

YUTA SHIMAMOTO, PhD
Associate Professor of Biophysics

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ACADEMIC APPOINTMENTS

- 7/2019- Associate Professor (Tenured), National Institute of Genetics
 Laboratory of Physics & Cell Biology, Department of Chromosome Science
Topic: Biophysics of cell division, Chromosome and nuclear mechanics
 Joint appointment: Department of Genetics, Sokendai University
- 7/2014-6/2019 Associate Professor (Tenure-track, US-equivalent to Assistant Professor)
 Center for Frontier Research, National Institute of Genetics
Topic: Biophysics of cell division, Nuclear mechanics
 Joint appointment: Department of Genetics, Sokendai University
- 4/2013-6/2014 Senior Research Associate, The Rockefeller University
 4/2008-3/2013 Postdoctoral Fellow, The Rockefeller University
Mentor: Prof. Tarun Kapoor (Chemistry and Cell Biology)
Topic: Motor protein dynamics and spindle assembly mechanisms
- 4/2005-3/2008 Research Associate, Waseda University
 4/2000-3/2007 Graduate and Undergraduate Research, Waseda University
Advisor: Prof. Shin'ichi Ishiwata (Experimental Biophysics)
Committee: Prof. Kazuhiko Kinoshita
Prof. Takashi Funatsu
Prof. Mitsunori Takano
Thesis: Self-regulatory mechanisms of the contractile system of muscle

ACADEMIC DEGREES

- 2007 Ph.D. Biophysics, Waseda University, Tokyo, Japan
 2003 M.S. Biophysics, Waseda University, Tokyo, Japan
 2001 B.S. Physics, Waseda University, Tokyo, Japan

PROFESSIONAL AWARDS

- 2015 The Young Scientists' Prize, MEXT (Ministry of Education, Culture, Sports, Science and Technology) of Japan
- 2010-2012 JSPS Postdoctoral Fellow
- 2008-2009 Uehara Memorial Foundation Postdoctoral Fellow
- 2004 Presentation Award, The 21st Century Center of Excellence Symposium on Physics of Self-Organization Systems

PROFESSIONAL AFFILIATIONS

- American Society for Cell Biology (ASCB ambassador since 2017)

- Biophysical Society
- Molecular Biology Society of Japan
- Biophysical Society of Japan

