

Periklis (Laki) Pantazis PhD

Extended CV (incl. Publications and Research Profile)

Periklis (Laki) Pantazis PhD

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Education

- 2001–2005 **Ph.D., Biology and Bioengineering (Dr.rer.nat.)** **Dresden, Germany**
Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG)
Marcos A. González-Gaitán Lab
Thesis “Role of endocytic trafficking during Dpp gradient formation”
Summa Cum Laude
- 1995–2000 **Master of Science in Biochemistry (Dipl.-Biochem.)** **Hanover, Germany**
Leibniz University of Hanover
Magna Cum Laude

Institutional Appointments

- since 02/2021 **Director, Imperial College London and LEICA Microsystems Imaging Hub** **ICL, UK**
Centre of Excellence in Imaging to collaborate on joint research projects to drive scientific discoveries benefitting human health.
- since 09/2020 **Reader (equiv. Associate Professor) in Advanced Optical Precision Imaging** **ICL, UK**
Creating a mechanistic understanding of development and disease progression by conceiving and applying advanced bioimaging techniques.
- 2018 - 2020 **Senior Lecturer** **ICL, UK**
Conceiving and applying advanced bioimaging techniques.
- 2016 - 2018 **HHMI Janelia Visiting Scientist** **HHMI Janelia Research Campus, USA**
Cooperation with the lab of Eric Schreiter in conducting primed conversion-related research at the Janelia Research Campus of the Howard Hughes Medical Institute.
- 2012 - 2018 **Assistant Professor of Biosystems Analysis** **ETH Zürich, Switzerland**
Department of Biosystems Science and Engineering (D-BSSE)
Conducting research on advancing biosystems imaging, advising Postdocs, PhD, and Master students in the Laboratory of Nano Bio Imaging.
- 2006 - 2011 **Postdoctoral Scholar** **Caltech, USA**
Scott E. Fraser Lab – Division of Biology
Developed imaging tools required for the mechanistic dissection of stem cell and developmental biology problems.
- 07-11/2005 **Research Consultant** **Carl Zeiss MicroImaging GmbH, Germany**
Application Centre
Designed and implemented localized photoactivation experiments on the newly developed Zeiss LSM 710 NLO microscope system.
- 02-11/2005 **Postdoctoral Scholar** **MPI-CBG, Germany**
Marcos A. González-Gaitán Lab
Combined sophisticated imaging with *in silico* modelling to quantitatively analyze the distribution, diffusion, and clearance of eGFP-labelled morphogens during Drosophila embryogenesis.

Awards and Honors (incl. Group members)

- 2018–2023 **Royal Society Wolfson Research Merit Award Holder** **London, UK**
5-year Research support and Salary enhancement from The Royal Society
- 2018–2020 **Peter und Traudl Engelhorn Postdoctoral Fellowship Award** **Munich, Germany**
2-year Postdoctoral Fellowship from the Peter und Traudl Engelhorn Stiftung (head: Nobel Laureate Prof. Robert Huber) for the postdoc Maaïke Welling to conduct research about asymmetry in mouse embryos using primed conversion. Only 7 fellowships/year are awarded.

- 2017 **Spark Award 2017 Nomination** **Zurich, Switzerland**
The invention 'Biodegradable SHG nanoprobe' by the graduate student Ali Y. Sonay was placed among the top innovations filed by ETH Zurich in 2016 and nominated for the prestigious Spark Award of ETH Zurich.
- 2016 **Janelia Graduate Research Fellowship Award** **HHMI Janelia Research Campus, USA**
Advisor of the graduate student Manuel A. Mohr who was granted a prestigious HHMI graduate fellowship that is awarded to only 5 applicants per year to conduct primed conversion-related research at the Janelia Research Campus of the Howard Hughes Medical Institute.
- 2016 **HHMI Janelia Visiting Scientist Award** **HHMI Janelia Research Campus, USA**
2-year HHMI Janelia Visiting Scientist Award to co-supervise primed conversion-related research at the Janelia Research Campus of the Howard Hughes Medical Institute. It covers travel and research expenses of \$15000/year.
- 2015 **Best Student Participant Award for the 65th Nobel Laureate Meeting** **Lindau, Germany**
Advisor of the graduate student Ali Y. Sonay who was selected among 650 young scientists from 88 countries to attend the 65th Meeting of Nobel Prize Winners in Physiology or Medicine, Chemistry, and Physics.
- 2013 **Best Student Poster Award** **Zurich, Switzerland**
Advisor on the best student poster at the Zurich Center for Imaging Science and Technology (CIMST) Summer School.
- 2008-2011 **German Science Foundation Postdoctoral Fellowship** **Caltech, USA**
3-year Postdoctoral Fellowship of €45.000/year to perform research at the Biological Imaging Center of the California Institute of Technology (Caltech).
- 2009 **NIH Travel Stipend Award** **Washington/DC, USA**
Travel Stipend Award of \$500 for presenting SHG nanoprobe for in vivo imaging at the 4th NIH Workshop "Imaging the Pancreatic Beta Cell".
- 2007 **Participant Award for the 57th Nobel Laureate Meeting** **Lindau, Germany**
Travel Stipend awarded among the leading applications of 500 young researchers from 64 countries to attend the 57th Meeting of Nobel Prize Winners in Physiology or Medicine.
- 2001-2005 **PhD Scholarship of the German Science Foundation** **Dresden, Germany**
Predoctoral Fellowship of €20.000/year to perform undergraduate studies at the Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG).

Publications

Refereed Primary Papers

Group members in bold

*contributed equally

#corresponding author

- Under Review [56] Guo, K., **Kalyviotis, K.**, **Pantazis, P.**, and Rowlands, C.J#, "Hyperspectral Oblique Plane Microscopy" *bioRxiv* 15.532804
- 2023 [55] **Yaganoglu, S.***, **Kalyviotis, K.***, Vagena-Pantoula, C., Jülich, D., Gaub, B.M., **Welling, M.**, Lopes, T., Lachowski, D., **Tang, S.S.**, Del Rio Hernandez, A., Salem, V., Müller, D.J., Holley, S.A., Vermot, J., Shi, J., Helassa, N., Török, K., and **Pantazis, P.#**, "Highly specific and non-invasive imaging of Piezo1-dependent activity across scales using GenEPI". *Nature Communications* 14 (1), 4352.
Featured in: Landhuis, E. (2021) "Seven technologies to watch in 2021" [Nature](#) 589: 630-632 (2021)
"Nobel-winning bodily 'pressure sensors' filmed for first time at Imperial" [Imperial College London News](#).
- 2021 [54] **Sonay, A.Y.**, **Kalyviotis, K.**, **Yaganoglu, S.**, **Unsal, A.**, Konantz, M., Teulon, C., Jiang, S., Behzadi, S., Crespy, D., Landfester, K., Roke, S., Lengerke, C., and **Pantazis, P.#**, (2021) "Biodegradable harmonophores for targeted high-resolution in vivo tumor imaging". *ACS Nano* 15, 4144-4154.

Invention nominated for the SPARK Award 2017 at ETH Zurich and publication featured in: Brogan, C. (2021) "Tumours illuminated brightly and precisely with new biodegradable nanoprobe" [Imperial College London News](#).

