

# NICOLAS C. PÉGARD, PH.D.

205 Life Sciences Addition building  
University of California, Berkeley  
Berkeley, CA 94720

pegard@unc.edu  
www.nicolaspegard.com  
www.sculptedlight.org

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## RESEARCH AND PROFESSIONAL EXPERIENCE

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### Assistant Professor

*University of North Carolina at Chapel Hill, 2019-Present*

Department of Applied Physical Sciences.

Group leader : Computational Biophotonics Laboratory.

Our research group develops advanced optical systems and computational methods for high performance applications in biophotonics and systems neuroscience.

### Postdoctoral Scholar

*University of California, Berkeley, 2014-2018*

Departments of Molecular & Cell Biology, and Electrical Engineering & Computer Science.

Advisors : Prof. Hillel Adesnik (MCB), Prof. Laura Waller (EECS)

Instrumentation and computational methods for 3D *in vivo* holographic optogenetic photostimulation and optical tracking of neural activity. Current projects : portable instrumentation for optogenetic photostimulation, supported by the Defense Advanced Research Projects Agency (DARPA).

### Doctoral Research

*Princeton University, 2010-2014*

Department of Electrical Engineering. Advisor : Prof. Jason W. Fleischer, Imaging Physics lab.

Microfluidic microscopy & optofluidics for 3D cell tomography and phase imaging. Optimization of optical surface patterning to improve photon trapping for organic photovoltaic cells.

### Research intern

*Julius-Maximilian University, Würzburg, Germany, Apr-Aug 2009*

Department of Applied Physics (EP3). Advisor : Prof. Charles Gould.

Anisotropic thermopower characterization in diluted (Ga,Mn)As magnetic semiconductors.

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## EDUCATION

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### Ph.D. in Electrical Engineering

*Princeton University, Princeton, NJ, 2009-2014*

Thesis: Computational methods for microfluidic microscopy and phase-space imaging. (08/05/2014)

Advisor: Prof. Jason W. Fleischer, Imaging Physics Lab.

M.A. Majors: solid state physics, nonlinear optics.

### M.S. in Engineering and B.S. in Physics

*École Polytechnique, Palaiseau, France, 2006-2010*

M.S. Majors: opto-electronics, spintronics, materials science.

B.S. Majors: applied mathematics, quantum physics.

### Classes Préparatoires

*CPGE Louis-le-Grand, Paris, France, 2003-2006*

Intensive preparatory science program preceding the competitive entrance into the Grandes Écoles

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## FUNDING AND AWARDS

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Career Award at the Scientific Interface (CASI)

*Burroughs Wellcome Fund, 2018*

Outstanding postdoc research award, MCB Department

*University of California, Berkeley, 2017*

Harold W. Dodds honorific competitive fellowship (dissertation funding)

*Princeton University, 2013*

Best research talk, 1<sup>st</sup> place

*Princeton University Research Symposium, 2013*

Outstanding Teaching Assistant award, Engineering Department

*Princeton University, 2010*

Gordon Y.S. Wu fellowship for engineering (doctoral funding)

*Princeton University, 2009*

University award for outstanding leadership and commitment to the student body

*École Polytechnique, 2009*

Carnot fellowship (funding for students pursuing Ph.D. programs abroad)

*Carnot Foundation, 2008*

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SERVICE AND OUTREACH IN RESEARCH AND EDUCATION

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- President. *Sculpted Light in the Brain Association (www.sculptedlight.org)* 2018-Present  
 A non-profit association to promote research at the interface between optics and neuroscience.
- Conference chair and organizer. *Sculpted Light in the Brain* 2017  
 2017 (UC Berkeley) \$20k sponsorship, 1-day, 11 invited speakers, 35 posters, 250 attendees.  
 2019 (Royal Society, London), \$80k sponsorship, in preparation.
- Session chair. *Multidimensional Microscopy conference (SPIE Photonics West)* 2017
- Session chair. *Advanced Imaging Methods (AIM) Workshop, University of California Berkeley* 2016 - 2017
- Technical group leader. *Optical Biosensors Technical Group (Optical Society of America)* 2017 - 2018
- Reviewer. *Applied Optics, JOSAA, Biomedical Optics Express, Optica, Optics letters, Nature Communications, Nature photonics, Scientific reports, MIT Press* 2012 - Present
- Scientific reviewer for grant applications. *OSA Special Program Grants* 2016 - 2017  
*National Natural Science Foundation of China, Hong Kong Research Grant Council*
- Volunteer scientist. *Bay Area Scientists In Schools (BASIS)* 2014