PUBLICATIONS

PubMed Link: <https://www.ncbi.nlm.nih.gov/pubmed/?term=yuta+shimamoto>

A. Original Research Papers

1. Fukuyama T, Yan L, Tanaka M, Yamaoka M, Saito K, Ti SC, Liao CC, Hsia KC, Maeda YT, **Shimamoto Y**. Morphological growth dynamics, mechanical stability, and active microtubule mechanics underlying spindle self-organization. *Proc Natl Acad Sci USA*. 119(44): e2209053119 (2022)
2. Sakamoto R, Izri Z, **Shimamoto Y**, Miyazaki M, Maeda YT. Geometric trade-off between contractile force and viscous drag determines the actomyosin-based motility of a cell-sized droplet. *Proc Natl Acad Sci USA*. 119(30):e2121147119 (2022)
3. Mori M, Yao T, Mishina T, Endoh H, Tanaka M, Yonezawa N, **Shimamoto Y**, Yonemura S, Yamagata K, Kitajima TS, Ikawa M. RanGTP and the actin cytoskeleton keep paternal and maternal chromosomes apart during fertilization. *J Cell Biol* 220, e202012001 (2021)
4. Yan L, Fukuyama T, Yamaoka M, Maeda YT, **Shimamoto Y**. Examining the assembly pathways and active microtubule mechanics underlying spindle self-organization. *arXiv* 2011.14592 (2020)
5. Kono F, Kawai S, **Shimamoto Y***, Ishiwata S* (*co-corresponding author). Nanoscopic changes in the lattice structure of striated muscle sarcomeres involved in the mechanism of spontaneous oscillatory contraction (SPOC). *Sci Rep* 10, 16372 (2020)
6. Takagi J, Sakamoto R, Shiratsuchi G, Maeda YT, **Shimamoto Y**. Mechanically distinct microtubule arrays determine the length and force response of the meiotic spindle. *Dev Cell* 49, 267-278 (2019) [\[highlighted in Preview by J. Simunić and I. Tolić, Dev Cell 2019\]](#)
7. Miyashiro D, Ohtsuki M, **Shimamoto Y**, Wakayama J, Kunioka Y, Kobayashi T, Ishiwata S, Yamada T. Radial stiffness characteristics of the overlap regions of sarcomeres in isolated skeletal myofibrils in pre-force generating state. *Biophys Physicobiol*. 14, 207-220 (2017)
8. Chang CC, Huang TL, **Shimamoto Y**, Tsai SY, Hsia KC. Regulation of mitotic spindle assembly factor, NuMA, by Importin- β . *J Cell Biol* 216, 3453-3462 (2017)
9. Takagi J, **Shimamoto Y**. High-quality frozen extracts of *Xenopus laevis* eggs reveal size-dependent control of metaphase spindle micromechanics. *Mol Biol Cell* 28, 2170-2177 (2017)
10. **Shimamoto Y***, Tamura S, Masumoto H, Maeshima K* (*co-corresponding author). Nucleosome-nucleosome interactions via histone tails and linker DNA regulate nuclear rigidity. *Mol Biol Cell* 28, 1580-1589 (2017) [\[highlighted in ASCB newsletter, July/August 2017 issue\]](#)
11. Kimura K, Mamane A, Sasaki T, Sato K, Takagi J, Niwayama R, Hufnagel L, **Shimamoto Y**, Joanny JF, Uchida S, Kimura A. Endoplasmic-reticulum-mediated microtubule alignment governs cytoplasmic streaming. *Nat Cell Biol*. 19, 399-406 (2017)
12. **Shimamoto Y**, Forth S, Kapoor TM. Measuring pushing and braking forces generated by ensembles of kinesin-5 crosslinking two microtubules. *Dev Cell* 34, 669-681 (2015) [\[highlighted in Preview by C. Hueschen et al., Dev Cell 2015\]](#)
13. Hsia KC, Wilson-Kubalek EM, Dottore A, Hao Q, Tsai KL, Forth S, **Shimamoto Y**, Milligan RA, Kapoor TM. Reconstitution of the augmin complex provides insights into its architecture and function. *Nat Cell Biol*. 16, 852-863 (2014)
14. Forth S, Hsia KC, **Shimamoto Y**, Kapoor TM. Asymmetric friction of nonmotor MAPs can lead to their directional motion in active microtubule networks. *Cell* 157, 420-432 (2014)
15. Takagi J, Itabashi T, Suzuki K, **Shimamoto Y**, Kapoor TM, Ishiwata S. Micromechanics of the vertebrate meiotic spindle examined by stretching along the pole-to-pole axis. *Biophys J*. 106, 735-740 (2014)