- 2020 [53] **Welling, M., Kalyviotis, K., and Pantazis, P.#** (2020), "Primed Track: Reliable Volumetric Single-cell Tracking and Lineage Tracing of Living Specimen with Dual-labeling Approaches". *[Bio-protocols](#)*. 10(11), June 05.
- [52] Malkinson, G.*, Mahou, P.*, Chaudan, E., Gacoin, T., **Sonay, A.Y., Pantazis, P.**, Beaufepaire, E., and Supatto, W.# (2020), "Fast in vivo imaging of SHG nanoprobe with multiphoton light-sheet microscopy". *[ACS Photonics](#)*. 7:1036-1049.
- 2019 [51] **Welling, M.A.*, Mohr, M.A.*, Ponti, A., Sabater, L.R., Boni, A., Kitazawa, Y., Liberali, P., Peters, A., Pelczar, P., and Pantazis, P.#** (2019), "High fidelity lineage tracing in mouse pre-implantation embryos using primed conversion of photoconvertible proteins". *[eLIFE](#)*. 21(8): e44491.
- 2018 [50] Slenders, E., Bové, H., Urbain, M., Mugnier, Y., **Sonay, A.Y., Pantazis, P.**, Bonacina, L., Vanden Berghe, P., vandeVen, M., and Ameloot, M.#, (2018) "Image Correlation Spectroscopy with Second Harmonic Generating Nanoparticles in Suspension and in Cells." *[J Phys Chem Lett](#)*. 20:6112-6118.
- [49] **Sugiyama, N.*, Sonay, A.Y.*, Tussiwand, R., Cohen, B., and Pantazis, P.#**, (2018) "Effective Labeling of Primary Somatic Stem Cells with BaTiO₃ Nanocrystals for Second Harmonic Generation Imaging". *[Small](#)* 8:1703386.

Provided cover of the journal

- 2017 [48] **Nugraha, B., Mohr, M.A., Ponti, A., Emmert, M.Y., Weibel, F., Hoerstrup, S.P., Moll, S., Certa, U., Prunotto, M., and Pantazis, P.#**, (2017) "Monitoring and manipulating cellular crosstalk during kidney fibrosis inside a 3D in vitro co-culture". *[Scientific Reports](#)* 7:14490.
- [47] **Mohr, M.A.**, Kobitski, A.Yu., **Sabater, L.R.**, Nienhaus, K., Obara, C.J, Lippincott-Schwartz, J., Nienhaus, G.U.#, and **Pantazis, P.#**, (2017) "Rational Engineering of Photoconvertible Fluorescent Proteins for Dual-Color Fluorescence Nanoscopy Enabled by a Triplet-State Mechanism of Primed Conversion". *[Angew. Chem. Int. Ed.](#)* 56:11628-11633.
- Featured in: Bergman, F. (2017) "Red fluorescence in two steps" [ETH Zurich News](#).*
- [46] Zhang, W., Lohman, A.W., Zhuravlova, Y., Lu, X., Wiens, M.D., Hoi, H., **Yaganoglu, S., Mohr, M.A.**, Kitova, E.N., Klassen, J.S., **Pantazis, P.**, Thompson, J.R., and Campbell, R.E.#, (2017) "Optogenetic control with a photocleavable protein" *[Nature Methods](#)* 14:391-394.
- 2016 [45] **Mohr, M.A.**, Argast, P., and **Pantazis, P.#**, (2016) "Labeling cellular structures in vivo using confined primed conversion of photoconvertible fluorescent proteins" *[Nature Protocols](#)* 11:2419-2431.
- 2015 [44] **Dempsey, W.P.*, Hodas, N.O.*, Ponti, A., and Pantazis, P.#**, (2015) "Determination of the source of SHG verniers in zebrafish skeletal muscle" *[Scientific Reports](#)* 5:18119.
- [43] **Dempsey, W.P.*, Georgieva, L.*, Helbling, P.M., Sonay, A.Y., Truong, T.V., Haffner, M., and Pantazis, P.#**, (2015) "In vivo single cell labeling by confined primed conversion" *[Nature Methods](#)* 12:645-648.

Featured in 11 news outlets and scientific blogs among them: Bergman, F. (2015) "Chameleon proteins make individual cells visible" [ETH Zurich News](#).

- 2012 [42] Culic-Viskota, J.*, **Dempsey, W.P.*, Fraser, S.E., and Pantazis, P.#**, (2012) "Surface functionalization of barium titanate SHG nanoprobe for in vivo imaging in zebrafish" *[Nature Protocols](#)* 7:1618-33.
- [41] **Dempsey, W.P.**, Fraser, S.E., and **Pantazis, P.#**, (2012) "PhOTO Zebrafish: A transgenic resource for in vivo lineage tracing during development and regeneration" *[PLoS ONE](#)* 7:e32888.

Featured in: "PhOTO zebrafish: a transgenic resource for in vivo lineage tracing during development and regeneration, Significance statement" [Global Medical Discovery](#).

- 2011 [40] Plachta, N., Bollenbach, T., Pease, S., Fraser, S.E., and **Pantazis, P.#**, (2011) "Oct4 kinetics predict cell lineage patterning in the early mammalian embryo" *[Nature Cell Biology](#)* 13:117-23.

Provided cover of the journal and featured in: Zernicka-Goetz, M., (2011) "Proclaiming fate in the early mouse embryo" [Nature Cell Biology](#) 13:112-4.

- [39] Caneparo, L.*, **Pantazis, P.***, Dempsey, W.P., and Fraser, S.E., (2011) "Intercellular bridges in vertebrate gastrulation" *PLoS ONE* 6:e20230.
- 2010 [38] **Pantazis, P.#**, Maloney, J., Wu, D., and Fraser, S.E., (2010) "Second Harmonic Generating (SHG) nanoprobes for in vivo imaging" *Proc Natl Acad Sci USA* 107:14535-40.
Featured in: Cohen, B., (2010) "Biological imaging: Beyond fluorescence" *Nature* 467:407-8; Evanko, D., (2010) "Microscope harmonies" *Nature Methods* 7:779.
- [37] Tu, C., Ma, X., **Pantazis, P.**, Kauzlarich, S.#, and Louie, A.#, (2010) "Paramagnetic, silicon quantum dots for magnetic resonance and two photon imaging of macrophages" *J Am Chem Soc* 132:2016-23.
- 2008 [36] Bollenbach, T.*, **Pantazis, P.***, Kicheva, A.*, Boekel, C., Kruse, K., Gonzalez-Gaitan, M.#, and Juelicher, F.#, (2008) "Precision of the Dpp gradient" *Development* 135:1137-46.
- 2007 [35] Kicheva, A.*, **Pantazis, P.***, Bollenbach, T.*, Kalaidzidis, Y., Bittig, T., Juelicher, F.#, and Gonzalez-Gaitan, M.#, (2007) "Kinetics of morphogen gradient formation" *Science* 315(5811):521-5.
Featured in: Kritikou, E., (2007) "Reaching one's range" *Nature Reviews Molecular Cell Biology* 8:181.
- [34] **Pantazis, P.#**, and González-Gaitán, M., (2007) "Localized multiphoton photoactivation of paGFP in Drosophila wing imaginal discs" *J Biomed Opt* 12:044004.
- [33] Bollenbach, T., Kruse, K., **Pantazis, P.**, Gonzalez-Gaitan, M., Juelicher, F.#, (2007) "Morphogen transport in epithelia." *Phys Rev E Stat Nonlin Soft Matter Phys.*75 (1 Pt 1):011901.
- 2005 [32] Bollenbach, T., Kruse, K., **Pantazis, P.**, Gonzalez-Gaitan, M., and Juelicher, F.#, (2005) "Robust formation of morphogen gradients" *Phys Rev Lett* 94:018103(1-4).
- [31] Kruse, K.*, **Pantazis, P.***, Bollenbach, T., Juelicher, F.#, and Gonzalez-Gaitan, M.#, (2004) "Dpp gradient formation by Dynamin-dependent endocytosis: receptor trafficking and the diffusion model" *Development* 131:4843-56.
- 1999 [30] Tsikas, D.#, Sandmann, J., Holzberg, D., **Pantazis, P.**, Raida, M., and Frolich, J.C., (1999) "Determination of S-nitrosoglutathione in human and rat plasma by high-performance liquid chromatography with fluorescence and ultraviolet absorbance detection after precolumn derivatization with o-phthalaldehyde" *Anal Biochem* 273:32-40.