JOURNAL PUBLICATIONS

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- Precise multimodal optical control of neural ensemble activity 2018  
*\*A.Mardinly, \*I. Oldenburg, \*N. Pégard, S. Sridharan, E. Lyall, Nature Neuroscience, 21, 881-893*  
*K. Chesnov, S. Brohawn, L. Waller, and H. Adesnik (\*Equal contributors)*
- Precise multimodal optical control of neural ensemble activity 2018  
*\*A.Mardinly, \*I. Oldenburg, \*N. Pégard, S. Sridharan, E. Lyall, Nature Neuroscience, 21, 881-893*  
*K. Chesnov, S. Brohawn, L. Waller, and H. Adesnik (\*Equal contributors)*
- UC Berkeley Sculpted Light in the Brain 2017 debates future technologies to communicate with the brain 2017  
*A. Shanker, N. Pégard, R. Eckert, and L. Waller* Neurophotonics special guest editorial, **4**, 4-5
- 3D Scanless Holographic Optogenetics with Temporal Focusing 2017  
*\*N. Pégard, \*A. Mardinly, I. Oldenburg, S. Sridharan, Nature Communications, 8, 1228*  
*L. Waller, and H. Adesnik (\*Equal contributors)*
- 3D Computer Generated Holography by Nonconvex Optimization 2017  
*\*J.Zhang, \*N. Pégard, J.Zhong, and L. Waller (\*Equal contributors)* Optica, **4**, 1306-1313
- Compressive light-field microscopy for 3D neural activity recording<sup>†</sup> 2016  
*N. Pégard, H-Y. Liu, N. Antipa, M. Gerlock, H. Adesnik, and L. Waller* Optica, **3**, 517-524  
<sup>†</sup>Featured research in Optics & Photonics News special issue : “Optics in 2016”
- Flow-scanning optical tomography<sup>†</sup> 2014  
*N. Pégard, M.Toth, M.Driscoll, and J. W. Fleischer* Lab-on-a-Chip, **14**, 4447-4450  
<sup>†</sup>Classified as “Hot article” due to receiving particularly high scores at peer review.
- Flow-based Structured Illumination 2013  
*C-H. Lu, N. Pégard, and J. W. Fleischer* Applied Physics Letters, **102**, 161115
- 3D Deconvolution Microfluidic Microscopy using a Tilted Channel 2013  
*N. Pégard, and J. W. Fleischer* Journal of Biomedical Optics, **18**, 040503
- Wrinkles and deep folds as photonic structures in photovoltaics 2012  
*\*J-B. Kim, \*P. Kim, \*N. Pégard(\* Equal contributors)* Nature Photonics, **6**, 327-332  
*S. Oh, C. Kagan, J. W. Fleischer, H. Stone, and Y-L. Loo*
- Optimizing holographic data storage using a Fractional Fourier Transform 2011  
*N. Pégard, and J. W. Fleischer* Optics Letters, **36**, 2551-2553

Diffusion thermopower of (Ga,Mn)As/GaAs tunnel junctions 2011  
*Ts. Naydenova, P. Durrenfeld, K. Tavakoli, N. Pégard, L. Ebel* Physical Review Letters, **107**, 197-201  
*K. Pappert, K. Brunner, C. Gould, and L. Molenkamp*

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BOOK CHAPTER

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Flow-scanning microfluidic imaging 2016  
*N. Pégard, C-H. Lu, M. Toth, M. Driscoll and J. W. Fleischer* Applications of Microfluidics  
 InTech, ISBN 978-953-51-4623-0

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SELECTED CONFERENCE PROCEEDINGS

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Partially Coherent Holographic Temporal Focusing for 3D Light Sculpting with Single Neuron Resolution 2018  
*N. Pégard, A. Mardinly, I. Oldenburg,* Optics in the brain, BW2C.2, Hollywood, FL  
*L. Waller, and H. Adesnik*

Holographic Temporal Focusing for 3D Photo-activation With Single Neuron Resolution 2017  
*N. Pégard, A. Mardinly, J. Zhang, S. Sridharan* Optics in the brain, BrM3B4, San Diego, CA  
*L. Waller, and H. Adesnik*

3D all-optical control of functionally defined neurons with cellular resolution and sub-ms precision 2017  
*A. Mardinly, N. Pégard, I. Oldenburg, S. Sridharan, R. Hakim* Optics in the brain, BrM3B4, San Diego, CA  
*L. Waller, and H. Adesnik*

