

Shotaro Otsuka

Personal Information

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Research Experience

2025- **Associate Professor** (tenured)
Max Perutz Labs, a joint venture of the University of Vienna and the Medical University of Vienna, Vienna Biocenter

2019-2024 **Group Leader**
Max Perutz Labs, a joint venture of the University of Vienna and the Medical University of Vienna, Vienna Biocenter

2017-2019 **Research scientist**
Laboratory of Dr. Jan Ellenberg, Cell Biology and Biophysics Unit, European Molecular Biology Laboratory (EMBL), Heidelberg, Germany

2011-2017 **Postdoctoral fellow** (EMBL Interdisciplinary Postdoc programme, shared by two laboratories)
Main Lab.: Dr. Jan Ellenberg, Cell Biology and Biophysics Unit, Associated Lab.: Dr. Martin Beck, Structural and Computational Biology Unit, EMBL, Heidelberg, Germany

2005-2011 **Bachelor, Master, and PhD student**
Laboratory of Prof. Kunio Takeyasu and Shigehiro Yoshimura, Graduate School of Biostudies, Kyoto University, Kyoto, Japan

Academic Qualifications

Education

4/2006-3/2011 Kyoto University, Graduate School of Biostudies
4/2002-3/2006 Kyoto University, Faculty of Integrated Human Studies

Degrees

3/2011 Doctoral degree at Kyoto University (Life science)
3/2008 Master's degree at Kyoto University (Life science)
3/2006 Bachelor's degree at Kyoto University (Natural Sciences)

Main areas of research and main scientific results

The lab investigates the molecular mechanisms of how cells control the intracellular communication, especially between the endoplasmic reticulum (ER) and the nucleus. The lab uses correlative live imaging with electron microscopy methodologies which enables visualizing cellular structures in situ at high temporal and spatial resolution, and combines it with quantitative live cell imaging and a microscopy-based loss-of-function screen.

In my postdoctoral research I established a novel correlative light and electron microscopy (CLEM) method and combined it with super-resolution microscopy. This “dynamic” nano-scale imaging approach allowed me to show for the first time that nuclear pores assemble via fundamentally different mechanisms in mitosis and interphase.

Funding

Research Grant

2024-2029	European Research Council (ERC) Consolidator Grant. “Understanding of the Membrane Connection Linking the Nucleus to the Endoplasmic Reticulum”.
2023-2024	Austrian Research Fund (FWF) Project. “How do endoplasmic reticulum and nucleus communicate?” P36743-B.
2021-2025	Austrian Research Fund (FWF) Doctoral Program “Signaling Mechanisms in Cellular Homeostasis.”
2020-2024	Vienna Science and Technology Fund (WWTF). “Elucidating the mechanics of mitotic chromosome assembly by light-, electron-, and atomic force microscopy.” LS19-001.

Fellowships and Awards

Fellowships

4/2013-3/2016	Interdisciplinary Postdoctoral fellowship (EMBL and Marie Curie Actions COFUND)
4/2011-3/2013	Postdoctoral fellowship for research abroad (the Japan Society for the Promotion of Science (JSPS))
4/2008-3/2011	JSPS research fellowship for young scientists

Awards

2024	Kazato Research Foundation - Kazato Prize for excellent scientific achievements
2024	European Microscopy Society - Outstanding Paper Award
6/2011	JSPS travel Grant for 61th Lindau Nobel Laureate Meeting

Fellowships obtained by lab members

2023-2025	Postdoctoral fellowship from EU H2020 - Vienna International PostDoc Program - (VIP2) to Pallavi Deolal
2021-2023	The Austrian Academy of Sciences (ÖAW) Ph.D. fellowship to Helena Bragulat Teixidor
2021	Max Perutz PhD fellowship to Helena Bragulat Teixidor

Mentoring and Teaching Experience

Lecturer

2024-	Lecture Series: Propedeutics: Molecular and Cell Biology for Medics
2024	Lecture Series: The Modern Concepts of Structural Biology
2023	Workshop: Advanced confocal laser scanning microscopy and live cell imaging
2023-	Lecture Series: Advanced Cell Biology
2023-	Lecture Series: Concepts in Molecular Biology
2020-	Lecture Series: Methods in Molecular Biology and Biochemistry
2019-2023	Lecture Series: Molecular Medicine II
2019, 2024	Lecture Series: Chromosome Biology I

Supervisor

2015-	4 PhD students, 6 Master students, 29 internship Master students, and 6 undergraduate students.
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Course instructor

2011, 2016	EMBL Cell Biology and Biophysics Ph.D. Course
2011, 2015	EMBO practical course "Current Methods in Cell Biology"

Professional Training

2022	EMBO workshop on Research Integrity, organized by European Molecular Biology Organization (EMBO)
2021	Leadership program "Thinking Your Way Into Leading a Research Group", organized by Dr. Iain Patten
2021	Leadership workshop "Empowering your team", organized by Vienna BioCenter Scientific Training
2019	PhD student supervision course, organized by Vienna BioCenter Scientific Training
2018	EMBO Lab Management Course, organized by European Molecular Biology Organization (EMBO)