Refereed Reviews Publications

- 2023 [29] **Kalyviotis, K.**, and **Pantazis, P. #**, "Primed conversion: The emerging player of precise and nontoxic photoconversion." *Journal of Microscopy*, 1-8.
- 2018 [28] **Mohr, M.A.**, and **Pantazis, P.#**, "Primed conversion: the new kid on the block for photoconversion" *Chemistry* 33:8268-8274.
- 2016 [27] **Welling, M.**, Ponti, A., and **Pantazis, P.#**, (2016) "Symmetry breaking in the early mammalian embryo: the case for quantitative single-cell imaging analysis" *MHR-Molecular Human Reproduction* 22:172-181.
- 2014 [26] **Pantazis, P.#**, and Supatto W., (2014) "Advances in whole-embryo imaging: a quantitative transition is underway" *Nature Reviews Molecular Cell Biology* 15:327-39.
- 2013 [25] Mikut R.#, Dickmeis T., Driever W., Geurts P., Hamprecht F.A., Kausler B.X., Ledesma-Carbayo M.J., Marée R., Mikula K., **Pantazis P.**, Ronneberger O., Santos A., Stotzka R., Strähle U., and Peyriéras N., (2013) "Automated processing of zebrafish imaging data: A survey" *Zebrafish* 10:401-21.
- 2012 [24] **Pantazis, P.#**, and Bollenbach, T., (2012) "Transcription factor kinetics and the emerging asymmetry in the early mammalian embryo" *Cell Cycle* 11:2055-8.
- [23] **Dempsey, W.P.**, Fraser, S.E., and **Pantazis, P.#**, (2012) "SHG nanoprobes: Advancing harmonic imaging in biology" *Bioessays* 34:351-60.
- 2004 [22] Dudu, V.*, **Pantazis, P.***, and Gonzalez-Gaitan, M.#, (2004) "Membrane traffic during embryonic development: epithelial formation, cell fate decisions and differentiation" *Curr Opin Cell Biol* 16:407-414.

Refereed Conference Publications

- 2020 [21] Malkinson, G., Maioli, V., Boniface, A., Mahou, P., Ortas, J.F., Chaudan, L.A.E., **Sonay, A.Y.**, Gacoin, T., **Pantazis, P.**, Beaufrepaire, E., and Supatto, W.#, (2020) "Advances in fast multiphoton microscopy using light-sheet illumination." *Biomedical Optics 2020*.
- 2018 [20] Nienhaus, K., **Mohr, M.A.**, Kobitski, A, Y., **Sabater, L.R.**, Obara, C.J., Lippincott-Schwartz, J., Nienhaus, G.U.#, and **Pantazis, P.#** (2018) "Primed Green-to-Red Photoconversion of Fluorescent Proteins Occurs via a Triplet State." *Biophysical Journal* 114:533a.
- 2017 [19] **Sonay, A.Y.**, and **Pantazis, P.#**, (2017) "Bioinspired Second Harmonic Generation" *Proc. SPIE 10411, Clinical and Preclinical Optical Diagnostics, 104110D*.
- 2009 [18] **Pantazis, P.#**, Pu, Y., Psaltis, D., and Fraser, S.E., (2009) "Second Harmonic Generating (SHG) Nanoprobes: A new tool for biomedical imaging" *Proc. SPIE* 7183:71831-5.

Refereed Books and/or Book Chapters

- 2021 [17] Fang, C., Drobizhev, M., Ng, H.L., **Pantazis, P.**, "Mechanisms of Fluorescent Proteins" *Front Mol Biosci*. 8:701523.
- 2020 [16] **Konstantinos, K.**, **Qin, H.**, and **Pantazis, P.#**, "Chapter 19 - PhOTo zebrafish and primed conversion: advancing the mechanistic view of development and disease" *Behavioral and Neural Genetics of Zebrafish*, Academic Press, Pages: 309-322.
- 2016 [15] **Mohr, M.A.**, and **Pantazis, P.#**, "Single neuron morphology in vivo with confined primed conversion" *Methods Cell Biology* 133:125-38.
Figure selected as cover image for: Volume 1, Methods in Cell Biology, The Zebrafish: Cellular and Developmental Biology, Part A Cellular Biology 4th Edition.
- 2014 [14] **Dempsey, W.P.**, **Qin, H.**, and **Pantazis, P.#**, "In vivo cell tracking using PhOTo Zebrafish" *Methods Molecular Biology* 1148:217-28.

Patents

Total number of issued patents and pending patent applications: 13

- 2021 [13] **Pantazis, P.**, **Sonay, A.Y.**, Landfester, K., and Crespy, D., "Biodegradable second harmonic generating nanoprobes" *E.P. patent granted* (12 November 2021, EP 3518986).
- 2018 [12] **Pantazis, P.**, **Dempsey, W.P.**, Truong, T.V., Fraser, S.E., and **Georgieva, L.** "Method And Device To Achieve Spatially Confined Photointeraction At The Focal Volume Of A Microscope" *U.P. patent granted* (15 May 2018, US 90,971,136).
- [11] **Pantazis, P.**, Pu, Y., Hong, J., Psaltis, D., and Fraser, S.E. "Second Harmonic Imaging Nanoprobes And Techniques For Use Thereof" *U.S. patent granted* (20 Feb 2018, US 9,971,136).
- 2017 [10] **Pantazis, P.** and **Yaganoglu, S.**, "Piezo1-based fluorescent reporter" *E.P. patent pending* (2017, EP 2017/17210479.6).
- [9] **Mohr, M.A.**, and **Pantazis, P.**, "Engineered photoconvertible fluorescent proteins (pcFPs) for primed conversion" *U.S. patent pending* (2017, US 62/446,023).
- 2016 [8] **Pantazis, P.**, Pu, Y., Hong, J., Psaltis, D., and Fraser, S.E. "Second Harmonic Imaging Nanoprobes And Techniques For Use Thereof" *U.S. patent granted* (25 Oct 2016, US 9,476,830).
- [7] **Pantazis, P.**, Culic-Viskota, J., **Dempsey, W.P.**, and Fraser, S.E. "Functionalization of and use of functionalized second harmonic generating nanoprobes" *U.S. patent granted* (31 May 2016, US 9,352,055).
- 2015 [6] **Pantazis, P.**, Culic-Viskota, J., **Dempsey, W.P.**, and Fraser, S.E. "Functionalization of and use of functionalized second harmonic generating nanoprobes" *U.S. patent granted* (29 Dec 2015, US 9,221,919).
- [5] **Pantazis, P.**, Masmanidis, S., and Fraser, S.E. "Multipurpose Analysis Using Second Harmonic Generating Nanoprobes" *U.S. patent granted* (03 Feb 2015, US 8,945,471 B2).