16. Takagi J, Itabashi T, Suzuki K, Kapoor TM, **Shimamoto Y**, Ishiwata S. Using micromanipulation to analyze control of vertebrate meiotic spindle size. *Cell Rep.* 5, 44-50 (2013)
17. Sato K, Kuramoto Y, Ohtaki M, **Shimamoto Y**, Ishiwata S. Locally and globally coupled oscillators in muscle. *Phys. Rev. Lett.* 111, 108104 (2013)
18. **Shimamoto Y**, Kapoor TM. Microneedle-based analysis of the micromechanics of the metaphase spindle assembled in *Xenopus* egg extracts. *Nat. Protoc.* 7, 959-969 (2012) [invited]
19. **Shimamoto Y**, Maeda YT, Ishiwata S, Libchaber AJ, Kapoor TM. Insights into the micromechanical properties of the metaphase spindle. *Cell* 145, 1062-1074 (2011) [highlighted in Dispatch by S. Dumont, *Curr Biol* 2011] [Cell PaperFlick video abstract] [F1000 Prime]
20. Sato K, Ohtaki M, **Shimamoto Y**, Ishiwata S. A theory on auto-oscillation and contraction in striated muscle. *Prog. Biophys. Mol. Biol.* 105, 199-207 (2011)
21. Terui T, **Shimamoto Y**, Yamane M, Kobirumaki F, Ohtsuki I, Ishiwata S, Fukuda N. Regulatory mechanism of length-dependent activation in skinned porcine ventricular muscle: role of thin filament cooperative activation in the Frank-Starling relation. *J. Gen. Physiol.* 136, 469-82 (2010)
22. **Shimamoto Y**, Suzuki M, Mikhailenko S, Yasuda K, Ishiwata S. Inter-sarcomere coordination in muscle revealed through individual sarcomere response to quick stretch. *Proc. Natl. Acad. Sci. USA* 106, 11954-9 (2009)
23. Itabashi T, Takagi J, **Shimamoto Y**, Onoe H, Kuwana K, Shimoyama I, Gaetz J, Kapoor TM, Ishiwata S. Probing the mechanical architecture of the vertebrate meiotic spindle. *Nat. Methods* 6, 167-72 (2009)
24. **Shimamoto Y**, Suzuki M, Ishiwata S. Length-dependent activation and auto-oscillation in skeletal myofibrils at partial activation by Ca^{2+} . *Biochem. Biophys. Res. Commun.* 366, 233-8 (2008)
25. **Shimamoto Y**, Kono F, Suzuki M, Ishiwata S. Non-linear force-length relationship in the ADP-induced contraction of skeletal myofibrils. *Biophys. J.* 93, 4330-41 (2007) [highlighted in New and Notable by C. dos Remedios, *Biophys J* 2007]

B. Reviews, Previews & Book chapters

1. Tanaka M, **Shimamoto Y**. Local body weight measurement of the spindle. *Dev Cell* 56, 871-872 (2021)
2. **Shimamoto Y**, Redemann S, Needleman DJ. Editorial: Mechanics of Cell Division. *Front Cell Dev Biol* 8:620111 (2020)
3. Maeshima K, Tamura S, **Shimamoto Y**. Chromatin as a nuclear spring. *Biophys Physicobiol* 15, 189-195 (2018)
4. **Shimamoto Y**, Tamura S, Maeshima K. DNA works as a spring in the cell. *Biophysics* 58, 24-26 (2018)
5. **Shimamoto Y***, Kapoor TM* (*co-corresponding author). Analyzing the micromechanics of the cell division apparatus. *Methods Cell Biol* 145, 173-190 (2018)
6. Kimura K, Takagi J, Niwayama R, **Shimamoto Y**, Uchida S, Kimura A. A mechanism for the emergence and reversal of cytoplasmic flow. *Jikken Igaku* 35, 2250-2253 (2017)
7. Ishiwata S, Miyazaki M, Sato K, Nakagome K, Shintani S, Kobirumaki-Shimozawa F, Fukuda N, Suzuki K, Takagi J, **Shimamoto Y**, Itabashi T. Dynamic properties of bi-motile systems with a liquid-crystalline structure. *Mol Cryst Liq Cryst* 647, 127-150 (2017)
8. **Shimamoto Y**. Deciphering the post-translational “code” of tubulin. *Jikken Igaku* 34, 2683-2684 (2016)
9. **Shimamoto Y**, Takagi J. Micromechanics of the metaphase spindle. *Biophysics* 55, 255-258 (2015)
10. Ishiwata S, **Shimamoto Y**, Fukuda N. Contractile system of muscle as an auto-oscillator. *Prog. Biophys. Mol. Biol.* 105, 187-98 (2011)
11. **Shimamoto Y**, Kapoor TM. Mechanoregulation: Cellular seat belts. *Nature* 468, 518-9 (2010)
12. Ishiwata S, **Shimamoto Y**, Suzuki M (all authors contributed equally). Molecular motors as an auto-oscillator. *HFSP J.* 4, 100-4 (2010)
13. **Shimamoto Y**, Ishiwata S. Mechanism of spontaneous oscillation emerging from collective molecular

