche e Medicina Traslazionale, (avviso bando pubblicato sulla G.U. n. 68 del 01/09/2020) Codice concorso 4436

[Giuseppe Di Caprio]

CURRICULUM VITAE

INFORMAZIONI PERSONALI

COGNOME	DI CAPRIO
NOME	GIUSEPPE
DATA DI NASCITA	[05, 11, 1978]

PROFILE

I am currently appointed as Instructor (Research Assistant Professor) at the Harvard Medical School, Department of Pediatrics. My research bridges Optical Microscopy, Biology and Image Processing. I am interested in mechanistic questions addressed at a molecular level aided by fluorescence microscopy imaging acquired with high temporal and spatial resolution. During the past years I focused on problems associated with viral particles endocytosis and fusion processes, in-vitro assembly of clathrin coated pits, the shape of intracellular energy gradients in living cells, Pylrin-mediated inflammasome assembly and activation, and the mechanisms that regulates cell internalization of Transferrin-decorated DNA origami barrels. Aspects of my studies involve close collaborations with other members in the Kirchhausen group and with external collaborators. Most of the imaging is carried using minimally invasive, 3D live-cell lattice light-sheet microscopy (LLSM); I have also been responsible for implementing the construction of one of these microscopes in the Kirchhausen lab as well as developing the computational processing tools used for the quantitative analysis of the data generated by myself and by other members of our group.

My second appointment is at the Massachusetts General Hospital, in collaboration with John Higgins, MD, and David Williams MD, where my research is dedicated to the development of material technologies for mimicking the environment of the circulatory system in vitro. This method provides biomarkers promising to improve management of sickle cell patients and to optimize the development and prioritization of candidate cures, and it's currently used to validate the efficacy of BCL11A as therapeutic target in Sickle Cell Disease, Clinical Trials Identifier: [NCT03282656](https://clinicaltrials.gov/ct2/show/study/NCT03282656) (Sponsor: David Williams - Boston Children's Hospital).

RESEARCH APPOINTMENTS

- FEB2020-PRESENT INSTRUCTOR (RESEARCH ASSISTANT PROFESSOR) - HARVARD MEDICAL SCHOOL**
Kirchhausen Lab @ Department of Cell Biology
Principal Investigator: Prof. Tomas Kirchhausen
- Faculty members are obligated to teach a minimum of 50 hours per year in the Harvard community as a requirement of their academic appointment.
 - Use and implementation of a state-of-the-art Lattice Light Sheet Microscope built in collaboration with the Nobel laureate Dr. Eric Betzig (<https://goo.gl/1mSNpU>);
 - Design and realization of microfluidic systems.
 - Development of Image Processing routines for sub-cellular tracking and segmentation using MatLab.
- SEPT2016-PRESENT VISITING SCIENTIST, HARVARD MEDICAL SCHOOL - Massachusetts General Hospital**
Higgins Lab @ Center for System Biology
Principal Investigator: Prof. John Higgins MD and Prof. Carlo Brugnara MD
- Use and implementation of the Functional Red Blood Cell analyzer (<http://goo.gl/mDIRUP>) for studies on sickle cell anemia and to detect blood doping manipulations;
 - Design and realization of microfluidic systems.
 - Development of Image Processing routines for single cell tracking and segmentation using MatLab.
 -
- SEPT2015-FEB2020 RESEARCH FELLOW, HARVARD MEDICAL SCHOOL - Boston Children's Hospital**
Kirchhausen Lab @ Department of Cell Biology
Principal Investigator: Prof. Tomas Kirchhausen
- Use and implementation of a state-of-the-art Lattice Light Sheet Microscope built in collaboration with the Nobel laureate Dr. Eric Betzig (<https://goo.gl/1mSNpU>);
 - Design and realization of microfluidic systems.
 - Development of Image Processing routines for sub-cellular tracking and segmentation using MatLab.
- JUNE2012-AUG2015 POST DOCTORAL RESEARCH FELLOW, HARVARD UNIVERSITY**
Optofluidic Cytometry Lab @ Rowland Institute at Harvard
Principal Investigator: Dr. Ethan Schonbrun
- Design and realization of imaging flow cytometry systems, for single cell analysis, based both on fluorescence and absorption spectroscopy;
 - Design and realization of microfluidic organ-on-chip systems.
 - Development of Image Processing routines for single cell tracking and segmentation using MatLab.
 - Bright Field and Fluorescence Microscopy;
 - Fluorescence staining procedures for leucocytes, erythrocytes and leukemia cells.
- OCT2010-MAY2011 GRADUATE INVITED RESEARCHER, UNIVERSITÉ LIBRE DE BRUXELLES**
Microgravity Research Center @ ULB
Supervisor: Prof. F. Dubois
- Development of Image Processing routines for 3D sperm cells tracking using MatLab.