Functional brain imaging at cellular resolution with Compressive Light-Field Microscopy 2015  
*N. Pégard, H-Y. Liu, N. Antipa* Computational Optical Sensing & Imaging (COSI), JTh4A.3, Arlington, VA  
*L. Waller, and H. Adesnik*

High-speed 3D brain activity quantification with Compressive Light-Field Microscopy 2015  
*N. Pégard, E. Lyall, A. Mardinly, N. Antipa* Bio-Optics: Design and Application (BODA), NW2C.3  
*L. Waller, and H. Adesnik*

Microfluidic Flow-Scanning Optical Tomography 2013  
*N. Pégard, and J. W. Fleischer* Frontiers in Optics (FIO), Orlando, FL

Tomographic Microfluidic Microscopy 2013  
*J. W. Fleischer and N. Pégard* 2<sup>nd</sup> EOS Conference on Optofluidics, (EOSOF), Munich, Germany

3D Microfluidic Microscopy 2013  
*J. W. Fleischer, and N. Pégard* Optics in the Life Sciences, BW5A.1., Waikoloa Beach, Hawaii

3D deconvolution microscopy using a microfluidic tilted channel 2012  
*N. Pégard, and J. W. Fleischer* Computational Optical Sensing & Imaging (COSI), CM3B.6., Monterey, CA

Microfluidic Structured Illumination Microscope 2012  
*C. Lu, N. Pégard, and J. W. Fleischer* Imaging and Applied Optics, (COSI), CM3B.7., Monterey, CA

3D microscopy using a tilted microfluidic channel 2012  
*N. Pégard, and J. W. Fleischer* Frontiers in Optics 2012, XXVIII, Rochester, NY

Wrinkles and Folds as Photonic Structures in Polymer Photovoltaics 2012  
*Y-L. Loo, J-B. Kim, P. Kim, H. Stone, N. Pégard* American Physical Society, APS March Meeting, L46.002  
*J. W. Fleischer, S-J. Oh, and C. Kagan*

3D microfluidic microscopy using a tilted channel 2012  
*N. Pégard, and J. W. Fleischer* Biomedical Optics and 3-D Imaging congress, BM4B.4., Miami, FL

Optimizing holographic storage by redistribution of the space-frequency domain using a Fractional Fourier Transform 2012  
*N. Pégard, and J. W. Fleischer* International OSA Network of Students, IONS-11, Paris

Fractional Optics for Image Processing and Measurement 2011  
*G. Situ, L. Waller, N. Pégard, and J. W. Fleischer* OSA Digital Holography and Three-Dimensional  
 Imaging conference, DWE2, Tokyo, Japan

Contrast Enhancement by Double Pass Phase Conjugation Microscopy 2010  
*N. Pégard, and J. W. Fleischer* Frontiers in Optics, (FIO), post-deadline paper, PDPA10

INVITED TALKS AND SEMINARS

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Computational optics beyond imaging May.18<sup>th</sup> 2018  
*Invited speaker* University of Bergen, Norway

Computational optics beyond imaging Feb.8<sup>th</sup> 2018  
*BME Seminar speaker* Georgia Tech & Emory University,IL

New Instrumentation to monitor and manipulate neural activity with light Jan. 25<sup>th</sup> 2018  
*Invited speaker* Northwestern University,IL

New instrumentation and computational methods for 3D optogenetic photo-stimulation Dec. 18<sup>th</sup> 2017  
*Invited speaker* T.U. Delft, Netherlands

3D Scanless Holographic Optogenetics with Temporal focusing Feb. 6<sup>th</sup> 2017  
*Hellen Wills Neuroscience Institute* University of California, Berkeley

Photoactivation of individual neurons with sparse holographic temporal focusing Jan. 26<sup>th</sup> 2017  
*14th Annual Advanced Imaging Methods (AIM) Workshop* University of California, Berkeley

3D functional imaging of the living brain May 19<sup>th</sup> 2016  
*Guest speaker* Inscopix, Palo Alto, CA

Compressive light field microscopy for 3D functional imaging of the living brain Apr. 6<sup>th</sup> 2016  
*Stanford Center for Image Systems Engineering (SCIEN) colloquia* Stanford University

Compressive light field microscopy for 3D functional brain imaging Feb. 12<sup>th</sup> 2016  
*QB3 - California Institute for Quantitative Biosciences* University of California, Berkeley

Compressive light field microscopy for 3D functional brain imaging Feb. 5<sup>th</sup> 2016  
*Redwood center seminar, Helen Wills Neuroscience Institute* University of California, Berkeley