- motors. *In Physics of Self-Organization Systems*, World Scientific, 47-56 (2008)
14. Ishiwata S, **Shimamoto Y**, Suzuki M, Sasaki D. Regulation of muscle contraction by Ca²⁺ and ADP: Focusing on the auto-oscillation (SPOC). *Adv. Exp. Med. Biol.* 592, 341-358 (2007)
 15. Ishiwata S, **Shimamoto Y**, Sasaki D, Suzuki M. Molecular synchronization in actomyosin motors -From single molecules to fibers via nanomuscle-. *Adv. Exp. Med. Biol.* 565, 25-35 (2005)

SCHOLARLY PRESENTATIONS

INVITED TALKS & SEMINARS:

1. ASCB/EMBO Annual Meeting, Washington D.C., Dec 4, 2022
2. Molecular Biology Society of Japan 45th Annual Meeting, Makuhari, Nov 30, 2022
3. Rikkyo University Seminar, Oct 4, 2022
4. World Congress of Biomechanics, Taiwan & Zoom, Jul 12, 2022
5. Organelle Zone seminar, Zoom, Feb 25, 2022
6. Molecular Biology Society of Japan 44th Annual Meeting, Yokohama & Zoom, Dec 3, 2021
7. Totipotency seminar, Zoom, Nov 16, 2021
8. Kyoto University LiMe seminar, Zoom, Sep 6, 2021
9. Japan Society for Medical & Biological Engineering 60th Annual Meeting, Zoom, Jun 16, 2021
10. Program of Totipotency & Gamete Integrity Joint Symposium, Zoom, Dec 21, 2020
11. Molecular Biology Society of Japan 43rd Annual Meeting, Zoom, Dec 2, 2020
12. Biophysical Society of Japan 57th Annual Meeting, Zoom, Sep 18, 2020
13. Chromosome Workshop, Niigata, Dec 22, 2019
14. American Society for Cell Biology (ASCB) Annual Meeting, Washington DC, Dec 7, 2019
15. Biochemical Society of Japan 93rd Annual Meeting, Yokohama, Sep 18, 2019
16. Circulation Society of Japan 83rd Annual Meeting, Yokohama, Mar 31, 2019
17. Motor Protein 8th Annual Meeting, Tokyo, Nov 24, 2018
18. Biophysical Society of Japan 56th Annual Meeting, Okayama, Sep 15, 2018
19. International Xenopus conference, Seattle, WA, Aug 12, 2018
20. UT Southwestern seminar, Dallas, TX, Dec 11, 2017
21. Cell Synthesis Research Meeting, Kyoto, Japan, Oct 19, 2017
22. Japan Society for Cell Biology Annual Meeting, Sendai, Japan, Jun 13, 2017
23. Bioengineering society of Japan annual meeting, Aichi, Jan 19, 2017
24. American Society for Cell Biology (ASCB) Annual Meeting, San Francisco, Dec 3, 2016
25. Frontiers in Motor protein research meeting, Osaka, Jul 25, 2016
26. Japan Q-bio meeting, Mishima, Jan 12, 2016
27. National Institute of Genetics symposium, Tokyo, Nov 7, 2015
28. CREST-PRESTO symposium, Kyoto, Mar 16, 2015
29. National Institute for Physiological Sciences, Okazaki, Mar 11, 2015
30. RIKEN Wako campus, Saitama, Mar 4, 2015
31. Molecular Biology Society of Japan 37th Annual Meeting, Yokohama, Nov 25, 2014
32. National Institute of Genetics symposium, Mishima, Shizuoka, Sep 24, 2013
33. Physiological Society of Japan 90th Annual Meeting, Tokyo, Mar 23, 2013
34. Biophysical Society of Japan 50th Annual Meeting, Aichi, Sep 10, 2012
35. Japanese Society for Quantitative Biology 4th Annual Meeting, Aichi, Jan 9, 2012
36. American Society for Cell Biology (ASCB) 51th Annual Meeting, Denver, CO, Dec 4, 2011