- 2014 [4] **Pantazis, P., Dempsey, W.P.,** Truong, T.V., Fraser, S.E., and **Georgieva, L.** "Method And Device To Achieve Spatially Confined Photointeraction At The Focal Volume Of A Microscope" [W.O. patent pending](#) (2014, WO 2014/147211).
- [3] **Pantazis, P., Dempsey, W.P.,** Truong, T.V., Fraser, S.E., and **Georgieva, L.** "Method And Device To Achieve Spatially Confined Photointeraction At The Focal Volume Of A Microscope" [E.P. patent pending](#) (2014, EP 2014/055669).
- 2010 [2] **Pantazis, P.,** Masmanidis, S., and Fraser, S.E. "Multipurpose Analysis Using Second Harmonic Generating Nanoprobes" [W.O. patent pending](#) (2010, WO 2010/090844).
- 2008 [1] **Pantazis, P.,** Pu, Y., Hong, J., Psaltis, D., and Fraser, S.E. "Second Harmonic Imaging Nanoprobes And Techniques For Use Thereof" [W.O. patent pending](#) (2008, WO 2008/140584).

Industry Brochure

- 2007 [1] **Pantazis, P.,** (2007) "Localized Photoactivation / Lokalisierte Photoaktivierung" [Brochure](#) - Carl Zeiss Microlmaging GmbH.

Invited Talks

15 invited plenary talks, 55 invited talks

Various online talks - available online: [Imaging ONEWORLD Series - Royal Microscopy Society](#)
[The London Stem Cell Network Conference](#)

01/2024	International Caparica Symposium on Nanoparticles/Nanomaterials and Applications (INSA 2024) Keynote	Caparica, Portugal
01/2024	10th Strategic Conference of Zebrafish Investigators Plenary Talk	Pacific Grove/CA, USA
09/2023	See the Hidden LEICA Workshop: Advanced Imaging of Disease Invited Online Talk	London, UK
07/2023	Microscience Microscopy Congress 2023 (mmc2023) Invited Talk	Manchester, UK
01/2023	London Zebrafish Meeting Invited Talk	London, UK
10/2022	Harvard Medical School, Department of Immunology Invited Talk	Boston/MA, USA
09/2022	Mini-Conference Raman Nanotheranostics (RaNT2022) Invited Talk	Exeter, UK
06/2022	Cancer Diagnostic Technology Summit 2022 Invited Online Talk	London, UK
05/2022	Physics of Living Systems Annual Symposium 2022 Invited Talk	London, UK
04/2022	6th European Zebrafish PI Meeting Invited Plenary Talk	Dresden, Germany
02/2021	Royal Microscopy Society Invited Online Talk 'Imaging ONEWORLD Series'	Cambridge, UK
01/2022	See the Hidden LEICA Workshop: Cancer Research Invited Online Talk	London, UK
02/2020	LMS-Helmholtz Metabolism Meeting Invited Talk	London, UK
12/2019	American Society of Cell Biology Annual Meeting Invited Talk	Washington/DC, USA

12/2019	Materials Research Society Fall 2019 Meeting Invited Talk	Boston/MA, USA
10/2019	EMBO/EMBL Symposium 'Seeing is Believing' Invited Plenary Talk	Heidelberg, Germany
09/2019	International workshop in cardiac mechanoelectric coupling and arrhythmia Invited Plenary Talk	Freiburg, Germany
10/2018	Princeton University Invited Talk	Princeton/NJ, USA
10/2018	Fluorescent Proteins and Biological Sensors VI at Janelia Research Campus Invited Plenary Talk	Ashburn/VA, USA
07/2018	EPFL, School of Engineering Invited Talk	Lausanne, Switzerland
11/2017	Bioengineering Symposium at EPFL Invited Plenary Talk	Lausanne, Switzerland
11/2017	University of Geneva Invited Talk	Geneva, Switzerland
10/2017	ETH Zurich, D-ITET Invited Talk	Zurich, Switzerland
10/2017	ETH Zurich, D-CHAB Invited Talk	Zurich, Switzerland
07/2017	International Symposium on Imaging Frontier 2017 Invited Plenary Talk	Tokyo, Japan
07/2017	10th European Zebrafish Meeting Plenary Talk	Budapest, Hungary
05/2017	University of Washington Invited Talk	Seattle/WA, USA
05/2017	Max Planck Institute for Biophysical Chemistry Invited Talk	Göttingen, Germany
04/2017	University of Chicago Invited Talk	Chicago/IL, USA
03/2017	Technical University of Munich Invited Talk	Munich, Germany
02/2017	University of Münster Invited Talk	Münster, Germany
01/2017	University of California Irvine (UCI) Invited Talk	Irvine/CA, USA
11/2016	NanoBioTech-Montreux Invited Session Talk	Montreux, Switzerland
11/2016	Labeling & Nanoscopy 2016 Deutsches Krebsforschungszentrum (DKFZ) Contributed talk	Heidelberg, Germany
10/2016	Harvard, Department of Systems Biology Invited Talk	Boston/MA, USA
06/2016	68th Annual Meeting of the Japan Society of Cell Biology Invited Session Talk	Kyoto, Japan
06/2016	Swiss-Kyoto Symposium 2016 Invited Talk	Kyoto, Japan

05/2016	16th European Light Microscopy Initiative (ELMI) Meeting Invited Talk	Debrecen, Hungary
04/2016	NIH Invited Talk	Washington/DC, USA
04/2016	HHMI Janelia Research Campus Invited Talk	Ashburn/VA, USA
03/2016	4th European Zebrafish Principal Investigator Meeting Invited Talk Session 6 - Emerging Technologies	Lisbon, Portugal
03/2016	7th Annual EFOR Meeting FIAP Jean Monnet Plenary Talk	Paris, France
02/2016	ETH Zurich, D-BIO, Institute of Biochemistry Invited Talk	Zurich, Switzerland
11/2015	Karlsruhe Institute of Technology (KIT) Invited Talk	Karlsruhe, Germany
10/2015	European Molecular Biology Laboratory (EMBL) Symposium "Seeing is Believing - Imaging the Processes of Life" Invited Fast Track Talk	Heidelberg, Germany
05/2015	15th European Light Microscopy Initiative (ELMI) Meeting Invited Fast Track Talk	Barcelona, Spain
03/2015	Max Planck Institute for Polymer Research (MPIP) Invited Talk	Mainz, Germany
02/2015	Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG) Invited Talk	Dresden, Germany
01/2015	6th Strategic Conference of Zebrafish Investigators Plenary Talk	Pacific Grove/CA, USA
11/2014	Max Planck Institute for Molecular Biomedicine Invited Talk	Münster, Germany
10/2014	Novartis Workshop "Using 3D cell cultures and organ printing in drug discovery - cells, biosensors and imaging technology" Plenary Talk	Basel, Switzerland
10/2014	University of Hasselt µFiBR 2014: Optical Imaging in Biomedical Nanotechnology Plenary Talk	Hasselt, Belgium
09/2014	Institut de Genetique et de Biologie Moleculaire and Cellulaire (IGBMC) Invited Talk	Strasbourg, France
05/2014	Agency for Science, Technology and Research (A*STAR) Invited Talk	Singapore
05/2014	Nanyang Technological University (NTU) META'14: 5th International Conference on Metamaterials, Photonic Crystals and Plasmonics Invited Talk	Singapore
05/2014	Korea Research Institute of Bioscience & Biotechnology (KRIBB) Swiss-Korean Life Science Symposium Invited Talk	Seoul, Korea
03/2014	Weizmann Institute 3rd European Zebrafish Principal Investigator Meeting	Rehovot, Israel