System optics optimization and application for in-vivo 3D microscopy Jan. 20<sup>th</sup> 2014  
*Mechanical Engineering Department Seminars* Technion, Israel Institute of Technology, Haifa, Israel

Tomographic Microfluidic Microscopy Mar. 12<sup>th</sup> 2013  
*8<sup>th</sup> Princeton Innovation Forum* Princeton University

Microfluidic devices for 3D microscopy, superresolution, and applications in biology Oct. 20<sup>th</sup> 2013  
*Princeton Research Symposium\* (\*Best Research Talk, 1st place)* Princeton University

3D microfluidic microscopy Oct. 10<sup>th</sup> 2012  
*Research seminar, Department of Molecular Biology and Biochemistry* Rutgers University

PATENTS

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3D Sparse Holographic Temporal focusing 2016  
*L. Waller, N. Pégard, and H. Adesnik* Patent Application #62-429,017

Compressive plenoptic microscopy 2015  
*L. Waller, N. Pégard, and H. Adesnik* Provisional Patent Application #62-188,626

Photoelectric cells incorporating wrinkles and folds to enhance efficiency and bendability 2014  
*J.-B. Kim, P. Kim, H. Stone, N. Pégard, J. W. Fleischer, Y-L. Loo* Patent Application #14-214,564  
 Provisional Patent Application #61-635,540

Tilted Channels for Computational Imaging in Optofluidic Microscopes 2013  
*J. W. Fleischer and N. Pégard* Patent Application #14-023,455

Flow Scanning Tomography 2013  
*J. W. Fleischer and N. Pégard* Provisional Patent Application #61-776,970

Rotating flow for 3D optofluidic tomography & Structured illumination optofluidic microscope 2011  
*J. W. Fleischer and N. Pégard* Provisional Patent Application #61-699,003 & #61-609,991

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TEACHING EXPERIENCE

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Invited lecturer, University of California, Berkeley 2017  
*Recording neural activity in 3D with compressive light field microscopy, Neurotech/BMI class, (EE290P)*

Guest lecturer, University of California, Berkeley 2014 - Present  
*Introduction to Optical Engineering, Fresnel Diffraction (EE 218A)* 2017  
*Introduction to Optical Engineering, Lasers (EE 118)* 2016

Private tutor, Lessons in physics and mathematics 2013 - Present

Teaching assistant, Princeton University 2010 - 2013  
*Algorithms and Data Structures (COS 226)* 2013  
*Logic Design & VLSI (ELE 206), Introduction to Engineering (EGR 191)* 2012  
*Optoelectronics (ELE 453)* 2010

Undergraduate Research mentor, Princeton University 2011 - 2013  
*MIRTHE's summer program* undergraduate level research internships.

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OTHER WORK EXPERIENCE

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Optofluidic engineering research consultant, Nodexus Inc. Berkeley, CA 2016

Apprenticeship in carpentry, Far Eastern Federal University, Vladivostok, Russia 2008

Junior navigation officer, Midshipman rank, (M649 Persée) French navy, Brest Arsenal 2006

Assistant teacher in music theory, Amiens, France 2005

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SKILLS AND ACTIVITIES

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Languages: French (native speaker), English (fluent), German (fluent), Russian (conversational)

Programming languages: Matlab, Caml, Java, Labview, C, Python, PHP, HTML, L<sup>A</sup>T<sub>E</sub>X

Special Licenses: US private pilot license (Single engine, VFR, land), French offshore boating license

Music: Trumpet player for Princeton wind ensemble and marching band, Conductor and founding member of école Polytechnique Big Band

Other Hobbies: Amateur Rugby player at École Polytechnique, Woodworking, Blues dancing

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REFERENCES

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**Prof. Hillel Adesnik**

Postdoctoral co-advisor  
Molecular & Cell Biology dpt.  
205, Life Science Addition.  
University of California, Berkeley  
Berkeley, CA 94720  
510-642-2107  
hadesnik@berkeley.edu

**Prof. Laura Waller**

Postdoctoral co-advisor  
Electrical Engineering & C.S. dpt.  
514, Cory Hall.  
University of California, Berkeley  
Berkeley, CA 94720  
510-642-2753  
waller@berkeley.edu

**Prof. Jason W. Fleischer**

Ph.D. advisor  
Electrical Engineering dpt.  
318, 87 Prospect ave.  
Princeton University.  
Princeton, NJ 08544  
609-258-8963  
jasonf@princeton.edu