ORGANIZED AND CO-CHAIRIED SYMPOSIUMS AND SCIENTIFIC EVENTS:

1. "Nucleocytoskeletal dynamics regulating development and cellular differentiation," with Kei Miyamoto at Kindai University, Molecular Biology Society of Japan 45th Annual Meeting, Makuhari, Japan, Nov 30, 2022

2. "Autonomous characterization of molecular and cellular ensembles: Toward an understanding of biological functions," with Motoshi Kaya at the University of Tokyo, Biophysical Society of Japan 60th Annual Meeting, Hakodate, Japan, Sep 28, 2022
3. "Microtubule-centrosome assembly systems that regulate divergent biological processes," with Daiju Kitagawa at the University of Tokyo, Biochemical Society of Japan 93rd Annual Meeting, Yokohama, Japan, Sep 18, 2019
4. "Living matter far from equilibrium: from DNA to cytoskeleton and cells," with Yusuke Maeda at Kyushu University, Biophysical Society of Japan 50th Annual Meeting, Aichi, Japan, Sep 23, 2012

MEDIA NEWS

"Measuring the strength needed to move chromosomes," March 11, 2009

News Medical (<https://www.news-medical.net/news/2009/03/11/46764.aspx>)

"Clever little tubules: Structural beauty in metaphase spindle mechanics," Dec 7, 2011

Naturally Selected, The Faculty 1000 blog (<http://blog.f1000.com/2011/12/07/clever-little-tubules/>)

"Cornstarch and the Metaphase Spindle – More Related than You Might Expect," Jun 9, 2011

Cell Paper Flick (<https://www.youtube.com/watch?v=y0uzgHplO8Q&nohtml5=False>)

"A novel insight into cardiac function: Development of a new model of spontaneous oscillatory contraction," Dec 18, 2013

Phys.org (<http://phys.org/news/2013-12-insight-cardiac-function-spontaneous-oscillatory.html>)

"Friction Harnessed by Proteins Helps Organize Cell Division," April 16, 2014

Science Daily (<https://www.sciencedaily.com>)

"Cell division: Physical forces involved in creating the mitotic spindle probed," Oct 2, 2015

Science Daily (<https://www.sciencedaily.com>)

RESEARCH FUNDING

JSPS, Challenging Research Pioneering (22K18362), 2022-2026, Development of intracellular force sensors and actuators for organelle research

(Total budget: JPY26,000,000, ~US\$200,000)

JSPS, Scientific Research (B) (22H02590), 2022-2025, Collective mechanics and regulation of mitotic kinesins for proper spindle assembly

(Total budget: JPY17,290,000, ~US\$130,000)

JSPS, Scientific Research on Innovative Areas (19H05751), 2019-2023, Mechanisms of constructing totipotent nuclei

(Total budget: JPY28,587,000, ~US\$263,000)

JSPS, Scientific Research (B) (19H03201), 2019-2022, Mechanosensing properties of mitotic chromosomes and chromosome assembly factors

(Total budget: JPY17,400,000, ~US\$160,000)

JSPS, Challenging Exploratory Research, 2017-2019, Micromechanics of mitotic chromosomes

(Total budget: JPY6,240,000, ~US\$58,000)

JSPS, Young Scientists (A), 2015-2019, Microtubule motor mechanics and mitotic mechanisms

(Total budget: JPY24,400,000, ~US\$225,000)

JSPS, Challenging Exploratory Research, 2015-2016, Force-based regulation of nuclear dynamics

(Total budget: JPY3,900,000, ~US\$36,000)

AMED, PRIME, 2015-2019, Nuclear mechanics and mechanotransduction mechanisms

(Total budget: JPY46,800,000, ~US\$430,000)

JST, PRESTO, 2012-2016, Reconstitution of the mitotic spindle micromechanics

(Total budget: JPY57,200,000, ~US\$530,000)