- OCT2008-DEC2011** **GRADUATE STUDENT, UNIVERSITY OF NAPLES “FEDERICO II”**
Institute for Microelectronics and Microsystems @ National Council of Research
Supervisor: Dr. G. Coppola
- Design and realization of a Digital Holographic Microscope, for single cell analysis based on phase microscopy;
 - Development of image libraries for automatic characterization of sperm cells morphological anomalies;
 - Design and realization of microfluidic systems for cell manipulation and sorting;
 - Development of Image Processing routines for single cell segmentation using MatLab.
- JUNE2008-OCT2008** **RESEARCH ASSISTANT, INSTITUTE FOR MICROELECTRONICS AND MICROSYSTEMS**
Institute for Microelectronics and Microsystems @ National Council of Research
Supervisors: Dr. G. Coppola
- Design and realization of a Digital Holographic Microscope, for single cell analysis based on phase microscopy.
- SEPT2007-MAR208** **RESEARCH ASSISTANT, NATIONAL INSTITUTE OF OPTICS**
National Institute of Optics @ National Council of Research
Supervisors: Dr. P. Ferraro and Dr. G. Coppola
- Design and realization of a Fringe projection Microscope for automatic surface analysis of helix blade.
- SEPT2005-JULY2007** **MASTER OF SCIENCE IN PHYSICS, NONLINEAR OPTICS LABORATORY**
Department of Physics @ University of Naples “Federico II”
Supervisors: Prof. E. Santamato
- Design and realization of an optical system for the study of the interaction between Azo-dyes and Liquid Crystals.

EDUCATION

- DEC2011** University of Naples “Federico II” – PhD in Novel Technologies for Material, Sensors and Imaging (Grading: EXCELLENT)
- JUL2006** University of Naples “Federico II” – MS in Physics (Grading: 110/110 cum laude)

AWARDED GRANTS

Associated academic partner in Wound Healing In Space: Key challenges towards Intelligent and Enabling Sensing platforms (WHISKIES) - MAP Project: (CORA) for MAP Program SciSpace, founded by the European Spatial Agency (2020).

AWARDS and QUALIFICATIONS

- SEPT2007** Undergraduate Research Fellowship, European Union/Italian Min. of Research @ National Institute of Optics, National Council of Research.

MAY2008	Undergraduate Research Fellowship, European Union/Italian Min. of Research @ National Institute of Optics, National Council of Research.
JUNE2013	Best Paper award for the work “Hyperspectral Microscopy of Flowing Cells”, Imaging and Applied Optics, OSA @ Washington DC.
SEPT2018	National Academic Qualification as Associate Professor – MIUR Settore concorsuale 02/D1 - Fisica applicata, didattica e storia della fisica

EDITORIAL ACTIVITIES

Editorial Board Member

2020 – Applied Science and Biomedicine (MDPI)

Reviewer

2012 – Ad-hoc reviewer for Optics Letters, OSA.

2012 – Ad-hoc reviewer for Applied Optics, OSA.

2013 – Ad-hoc reviewer for JOSA A, OSA.

2014 – Ad-hoc reviewer for Biomedical Optics Express, OSA.

2015 – Ad-hoc reviewer for Optics Express, OSA.

2015 – Ad-hoc reviewer for PLOS One

2015 – Ad-hoc reviewer for Journal of Biophotonics, Wiley Online Library.

2017 – Ad-hoc reviewer for Biophysical Journal - Cell Press.

2018 - Ad-hoc reviewer for Applied Science

2018 - Ad-hoc reviewer for Computer in Biology

2018 - Ad-hoc reviewer for Sensors and Actuators

2018 - Ad-hoc reviewer for Micromachines

2018 - Ad-hoc reviewer for Scientific Report – Nature Press

GRANTS REVIEW COMMITTEE

2016 - Grants reviewer for the Université libre de Bruxelles – Belgium

2015 - Grants reviewer for the Ministry of Science, Technology and Space - Israel

TEACHING ACTIVITIES

As a faculty members I am obligated to teach a minimum of 50 hours per year in the Harvard community as a requirement of my academic appointment .

List of Courses taught

Undergraduate teaching

1. Laboratory Assistant for the course “Laboratory of Physics II” 35 hours course @ Department of Physics, University of Naples “Federico II”, Academic Year 2009/10.
2. Teaching assistant for PHYSICS 15B - Introductory Electromagnetism and Statistical Physics @ Harvard University, Fall 2017.