	Symposium on Imaging and Image Processing Plenary Talk	
03/2014	Biomedical Research Foundation Academy of Athens (BRFAA), Invited Talk	Athens, Greece
11/2013	Swiss-Kyoto Symposium 2013 Invited Talk	Zurich, Switzerland
10/2013	Quantitative Single Cell Biology in Stem Cell Research Abcam Meeting Invited Talk	Munich, Germany
07/2013	European Zebrafish Meeting Workshop "Strategies for cell lineage tracing" Plenary Talk	Barcelona, Spain
04/2013	Annual Meeting of the Basel Stem Cell Network (BSCN) Plenary Talk	Basel, Switzerland
02/2013	LS2 Annual Meeting, "(R)evolutions in Biology" Invited Talk	Zurich, Switzerland
10/2012	École Polytechnique CNRS Conference "Microscopie non-linéaire en sciences du vivant" Invited Talk	Palaiseau, France
09/2012	University of Cambridge EMBO Workshop "Cell Biology of Early Mouse Development" Invited Talk	Cambridge, UK
09/2012	Lawrence Berkeley National Laboratory (LBNL) The Molecular Foundry Workshop Invited Talk	Berkeley/CA, USA
01/2012	3rd Annual EFOR Meeting FIAP Jean Monnet Invited Talk	Paris, France
11/2011	Institute of Science and Technology Austria (IST Austria) Invited Talk	Klosterneuburg, Austria

External Funding

Raised ~€ 6.75M since 2012 in funding from government, charities (BBSRC, MRC, CRUK, The Royal Society, EU, SNF, HHMI, NWO, US Department of Energy and the Peter und Traudl Engelhorn Stiftung) and industry (LEICA Microsystems Ltd and F.Hoffman-La Roche)

2023-now	MRC Grant (MR/X019837/1) Co-PI of proposal "Dissecting the molecular crosstalk between mechanotransduction and primary cilia in models of congenital valvulopathies " <u>£620,000</u>	MRC
2022-now	Convergence Science Centre Grant PI of proposal "Winners versus Losers: Deciphering the mechanism of cell competition via optogenetics and single cell tracking of organoids" <u>£120,000</u>	Cancer Research UK
2021-now	Imperial College London and LEICA Microsystems Imaging Hub Director of the Centre of Excellence in Imaging; LEICA contribution <u>≥£1.0M</u>	LEICA Microsystems
2021-now	Convergence Science Centre Grant PI of the grant 'Bioharmonophores: Redefining Photodynamic Therapy of Cancer'; <u>£120,000</u>	Cancer Research UK
2021-now	BBSRC Grant (BB/T017929/1) PI of the grant 'A digital light-sheet microscope for the analysis of biological processes under almost natural conditions'; <u>£0.60M</u>	BBSRC

2021-2022	BBSRC Grant (BB/T011947/1) Co-PI of the grant 'Primed Conversion Oblique Plane Microscopy'; <u>£200,000</u>	BBSRC
2018-2023	Royal Society Wolfson Research Merit Award 5-year Research support and Salary enhancement, London/UK; <u>£220,000</u>	The Royal Society
2018-2020	Postdoctoral Fellowship for Maaïke Welling 2-year Postdoctoral Fellowship from the Peter und Traudl Engelhorn Stiftung, Munich/Germany; <u>CHF200,000</u>	Peter und Traudl Engelhorn Stiftung
2016-2018	Janelia Graduate Research Fellowship for Manuel A. Mohr 2-year Graduate Fellowship to perform part of the PhD research at the Janelia Research Campus of the Howard Hughes Medical Institute; <u>\$96,000</u>	HHMI
2016-2018	Rubicon Postdoctoral Fellowship for Maaïke Welling 2-year Postdoctoral Fellowship from the Netherlands Organization for Scientific Research; <u>€150,000</u>	NWO
2016-2017	R'Equip Grant: 316030_164087/1 co-PI of the Equipment grant "Light-Sheet Microscopy" to acquire a light-sheet microscope for performing fast volumetric imaging; <u>CHF461,364</u>	SNF
2015-2016	Project Grant: #3776 PI of the grant "Synthesis and fractionation of BaTiO ₃ nanocrystals as SHG nanoprobe" to perform nanocrystal fractionation at the Lawrence Berkeley National Laboratory Molecular Foundry; <u>\$10,000</u>	US Department of Energy
2013-2016	Project Grant: 310034A_144048 PI of the grant "Imaging of pluripotency in systems biology"; <u>CHF471,500</u>	SNF
2013-2016	Marie Curie Career Integration Grant: RPF-ID277 PI of the grant "Systems imaging of emerging asymmetry in vertebrate development (SIEAVD)"; <u>€100,000</u>	European Commission (FP7)
2013-2015	Project Grant: RPF-ID277 PI of the grant "Establishing 3D in vitro reconstructed renal microenvironment through advanced multiphoton microscopy imaging"; <u>CHF420,000</u>	F. Hoffman-La Roche
2012-2013	Project Grant: #1603 PI of the grant "Synthesis and functionalization of BaTiO ₃ Nanocrystals as SHG nanoprobe" to synthesize nanocrystals at the Lawrence Berkeley National Laboratory Molecular Foundry; <u>\$10,000</u>	US Department of Energy
2012-2013	NCCR Nano Module 1 Project Grant PI of the grant "Optical tracking of neutrophil dynamics in vivo"; <u>CHF80,000</u>	SNF
2011	Zeiss LSM780NLO Donation Global donation from Roche Pharma Research and Early Development (pRED) to ETH Zurich that included a share intended for the purchase of a non-linear optical microscope; <u>CHF1.4M</u>	F. Hoffman-La Roche

Teaching Experience

Lectures and Workshops

10-12/2023	BIOE97159 "Principles of Biomedical Imaging" Undergraduate class of >100 students (50% cover)	ICL
10-12/2023	BIOE60015 "Advanced Imaging Technologies for Systems Biology and Biomedical Research" Undergraduate class of <50 students (100% cover)	ICL
10-12/2022	BIOE97159 "Principles of Biomedical Imaging" Undergraduate class of >100 students (50% cover)	ICL
10-12/2022	BIOE60015 "Advanced Imaging Technologies for Systems Biology and Biomedical Research" Undergraduate class of <50 students (100% cover)	ICL
01-02/2022	BE9-MBMI "Brain Machine Interfaces" Undergraduate class of >100 students (25% cover)	ICL
10-12/2021	BIOE96041 "Principles of Biomedical Imaging" Undergraduate class of >100 students (50% cover)	ICL