Takeda Science Foundation, 2018

(Total budget: JPY10,000,000, ~\$92,000)

PATENTS

- Shimamoto Y, Takagi J. "Method and kit for frozen *Xenopus* egg extract," Patent#7023519

EDITORIAL SERVICE

- Frontiers in Cell and Developmental Biology (with Daniel Needleman at Harvard and Stefanie Redemann at University of Virginia)

(<https://www.frontiersin.org/research-topics/9235/mechanics-of-cell-division>)

REVIEWING SERVICE

- For Scientific Journals:

Cell (3), Dev Cell (6), eLife (2), Nature, Nat Cell Biol, Nat Phys, Curr Biol, J Cell Biol (2), PNAS, Angew Chem, Trends Cell Biol, Biophys Rev, Biology, Physics, Front Cell Dev Biol (2), Sci Rep, STAR Protoc

- For Grants and Awards:

Japan Society for the Promotion of Science (JSPS) fellowship (2), JSPS international fellowship, JSPS KAKENHI grant, Netherland Organization for Scientific Research (NWO) KLEIN grant, German Research Foundation (DFG) grant (3), Wellcome Trust grant, Human Frontier Science Program (HFSP) fellowship

- Review Board:

Frontiers in Cell and Developmental Biology (Frontiers Media), Physics (MDPI)

ACADEMIC SERVICE

- Thesis committee member of SOKENDAI university (Yuki Tsuchiya, Akshari Gupta, Harsh Nagpal, Aisha Yesbolatova, Aiya Yesbolatova, Ken Fujii, Katsuhiko Minami, Adilgazy Semeigazin, Shiori Iida, Hiya Kanbe, Zenki Ikeda, Wang Chung Han)

- Committee member of National institute of Genetics assistant professor hiring/promotion

- Advisor for scientific research presentation class at National Institute of Genetics, 2019-2022

- Steering committee member of common research equipment at NIG

- Steering committee member of NIG international internship program (chair: 2022-)

SOCIETY SERVICE

- Lecture for General Audience at Annual NIG Science Fair, 2014 - present

- Lecture and Lab Tour for High School Students, 2017

- Lecture and One-day Laboratory Experience for High School Students, 2018

- Lecture and Lab Tour for First-year Undergraduate Students from Local University, 2019

- Advisor for High School Summer Science Project, 2023

TEACHING EXPERIENCES

2014- Graduate Lecture course (Functional Imaging course, Systems biology course, Molecular biology course), National Institute of Genetics and SOKENDAI University

2005-2008 Undergraduate Experimental biochemistry course (enzymatic reaction kinetics), Undergraduate Physics course (classical mechanics, electromagnetics, thermodynamics, statistical mechanics), Undergraduate Mathematics course (differential equation, matrix operation, induction), Waseda University

2003-2005 Undergraduate Experimental biophysics course (DNA circular dichroism), Waseda University

TRAINED STUDENTS, RESEARCHERS, AND POST-DOCTORAL FELLOWS

National Institute of Genetics:

- Postdoctoral Fellows (Jun Takagi, Gen Shiratsuchi, Masahito Tanaka, Kei Saito)

- Research Assistants (Megumi Yamaoka, Naoko Watanabe, Miyuki Kondo, Mayumi Aono)
- Graduate Students (Domestic: Yuki Tsuchiya, Zenki Ikeda, Katsuhiko Minami, Shiori Iida, Hiyu Kanbe; International: Akshari Gupta, Harsh Nagpal, Aiya Yesbolatova, Aisha Yesbolatova, Adilgazy Semeigazin)
- Internship Undergraduate Students (Domestic: Etsu To, Nahoko Tanaka, Kanta Tazawa; International: Yogiraj Jakkal)
- Internship High School Students (Tamami Kobayashi, Nanako Aono, Yuki Nakata, Akiba Onuma)

Rockefeller University:

- Graduate student (Alejandro Dottore)

Waseda University:

- Graduate students (Hisashi Maejima, Fumiaki Kono, Seitaro Kawai, Takeshi Konno)