Post-Graduate teaching

3. PhD course “Novel Imaging Techniques in Microscopy”, 21 hours course dedicate at the PhD panel in Industrial Engineer, University of Naples “Federico II”, Academic Year 2013/14

Mentoring Activity

1. Pasquale Longo, Master Thesis in Digital in-line Holography @ Institute for Microelectronics and Microsystems, (2010).
2. Guðfríður Möller, RIU (Research Immersion for Undergraduates). Research topic: Development of a tunable color filter array @ Optofluidic Cytometry Lab, Harvard University (2013-14)
3. Stefania Torino, Visiting PhD Student. Research topic: Flow focusing in Microfluidics @ Optofluidic Cytometry Lab, Harvard University (2014).
4. Wesley Skillern, Research Technician Assistant at PCMM-BCH (2015-18).
5. Bronner Goncalves, MD, Postdoctoral Research Fellow (2018-19).
6. George Ohashi, Research Technician Assistant at PCMM-BCH (2018-Present).
7. Johannes Thomsen, MS / PhD Candidate at Copenhagen University, Visiting Graduate Student (2019)
8. Daniel De Souza, PhD, Postdoctoral Research Fellow at MGH (2019-Present)
9. Henrik Pinholt, Master Student at Copenhagen University (2019-2020).
10. Elliott Sommerville, Master Student at McGill University (2020-Present)

PATENTS

1. E. Schonbrun, G. Moller, G. Di Caprio, and C. Stokes, “Pixelated tunable color filter,” Full patent filed May 2014.

We invented a method to implement a B&W camera mounting a pixelated polarized in a color camera, with the possibility of tuning continuously the color filter, making use of chiral transparent materials.

2. G. Di Caprio, E. Schonbrun and J. Higgins “A functional Red Blood Cell Cytometer”, Provisional patent filed June 2016.

We invented a system-on-chip to tune continuously the oxygen environment of flowing red blood cells (Circulatory System on chip) and an optical setup that allows the simultaneous measurement of cell volume, hemoglobin mass and oxygenated fraction.

PUBLICATIONS

PAPERS

2020

1. V. Magupalli†, R. Negro†, Y. Tian†, A. Hauenstein†, G. Di Caprio, W. Skillern, Q. Deng, P. Orning, H. Alam, Z. Maliga, H. Sharif, J. Hu, C. Evavold, J. Kagan, F. Schmidt, K. Fitzgerald, T. Kirchhausen, Y. Li, and H. Wu, “HDAC6-mediated aggresome-like mechanism for NLRP3 and Pyrin inflammasome activation”, *SCIENCE*, vol. 369, eaas8995 (2020).
2. M. Salman¹, G. Marsh, I. Küsters¹, M. Delincé, G. D. Caprio, S. Upadhyayula¹, G. De Nola, R. Hunt, K. Ohashi, F. Shimizu, Y. Sano, T. Kanda, B. Obermeier and T. Kirchhausen¹, “Design and validation of a human brain endothelial microvessel-on-a-chip open microfluidic model enabling advanced optical imaging”, *Front. Bioeng. Biotechnol.*, doi: 10.3389/fbioe.2020.573775 (2020)

2019

3. G. Di Caprio†, E. Schonbrun†, B. Goncalves, J. Valdez, D. Wood and J. Higgins, "Semi-Quantitative Measurement of Sick Hemoglobin Polymer in Single Red Blood Cells under Controlled Oxygen Tension", *Proceedings of the National Academy of Science*, vol. 116(50) pp. 25236-25242 (2019).

2017

4. M. Schuler, A. Lewandowska, G. Di Caprio, W. Skillern, S. Upadhyayula, T. Kirchhausen, J. M. Shaw, and B. Cunniff, “Miro1-mediated mitochondrial positioning shapes intracellular energy gradients required for accelerated cell migration”, *Molecular Biology of the Cell*, vol. 28(16), pp. 2159-2169 (2017).

2016

5. E. Schonbrun, G. Di Caprio, “A virtually imaged defocused array (VIDA) for high-speed 3D microscopy”, *Journal of biophotonics*, vol. 9(10), pp. 1044-1049 (2016).

2015

6. G. Di Caprio, C. Stokes, J. M. Higgins, and E. Schonbrun, “Single-cell measurement of red blood cell oxygen affinity”, *Proceedings of the National Academy of Science*, vol. 112(32), pp. 9984-9989 (2015).
7. P. Memmolo, L. Miccio, M. Paturzo, G. Di Caprio, G. Coppola, P. A. Netti, and P. Ferraro, “Recent advances in holographic 3D particle tracking”, *Advances in Optics and Photonics*, vol. 7(4), pp. 713-755 (2015).
8. M. A. Ferrara, G. Di Caprio, S. Managò, A. De Angelis, L. Sirleto, G. Coppola, and A. C. De Luca, “Label-free imaging and biochemical characterization of bovine sperm cells”, *Biosensors*, vol. 5(2), pp. 141-157 (2015).