10-12/2021	BIOE60015 "Advanced Imaging Technologies for Systems Biology and Biomedical Research" Undergraduate class of <50 students (100% cover)	ICL
01-02/2021	BE9-MBMI "Brain Machine Interfaces" Undergraduate class of >100 students (25% cover)	ICL
10-12/2020	BIOE96041 "Principles of Biomedical Imaging" Undergraduate class of >100 students (50% cover)	ICL
10-12/2020	BIOE96072 "Advanced Imaging Technologies for Systems Biology" Undergraduate class of <50 students (100% cover)	ICL
01-02/2020	BIOE97075 "Brain Machine Interfaces" Undergraduate class of >100 students (25% cover)	ICL
11-12/2019	BIOE96041 "Principles of Biomedical Imaging" Undergraduate class of >100 students (25% cover)	ICL
01-02/2019	BE9-MBMI "Brain Machine Interfaces" Undergraduate class of >100 students	ICL
09-12/2017	636-0014-00L "Advanced Imaging Technologies" Master class of ~17 students	ETH Zurich
02-06/2017	636-0014-00L "Imaging in Systems Biology" Master class of ~15 students	ETH Zurich
02-06/2016	636-0014-00L "Imaging in Systems Biology" Master class of ~15 students	ETH Zurich
12/2015	41130-01 "Genetic Approaches in Biomedical Research" Bachelor class of ~100 students; Lecture "In vivo single-cell labeling by confined Primed Conversion"	UNI Basel
11/2015	Workshop "2nd course on Optogenetics" Institut Curie Workshop of ~30 students; Lecture "In vivo single-cell labeling by confined Primed Conversion"	Paris, France
02-06/2015	636-0014-00L "Imaging in Systems Biology" Master class of ~15 students	ETH Zurich
12/2014	35823-01 "Genetic Approaches in Biomedical Research" Bachelor class of ~100 students; Lecture "Advances in whole embryo imaging: A quantitative transition is underway"	UNI Basel
05/2014	35823-01 "Genetic Approaches in Biomedical Research" Bachelor class of ~100 students; Lecture "pHOTO Zebrafish: A transgenic resource for in vivo lineage tracing during development and regeneration"	UNI Basel
02-06/2014	636-0014-00L "Imaging in Systems Biology" Master class of ~15 students	ETH Zurich
11/2013	32672-01 "Genetic Approaches in Biomedical Research" Bachelor class of ~100 students; Lecture "Tracking pluripotency: Advanced imaging tools for probing asymmetry in early mammalian embryos"	UNI Basel
02-06/2013	636-0014-00L "Imaging in Systems Biology" Master class of ~15 students	ETH Zurich

Advising and Mentoring (Past and Present)

Present lab members

Postdoctoral Fellows

Konstantinos (PhD, Imperial College, start in 2023)

PhD Students

See Swee (Elijah) Tang (MS, Imperial College London; PhD expected 12/2023)

Edagül Uluçay (MD, Imperial College London; PhD expected 07/2024)

Julian Boecker (MD, Imperial College London; PhD expected 07/2025)

Victoria Stomberg (MS, Imperial College London; PhD expected 09/2027)

Master Students

ICL

Andrei Enoae
Myles Vinh Farr
Reevesh Shrestha
Bollier-Gave, Pomone
Zhao Gao
Andrew Kloska
Daniel Lee
Papavee Phongsopa
Vishnu Seshan

Past

Postdoctoral Fellows

ICL/ETH Zurich

Maria Antonetta 'Maaiké' Welling (PhD, Utrecht University)
Current position: Grant Advisor at UMC Utrecht, Netherlands

Nami Sugiyama (PhD, University of Helsinki)
Current position: Assistant Professor, Kyoto University, Japan

Bramasta Nugraha (PhD, National University of Singapore)
Current position: Senior Scientist, Novo Nordisk, Copenhagen, Denmark

William P. Dempsey (PhD, California Institute of Technology)
Current position: Head of Research, Esperto Medical, Los Angeles/CA, USA

PhD Students

HHMI/ETH Zurich

Konstantinos Kalyviotis (MS, Democritus University of Thrace; PhD 05/2023)
Current position: Postdoctoral Fellow, Imperial College London, London, UK

Hanyu Qin (MS, Uppsala University; PhD 01/2019)
Current position: Director in Business Development, Artivila Therapeutics, Shenzhen, China

Manuel Mohr (MS, ETH Zurich; PhD 08/2018)
Current position: Blavatnik Entrepreneurial Fellow, Yale, West Haven/CT, USA

Ali Yasin Sonay (MS, Yeditepe University; PhD 02/2018)
Current position: Postdoctoral Fellow, MSKCC, New York/NY, USA

Sine Yaganoglu (MS, ETH Zurich; PhD 01/2018)
Current position: Strategy Manager, F. Hoffmann-La Roche AG, Basel, CH

Master Students

ETH Zurich

Maëlle Benefice (BS, École Polytechnique ; MS 2020)
Aysen Unsal (BS, University of Surrey; MS 2020)
Dan-Felix Scherrer (MSc, University of Basel; MS 2018)
Lluc Rullan Sabater (BS, University of Pennsylvania; MS 2017)
Gabriel Hauswirth (BS, ETH Zurich; MS 2015)
Patrick Helbling (BS, ETH Zurich; MS 2014)

Scientific Research Assistant

ETH Zurich

Lada Georgieva (MS, EPFL)

Outside Lab activities

- 2020 **PhD Thesis Co-Referee** ICL
Serving as examiner of the PhD Thesis of Håkon Høgset (Prof Molly Stevens)
- 2020 **PhD Thesis Committee Member** ICL
Serving on the PhD committee of Ioannis Gkouzionis (Prof Daniel Elson)
- 2018 **MSc Thesis Co-Referee** UNI Basel
Served as examiner of the MSc Thesis of Deborah Huber (Prof. Markus Affolter)
- 2018 **MSc Thesis Co-Referee** EPFL
Served as examiner of the MSc Thesis of Anton Stroganov (Prof. Aleksandra Radenovic)

2018	PhD Thesis Co-Referee Served as examiner of the PhD Thesis of Deborah Huber (Dr. Govind Kaigala)	IBM
2018	PhD Thesis Co-Referee Served as examiner of the PhD Thesis of Daniel Strebinger (Prof. David Suter)	EPFL
2016-2019	PhD Thesis Committee Member Served on the PhD committee of Karin Prummel (Prof. Christian Mosimann)	University of Zurich
2013-2017	PhD Thesis Committee Member Served on the PhD committee of Joanna Torres (Prof. Renato Paro)	ETH Zurich
2012-2017	PhD Thesis Committee Member Served on the PhD committee of Allwyn Pereira (Prof. Renato Paro)	ETH Zurich
2013-2017	PhD Thesis Committee Member Served on the PhD committee of Tetjana Serdiuk (Prof. Daniel Müller)	ETH Zurich
2012-2015	PhD Thesis Committee Member Served on the PhD committee of Moritz Freunds Schuh (Prof. Daniel Müller)	ETH Zurich
2015	PhD Thesis Co-Referee Served as examiner of the PhD Thesis of Moritz Freunds Schuh (Prof. Daniel Müller)	ETH Zurich
2015	PhD Thesis Co-Referee Served as examiner of the PhD Thesis of Subramanian Ramanathan (Prof. Daniel Müller)	ETH Zurich
2012	PhD Thesis Co-Referee Served as examiner of the PhD Thesis of Jelena Čulić-Viskota (Prof. Scott E. Fraser & Prof. Mark E. Davis)	Caltech

Service

Leadership Service to Imperial College London

2021-now	Imperial College London and LEICA Microsystems Imaging Hub Council of Operations , Director
2021-now	MEng Molecular Bioengineering , Programme Director
2021-now	Facility for Imaging by Light Microscopy steering committee , Academic Member for Engineering
2021-now	Department Research Committee , Member covering Optical Imaging and Fellowships
2018-2022	Animal Welfare and Ethical Review Body , Academic Member for Engineering

Scientific Journal Reviewer

ACS Nano
Advanced Science
Angewandte Chemie International Edition
Biophysical Journal
Chemical Communications
Development
Developmental Biology
Faculty of 1000 (F1000)
International Journal of Developmental Biology
Journal of Applied Physics
Journal of the American Chemical Society (JACS)
Journal of Visualized Experiments (JoVE)
Molecular Human Reproduction (MHR)
Nanoscale
Nature
Nature Biotechnology
Nature Cell Biology
Nature Chemical Biology
Nature Communications Biology
Nature Methods
Nature Nanotechnology
Nature Protocols