Conferences and Seminars

Invited lecturer at EMBL advanced course

4/2016	EMBL course, High-Accuracy Correlated Light and Electron Microscopy: Applications at Room Temperature and in Cryo, Heidelberg, Germany
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Invited speaker at international and domestic conferences

8/2024	The European Microscopy Congress (EMC) 2024, Copenhagen, Denmark.
6/2024	21st IUPAB Congress 2024, Kyoto, Japan
6/2024	RIKEN Symposium, Challenges in Bioimaging: beyond the scales and beyond the borders, Kobe, Japan
11/2023	The 46th Annual Meeting of the Molecular Biology Society of Japan, Kobe, Japan, online participation

- 6/2023 The 79th Annual Meeting of the Japanese Society of Microscopy, Shimane, Japan.
- 6/2023 The 75th Annual Meeting of the Japan Society for Cell Biology, Nara, Japan.
- 10/2019 COST (European Cooperation in Science and Technology) Workshop on Nuclear Architecture, Lipids, and Phase Separation, Prague, Czech Republic.
- 9/2019 2nd Symposium on Recent Advances in Cryo-Electron Microscopy, Krakow, Poland.
- 5/2018 The 74th annual meeting for the Japanese Society of Microscopy, in an organized session entitled “Application of Correlative Light and Electron Microscopy”, Kurume, Japan.

Selected speaker at international conferences

- 6/2019 Nucleocytoplasmic transport 2019, Scotland, UK
- 5/2019 XXVI Wilhelm Bernhard Workshop on Cell Nucleus, Dijon, France
- 4/2019 9th Austrian Society for Electron Microscopy Workshop, Graz, Austria
- 10/2017 EMBO Nuclear Structure and Dynamics meeting, L'Isle sur la Sorgue, France
- 9/2017 Nucleocytoplasmic transport 2017, Girona, Spain
- 10/2015 EMBO | EMBL Symposium: Seeing is Believing, Heidelberg, Germany
- 9/2015 The EMBO Meeting 2015, Birmingham, UK
- 12/2014 ASCB Annual Meeting 2014, Philadelphia, USA

Invited seminars

- 12/2022 Kyoto-Vienna BioMath Workshop “Mathematical Methods for the Study of Self-organization in the Biological Sciences”, the Erwin Schrödinger International Institute for Mathematics and Physics of the University of Vienna, Vienna, Austria
- 10/2022 Center for Anatomy and Cell Biology, Medical University of Vienna, Austria
- 5/2022 A virtual Seminar Series on the Nuclear Pore and Nuclear Envelope, organized by Dr. Marry Dasso at NIH, USA
- 2016- Invited seminars in Japan (National Institute of Genetics, Tokyo Institute of Technology, the Juntendo University School of Medicine, Tokushima University, RIKEN in Kobe, Kyoto University, National Institutes of Natural Sciences, RIKEN in Saitama, Osaka University, and National Institute of Information and Communications Technology).