Invited review on *Biosensors*.

2014

9. G. Coppola, G. Di Caprio, M. Wilding, P. Ferraro, G. Esposito, L. Di Matteo, R. Dale, G. Coppola and B. Dale “Digital holographic microscopy for the evaluation of human sperm structure”, *Zygote*, vol. 22(4), pp. 446-54, (2014).
10. G. Di Caprio, A. El Mallahi, P. Ferraro, G. Coppola, B. Dale, G. Coppola and F. Dubois, “4D spermatozoa tracking for fertility analysis on seminal clinical samples”, *Biomedical Optics Express*, vol. 5, n° 3, pp. 690-700 (2014).

IMAGE OF THE WEEK on the OpticsInfobase web site, TOP download for the month (>1500). Reviewed on the OSA newsroom (<http://goo.gl/LA6f34>), this research has been commented on Asian Journal of Andrology (<http://goo.gl/QvUDRt>) and MD News (<http://goo.gl/WAkxSi>).

11. E. Schonbrun, G. Möller and G. Di Caprio, “Polarization encoded color camera”, *Optics letters*, vol. 39, n° 6, pp. 1433-1436 (2014).
12. E. Schonbrun, R. Malka, G. Di Caprio, D. Schaak, J. Higgins, “Quantitative absorption cytometry for measuring red blood cell hemoglobin mass and volume”, *Cytometry Part A*, vol. 85, n° 4, pp. 332-338 (2014).
13. G. Di Caprio, M. A. Ferrara, L. Miccio, F. Merola, P. Memmolo, P. Ferraro, and G. Coppola, “Holographic imaging of unlabelled sperm cells for semen analysis: a review”, *Journal of Biophotonics*, doi: 10.1002/jbio.201400093 (2014).

Invited review on *Journal of Biophotonics*

2013

14. E. Schonbrun, G. Di Caprio and D. Schaak “Dye exclusion microfluidic microscopy”, *Optics Express*, vol. 21, Issue 7, pp. 8793-8798 (2013).
15. G. Di Caprio, D. Schaak and E. Schonbrun “Hyperspectral Fluorescence Microfluidic (HFM) Microscopy”, *Biomedical Optics Express*, vol. 4, Issue 8, pp. 1486-1493 (2013).

IMAGE OF THE WEEK on the OpticsInfobase website, 5th August 2013.

16. F. Merola, L. Miccio, P. Memmolo, G. Di Caprio, A. Galli, R. Puglisi, D. Balduzzi, G. Coppola, P. Netti, P. Ferraro “Digital holography as a method for 3D imaging and estimating the biovolume of motile cells”, *Lab on a Chip*, vol. 13, n°23, pp. 4512-4516 (2013).

2012

17. G. Di Caprio, G. Coppola, P. Dardano, S. Cabrini and V. Mocella “Digital holographic microscopy characterization of superdirective beam by metamaterial”, *Optics Letters*, vol. 37, n° 7, pp. 1142-1144 (2012).

First report of Quantitative Phase Microscopy for the analysis of properties of light diffracted by a photonic crystal structure.

18. G. Di Caprio, G. Coppola, L. De Stefano, M. De Stefano, A. Antonucci, R. Congestri and E. De Tommasi, "Shedding light on diatom photonics by means of digital holography", *Journal of Biophotonics*, vol. 7, n° 5, pp. 341-350, (2014, First published online May 2012).

2011

19. P. Memmolo, G. Di Caprio, C. Distanto, M. Paturzo, R. Puglisi, D. Balduzzi, A. Galli, G. Coppola and P. Ferraro "Identification of bovine sperm head for morphometry analysis in quantitative phase-contrast holographic microscopy", vol. 19, Issue 23, pp. 23215-23226, *Optics Express* (2011).

2010

20. G. Di Caprio, M. Gioffré, N. Saffioti, S. Grilli, P. Ferraro, R. Puglisi, D. Balduzzi, A. Galli and G. Coppola "Quantitative Label-Free Animal Sperm Imaging by Means of Digital Holographic Microscopy", *IEEE, Journal of Selected Topics in Quantum Electronics*, Special Issue in Biophotonics, vol 43, pp. 833-840 (2010).