Proceedings of the National Academy of Science (PNAS)
Public Library of Science ONE (PLoS ONE)
Royal Society Open Science
Scientific Reports
Small
Theranostics

Scientific Journal Editorial Boards

- 2020-now **Nature Communications Biology**
Serving as External Editor for the Research Topics "Bioengineering, Biotechnology & Methods"
- 2019-now **Frontiers in Molecular Biosciences**
Serving as an Editor on the Research Topic "Mechanisms of Fluorescent Proteins"
- 2015-now **Stem Cell Reviews and Reports (SCRR)**
Serving on the Editorial Board supervising the review of manuscripts and reviews

Advisory Service

- 2022 **Review Board Member, Cyprus University of Technology** **Limassol, CY**
Assessing the Biomedical Engineering program
- 2021 **Engineering and Physical Sciences Research Council (EPSRC) Reviewer** **Swindon, UK**
Reviewed grant proposal asking for ~£1.5M
- 2021 **ETH Grants** **Zurich, Switzerland**
Reviewed grant proposal asking for ~ CHF 1.0M
- 2020 **Austrian Science Fund (FWF) Reviewer** **Vienna, Austria**
Reviewed grant proposal asking for ~€1.5M
- 2017 **Department of Research and Development** **Prague, CZ**
Ministry of Education, Youth and Sports of the Czech Republic
Assessing the large research infrastructure, CzechBioluminescence RI
- 2015 **Netherlands Organization for Scientific Research (NOW) Reviewer** **The Hague, NL**
Reviewed grant proposal asking for ~€250.000
- 2015 **The French National Research Agency (ANR) Reviewer** **Paris, France**
Reviewed grant proposal asking for ~€150.000
- 2015 **The Austrian Academy of Science (ÖAW) Reviewer** **Vienna, Austria**
Reviewed fellowship proposal asking for ~€100.000
- 2014 **The German Science Foundation (DFG) Reviewer** **Bonn, Germany**
Reviewed grant proposal asking for ~€750.000
- 2014 **The Austrian Academy of Science (ÖAW) Reviewer** **Vienna, Austria**
Reviewed fellowship proposal asking for ~€100.000
- 2013 **The Swiss National Science (SNF) Reviewer** **Bern, Switzerland**
Reviewed grant proposal asking for ~CHF500.000

Leadership Service to the Academic Community

- 2021/22 **Co-Organizer Workshop "See the Hidden"** **London, UK**
Organizing with LEICA Microsystems a workshop about advanced imaging in translating cancer research within the framework of the LEICA and Imperial College Imaging Hub.
- 2017 **Co-Chair "Technological Breakthroughs"** **Pacific Grove/CA, USA**
Organizing a workshop about advanced imaging in the framework of the 7th Strategic Conference for Zebrafish Investigators at Asilomar in Pacific Grove, California.
- 2016 **Co-Category Chair "Transdisciplinary Imaging - Developmental Biology" for the World Molecular Imaging Congress** **New York/NY, USA**
Identified abstract reviewers, managed the review process in the category, and assisted with identifying abstracts for oral or poster presentation.

- 2016 **EXCITE Summer School 2016** **Zurich, CH**
Presented imaging lecture and organized practical session.
- 2015 **Practical Day on aquatic animals in the framework of the LTK module 20** **Basel, CH**
Co-organized the practical animal experimentation course and participated as speaker and my laboratory members as tutors.
- 2012-now **European Zebrafish Image Processing Expert Group, Member** **Karlsruhe, Germany**
Identifying and exchanging knowledge about key areas for automation of embryo handling and automated image acquisition and processing.

Professional Organizations

- 2020-now **Royal Microscopical Society (RMS)**, Committee Member, Life Science Section
- 2020-now **British Society for Developmental Biology (BSDB)**, Member
- 2019-2021 **Material Research Society (MRS)**, Member
- 2016-now **American Chemical Society (ACS)**, Member
- 2016-now **International Zebrafish Society (IZFS)**, Member
- 2011-now **European Zebrafish Society**, Member

Research Profile

Live imaging offers the unique advantage of observing biological processes with high spatiotemporal resolution in whole organisms, offering a path to more refined, quantitative dynamic models. The introduction of advanced imaging tools and automated instrumentation is the main focus of my laboratory, which will enable us to apply imaging for both hypothesis-driven research and high-throughput analysis.

Since establishing my lab, the aim of my research activity was to develop advanced imaging technologies (probes, imaging modality, and quantitative analysis; see **Fig. 1**) to establish an effective acquisition and interpretation workflow i) for the mechanistic analysis of biological systems in animal models such as mouse and zebrafish and ii) for the use in novel diagnostic and therapeutic strategies.

1. **Primed Conversion - nontoxic, precise labelling for inferring development and disease progression**

To get more insight into the elaborate cell and protein dynamics that underlie development and disease^{1,2}, my lab introduced a unique optical mechanism, primed conversion, where dual-wavelength illumination results in pronounced photoconversion of photoconvertible fluorescent proteins (pcFPs)³⁻⁵. As two-photon-based photoconversion is extremely inefficient, primed conversion is the only way to precisely photoconvert in 3D pcFPs for real-time *in vivo* studies aiming to unravel complex structural and dynamic information. Using confined primed conversion, we revealed the complex anatomy of individual neurons packed between neighboring cells in zebrafish^{3,6}. The combination of primed conversion and a spatial drift correction algorithm, primed Track, allowed us to accomplish high-fidelity volumetric lineage tracing in mouse pre-implantation embryos^{7,8}. Primed conversion has also been successfully extended to manipulate the pcFP-based optogenetic effector, photocleavable protein (PhoCl). PhoCl spontaneously dissociates into two fragments after light-induced cleavage of a specific bond in the protein backbone, opening the path to transcriptional manipulation of cells *in vivo* at single cells resolution⁹. Using engineered optimized primed convertible FPs (pr-FPs), we (and others) have applied primed conversion also in nontoxic single molecule dynamic analysis using super-resolution imaging¹⁰. The combination of the primed conversion toolbox with light-sheet microscopy and machine-learning algorithms will soon allow to capture with high precision the emergence of cell lineages and heterogeneities in embryos/organoids/tissue that will prove critical in gaining a fundamental understanding of many biological and pathological processes such as cancer.

2. **GenEPI - a fluorescent reporter for non-invasively investigating cellular mechanosensing**

Throughout an organism's lifetime, cell mechanosensation (i.e., the ability to perceive and respond to mechanical stimuli in the form of shear stress, tension, or compression) is essential in a myriad of developmental, physiological, and pathophysiological processes including embryogenesis, homeostasis, metastasis, and wound healing. To investigate how physical forces and changes in mechanical properties of cells contribute to development and disease, we designed the fluorescent reporter GenEPI for visualizing dynamics and mechanical stimuli of Piezo1^{11,12}, an essential mechanosensitive ion channel found in plants and animals. We show that the intensimetric, genetically-encoded reporter GenEPI has high specificity and spatiotemporal resolution for Piezo1-dependent mechanical stimuli, exemplified by resolving repetitive mechanical stimuli of spontaneously contracting cardiomyocytes within microtissues and revealing mobile and functionally dynamic Piezo1 clusters in the plasma membrane using time-lapse TIRF imaging. GenEPI is an ideal tool to elucidate the full extent to which mechanical signals, and more specifically Piezo1 channels, regulate development, physiology, and disease.