Publications

Research articles

- 1) Latham AP, Zhang W, Tempkin JOB, **Otsuka S**, Ellenberg J, Sali A*. Integrative spatiotemporal modeling of biomolecular processes: application to the assembly of the Nuclear Pore Complex. *Proc. Natl. Acad. Sci. USA*, 122 (11):e2415674122, (2025). DOI: 10.1073/pnas.2415674122.
- 2) Bragulat-Teixidor H*, Ishihara K, Szücs GM, **Otsuka S***. The endoplasmic reticulum connects to the nucleus by constricted junctions that mature after mitosis. *EMBO Rep.*, 25(7):3137-3159, (2024). DOI: 10.1038/s44319-024-00175-w. *: Co-corresponding author.
- 3) Forer A*, **Otsuka S***. Structural evidence for elastic tethers connecting separating chromosomes in crane-fly spermatocytes. *Life Sci. Alliance*, 6(11):e202302303, (2023). DOI: 10.26508/lsa.202302303. *: Co-corresponding author.
- 4) **Otsuka S***, Tempkin JOB, Zhang W, Politi AZ, Rybina A, Hossain MJ, Kueblbeck M, Callegari A, Koch B, Morero NR, Sali A, Ellenberg J*. "A quantitative map of nuclear pore assembly reveals two distinct mechanisms." *Nature*, 613(7944):575-581, (2023). DOI: 10.1038/s41586-022-05528-w. *: Co-corresponding author.
- 5) Schneider MWG, Gibson BA*, **Otsuka S***, Spicer MFD, Petrovic M, Blaukopf C, Langer CCH, Batty P, Nagaraju T, Doolittle LK, Rosen MK, Gerlich DW. "A chromatin phase transition protects mitotic chromosomes against microtubule perforation." *Nature*, 609(7925):183-190, (2022). DOI: 10.1038/s41586-022-05027-y. *Equal contribution.
- 6) Farrants H, Tarnawski M, Müller TG, **Otsuka S**, Hiblot J, Koch B, Kueblbeck M, Kräusslich HG, Ellenberg J, Johnsson K. "Chemogenetic Control of Nanobodies." *Nat. Methods*, 17(3):279-282, (2020). DOI: 10.1038/s41592-020-0746-7.
- 7) **Otsuka S**, Steyer AM, Schorb M, Hériché JK, Hossain MJ, Sethi S, Kueblbeck M, Schwab Y, Beck M, Ellenberg J. "Postmitotic nuclear pore assembly proceeds by radial dilation of small membrane openings." *Nat. Struct. Mol. Biol.*, 25(1):21-28, (2018). DOI: 10.1038/s41594-017-0001-9.
- 8) **Otsuka S**, Bui KH, Schorb M, Hossain MJ, Politi AZ, Koch B, Eltsov M, Beck M, Ellenberg J. "Nuclear pore assembly by an inside-out extrusion of the nuclear envelope." *Elife*, 5:e19071, (2016). DOI: 10.7554/eLife.19071.
- 9) Lolodi O, Yamazaki H, **Otsuka S**, Kumeta M, Yoshimura SH. "Dissecting in vivo steady-state dynamics of karyopherin-dependent nuclear transport." *Mol. Biol. Cell*, 27(1):167-76, (2016). DOI: 10.1091/mbc.E15-08-0601.
- 10) Yoshimura SH, **Otsuka S**, Kumeta M, Taga M, Takeyasu K. "Intermolecular disulfide bonds between nucleoporins regulate karyopherin-dependent nuclear transport." *J. Cell. Sci.*, 126(Pt 14):3141-3150, (2013). DOI: 10.1242/jcs.124172.
- 11) Asally M, Yasuda Y, Oka M, **Otsuka S**, Yoshimura SH, Takeyasu K, Yoneda Y. "Nup358, a nucleoporin, functions as a key determinant of the nuclear pore complex structure remodeling during skeletal myogenesis." *FEBS J.*, 278(4):610-621, (2011). DOI: 10.1111/j.1742-

4658.2010.07982.x.

- 12) **Otsuka S**, Iwasaka S, Yoneda Y, Takeyasu K, Yoshimura SH. "Individual binding pockets of importin β for FG-nucleoporins have different binding properties and different sensitivities to RanGTP." *Proc. Natl. Acad. Sci. USA*, 105(42): pp16101-16106, (2008). DOI: 10.1073/pnas.0802647105.
- 13) Yoshimura SH, Takahashi H, **Otsuka S**, Takeyasu K. "Development of glutathione-coupled cantilever for the single-molecule force measurement by scanning force microscopy." *FEBS Lett.*, 580, pp3961-3965, (2006). DOI: 10.1016/j.febslet.2006.06.032.

Reviews

- 14) Deolal P, Scholz J, Ren K, Bragulat-Teixidor H, **Otsuka S**. "Sculpting nuclear envelope identity from the endoplasmic reticulum during the cell cycle". *Nucleus*, 15(1):2299632, (2024). DOI: 10.1080/19491034.2023.2299632.
- 15) **Otsuka S***, Ellenberg J*. "Mechanisms of nuclear pore complex assembly – two different ways of building one molecular machine." *FEBS Lett.*, 592(4):475-488, (2018). DOI: 10.1002/1873-3468.12905. *: Co-corresponding author.
- 16) Hirano Y, Takahashi H, Kumeta M, Hizume K, Hirai Y, **Otsuka S**, Yoshimura SH, Takeyasu K. "Nuclear architecture and chromatin dynamics revealed by atomic force microscopy in combination with biochemistry and cell biology." *Pflugers Arch*, 456(1):139-53, (2008). DOI: 10.1007/s00424-007-0431-z.

Book chapters

- 17) Bragulat-Teixidor H*, **Otsuka S***. "Correlative light and electron microscopy at defined cell cycle stages in a controlled environment." *Methods Cell Biol.*, 187:73-97, (2024). DOI: 10.1016/bs.mcb.2024.02.025. *: Co-corresponding author.
- 18) Bragulat-Teixidor H, Hossain MJ, **Otsuka S**. "Visualizing Nuclear Pore Complex Assembly In Situ in Human Cells at Nanometer Resolution by Correlating Live Imaging with Electron Microscopy." *Methods Mol. Biol.*, 2502:493-512, (2022). DOI: 10.1007/978-1-0716-2337-4_31.
- 19) **Otsuka S**, Szyborska A, Ellenberg J. "Imaging the assembly, structure, and function of the nuclear pore inside cells." *Methods Cell Biol.*, 122:219-238, (2014). DOI: 10.1016/B978-0-12-417160-2.00010-2.
- 20) Yoshimura SH, Takahashi H, **Otsuka S**, Yokokawa M. "Atomic force microscopy as a single-molecule imaging and force measurement tool for the cell nucleus." *Tanpakusitsu Kakusan Koso*, Kyoritsu Shuppan, Vol.51, pp1981-1988, (2006). PMID: 17471897.