This paper reports the first use of Quantitative Phase Microscopy for the analysis of sperm cells; many research groups have subsequently exploited the potentialities of QPM for spermatozoa motility and morphology studies.

21. G. Coppola, G. Di Caprio, M. Gioffré, R. Puglisi, D. Balduzzi, A. Galli, L. Miccio, M. Paturzo, S. Grilli, A. Finizio and P. Ferraro "Digital self-referencing quantitative phase microscopy by wavefront folding in holographic image reconstruction", *Optics Letters*, vol. 35, pp.3390-3392 (2010).

Top 5% cited paper on Optics Letter in the 1-year.

CONTRIBUTION IN VOLUMES AND BOOKS

1. G. Coppola, M. A. Ferrara, G. Di Caprio, G. Coppola, and B. Dale "Unlabeled Semen Analysis by Means of the Holographic Imaging" on *Holographic Materials and Optical Systems*, Computer and Information Science, Chapter 15, pp. 335-351, Ed. Intech (2017).
2. L. Miccio, S. Grilli, M. Paturzo, A. Finizio, G. Di Caprio, G. Coppola, P. Ferraro, R. Puglisi, D. Balduzzi and A. Galli "Quantitative Phase Contrast in holographic microscopy through the numerical manipulation of the retrieved wavefronts" in *Coherent Light Microscopy, Imaging and Quantitative Phase Analysis*, Springer Series in Surface Sciences, vol. 46, pp. 61-85, Ed. Springer (2010).

SELECTED ORAL CONTRIBUTIONS IN CONFERENCES

1. G. Di Caprio, D. Shaak, J. M. Higgins and E. Schonbrun, "A lung-on-chip to measure oxygen affinity of single red blood cells", *Micro TAS -San Antonio (TX)* (2014).

Oral presentation in the session "ORGANS ON CHIP" - Oral acceptance rate 7%.

2. G. Di Caprio, D. Schaak and E. Schonbrun, "Hyperspectral Microscopy of Flowing Cells" *Imaging and Applied Optics - Imaging Systems and Applications*, OSA - Arlington (VI) (2013).

Winner of the BEST PAPER AWARD.

3. G. Di Caprio, A. El Mallahi, P. Ferraro, G. Coppola and F. Dubois “Authomatic algorithm for the detection and 3D tracking of biological particles in Digital Holographic Microscopy”, EOS Optical MicroSystems 2011 (Capri).
4. G. Di Caprio, N. Saffioti, M. Gioffrè, S. Grilli, P. Ferraro, D. Balduzzi, R. Puglisi, A. Galli and G. Coppola “Development of a microfluidic system based on a digital holography microscope for the analysis of bovine sperm cells”, EOS Optical MicroSystems 2009 (Capri).
5. G. Di Caprio, S. Grilli, P. Ferraro, D. Balduzzi, R. Puglisi, A. Galli and G. Coppola “Microfluidic system based on the digital holography microscope for analysis of motile sperm”, SPIE Europe Optical Metrology 2009 (Munich), Proc. SPIE, vol. 7389, 738907/01-08.

ORAL POSTER IN CONFERENCES AND WORKSHOPS

1. G. Di Caprio, S. Grilli, P. Ferraro, D. Balduzzi, R. Puglisi, A. Galli and G. Coppola, “Animal sperm morphology analyzed by means of digital holography microscope” CMOS Photonics, 5th Optoelectronics and Photonics Winter School 2009, Fai della Paganella.
2. G. Di Caprio, G. Coppola, S. Grilli, P. Ferraro, D. Balduzzi, R. Puglisi and A. Galli “Microfluidic system for cell analysis by means of Digital Holography”, The 42nd Annual Meeting of the Electronic Group GE2010 – Frascati (RM).
3. G. Di Caprio, G. Coppola, L. De Stefano and E. De Tommasi, “Digital Holographic Reconstruction of the optical field transmitted by a single diatom valve”, PSST-2012, (Malaga).
4. E. Schonbrun, G. Muller, G. Di Caprio and C. Stockes, “Computational imaging cytometry”, IEEE International Conference on Computational Photography, ICCP 2013 (Cambridge).
5. G. Di Caprio and E. Schonbrun, “Single red blood cells oxygen delivery”, Wyss Annual Diabetes Symposium 2015 (Boston).

Dichiaro, ai senso dell’art. 46 del D.P.R. n. 445/2000, la veridicità di quanto dichiarato nel presente curriculum.

Autorizzo il trattamento dei dati personali contenuti nel mio curriculum vitae in base all’art. 13 del D. Lgs. 196/2003 e all’art. 13 GDPR 679/16.

Data

15/09/2020

Luogo

Boston