3. **Bioharmonophores - a precision imaging approach for biomedical applications**

Previously, we introduced inorganic second harmonic generating (SHG) nanocrystals, SHG nanoprobe, as a class of imaging probes that can be used for *in vivo* imaging¹³⁻¹⁶. Given that SHG imaging employs near-infrared (NIR) incident light for contrast generation, SHG nanoprobe can be utilized for deep tissue imaging. Unlike commonly used fluorescent probes, SHG nanoprobe neither bleaches nor blinks, and their signal does not saturate with increasing illumination intensity, ensuring high probe sensitivity¹⁷⁻¹⁹. To create a foundation for safe SHG nanoprobe-based clinical imaging, we generated bioharmonophores as a novel class of imaging probes that retain all the photophysical advantages of previously introduced inorganic SHG nanoprobe. Because bioharmonophores consist of a biodegradable peptide core and a polymer shell, they can be metabolized within cells, which render them ideal contrast agents for clinical imaging applications. The straightforward implementation of robust functionalization strategies and a sufficiently high metabolic stability *in vivo* allowed us to target bioharmonophores with high detection sensitivity to individual tumor cells *in vivo*^{20,21}. The biocompatible and biodegradable bioharmonophores hold great potential as very bright clinical contrast agents for more accurate diagnosis and staging of disease. Importantly, their nonlinear signal can be also used for fast and powerful light-induced functional modulation which can benefit photodynamic therapy and photoimmunotherapy.

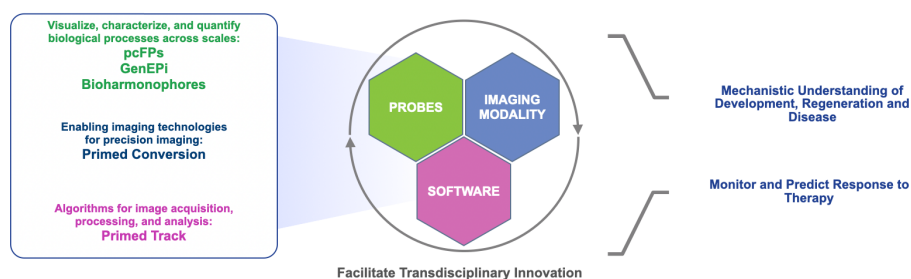


Figure 1: Advanced Optical Precision Imaging. The interplay between probes, imaging modality, and software leads to an effective acquisition and interpretation workflow to accurately display complex dynamics in biological systems.

References of own work

- 1 Plachta, N., Bollenbach, T., Pease, S., Fraser, S. E. & Pantazis, P. Oct4 kinetics predict cell lineage patterning in the early mammalian embryo. *Nat Cell Biol* **13**, 117-123 (2011). <https://doi.org:10.1038/ncb2154>
- 2 Dempsey, W. P., Fraser, S. E. & Pantazis, P. PhOTo zebrafish: a transgenic resource for in vivo lineage tracing during development and regeneration. *PLoS one* **7**, e32888 (2012). <https://doi.org:10.1371/journal.pone.0032888>
- 3 Dempsey, W. P. et al. In vivo single-cell labeling by confined primed conversion. *Nat Methods* **12**, 645-648 (2015). <https://doi.org:10.1038/nmeth.3405>
- 4 Mohr, M. A., Argast, P. & Pantazis, P. Labeling cellular structures in vivo using confined primed conversion of photoconvertible fluorescent proteins. *Nat Protoc* **11**, 2419-2431 (2016). <https://doi.org:10.1038/nprot.2016.134>
- 5 Mohr, M. A. & Pantazis, P. Primed Conversion: The New Kid on the Block for Photoconversion. *Chemistry* **24**, 8268-8274 (2018). <https://doi.org:10.1002/chem.201705651>
- 6 Mohr, M. A. & Pantazis, P. Single neuron morphology in vivo with confined primed conversion. *Methods in cell biology* **133**, 125-138 (2016). <https://doi.org:10.1016/bs.mcb.2015.12.005>
- 7 Welling, M. et al. Primed Track, high-fidelity lineage tracing in mouse pre-implantation embryos using primed conversion of photoconvertible proteins. *eLife* **8** (2019). <https://doi.org:10.7554/eLife.44491>
- 8 Welling, M., Kalyviotis, K. & Pantazis, P. P. Primed Track: Reliable Volumetric Single-cell Tracking and Lineage Tracing of Living Specimen with Dual-labeling Approaches. *Bio-Protocol* **10** (2020). <https://doi.org:10.21769/BioProtoc.3645>
- 9 Zhang, W. et al. Optogenetic control with a photocleavable protein, PhoCl. *Nat Methods* **14**, 391-394 (2017). <https://doi.org:10.1038/nmeth.4222>
- 10 Mohr, M. A. et al. Rational Engineering of Photoconvertible Fluorescent Proteins for Dual-Color Fluorescence Nanoscopy Enabled by a Triplet-State Mechanism of Primed Conversion. *Angewandte Chemie (International ed. in English)* **56**, 11628-11633 (2017). <https://doi.org:10.1002/anie.201706121>
- 11 Yaganoglu, S. et al. Highly specific and non-invasive imaging of Piezo1-dependent activity across scales using GenEPi. *Nature communications* **14**, 4352 (2023). <https://doi.org:10.1038/s41467-023-40134-y>
- 12 Landhuis, E. Seven technologies to watch in 2021. *Nature* **589**, 630-632 (2021). <https://doi.org:10.1038/d41586-021-00191-z>
- 13 Pantazis, P., Pu, Y., Psaltis, D. & Fraser, S. Second Harmonic Generating (SHG) Nanoprobes: a New Tool for Biomedical Imaging. *Proc Spie* **7183** (2009). <https://doi.org:10.1117/12.808434>
- 14 Pantazis, P., Maloney, J., Wu, D. & Fraser, S. E. Second harmonic generating (SHG) nanoprobes for in vivo imaging. *Proc Natl Acad Sci U S A* **107**, 14535-14540 (2010). <https://doi.org:10.1073/pnas.1004748107>
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- 16 Culic-Viskota, J., Dempsey, W. P., Fraser, S. E. & Pantazis, P. Surface functionalization of barium titanate SHG nanoprobes for in vivo imaging in zebrafish. *Nat Protoc* **7**, 1618-1633 (2012). <https://doi.org:10.1038/nprot.2012.087>
- 17 Dempsey, W. P., Fraser, S. E. & Pantazis, P. SHG nanoprobes: advancing harmonic imaging in biology. *BioEssays : news and reviews in molecular, cellular and developmental biology* **34**, 351-360 (2012). <https://doi.org:10.1002/bies.201100106>
- 18 Pantazis, P. & Supatto, W. Advances in whole-embryo imaging: a quantitative transition is underway. *Nat Rev Mol Cell Biol* **15**, 327-339 (2014). <https://doi.org:10.1038/nrm3786>
- 19 Sugiyama, N., Sonay, A. Y., Tussiwand, R., Cohen, B. E. & Pantazis, P. Effective Labeling of Primary Somatic Stem Cells with BaTiO₃ Nanocrystals for Second Harmonic Generation Imaging. *Small* **14** (2018). <https://doi.org:10.1002/smll.201703386>
- 20 Sonay, A. Y. & Pantazis, P. in *Clinical and Preclinical Optical Diagnostics* Vol. 10411 (2017).
- 21 Sonay, A. Y. et al. Biodegradable Harmonophores for Targeted High-Resolution In Vivo Tumor Imaging. *ACS Nano* **15**, 4144-4154 (2021). <https://doi.org:10.1021/acsnano.0c10634>