Ziqing (Winston) Zhao: Curriculum Vitae

Department of Chemistry | Centre for BioImaging Sciences | Mechanobiology Institute
National University of Singapore
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https://cbis.nus.edu.sg/zhao-ziqing-winston/

RESEARCH INTERESTS

My research interests intersect optical imaging, molecular biology and biophysical chemistry, with a focus on developing and applying advanced "imagenomic" approaches to quantitatively probe the biophysics of chromatin dynamics at the single-molecule/super-resolution level. In particular, we are interested in understanding how molecular processes that modulate genome organization, accessibility and expression are regulated in *space* and *time*, and how their misregulation underpin human diseases (particularly cancer and aging-associated disorders). More fundamentally, we also aim to illuminate the physico-chemical driving forces (*e.g.* biomolecular phase separation) that govern chromatin dynamics and cell nuclear architecture *in vivo*.

PROFESSIONAL APPOINTMENTS

National University of Singapore (NUS)

Assistant Professor (Presidential Young Professorship), Dept. of Chemistry	2019 – present
Principal Investigator, Centre for BioImaging Sciences (CBIS)	2019 – present
Co-Principal Investigator, Mechanobiology Institute (MBI)	2021 – present
Faculty Member, Integrative Sciences and Engineering Programme (ISEP)	2022 – present

Agency for Science, Technology and Research (A*STAR)

Postdoctoral Fellow, Genome Institute of Singapore (GIS)	2018 – 2019
Research Fellow, Institute of Molecular and Cell Biology (IMCB)	2015 – 2018
Research Officer, Institute of Bioengineering and Nanotechnology (IBN)	2008 – 2009

EDUCATION

Harvard University, Cambridge, MA 2009 – 2015
Ph.D. in Biophysics
Thesis: "Probing the Spatio-Temporal Organizations and Dynamics of Gene Expression and DNA Replication in the Mammalian Cell Nucleus"
Advisor: X. Sunney Xie, Mallinckrodt Professor of Chemistry and Chemical Biology

California Institute of Technology (Caltech), Pasadena, CA 2004 – 2008
B.S. (with honors), double major in Chemistry and Biology
GPA: 4.12/4.0

Raffles Junior College, Singapore 2002 – 2003
University of Cambridge GCE Advanced Level Examination Certificate

AWARDS AND HONORS

Invited to nominate candidates for the Kavli Prize, Norwegian Academy of Science and Letters 2023

Invited to nominate candidates for the Nobel Prize in Physiology or Medicine, Nobel Committee 2020, 2021

NUS Presidential Young Professorship, National University of Singapore 2019

GIS Super Team Award (Team Member), Genome Institute of Singapore 2018

Selected Delegate of 65th Lindau Nobel Laureate Meeting, Lindau, Germany 2015

Certificate of Distinction in Teaching, Harvard University 2011, 2014

Cold Spring Harbor Asia Poster Award, Second Prize, Cold Spring Harbor Asia 2013

Student Research Achievement Award, The Biophysical Society 2013
One of the thirteen recipients selected internationally

Dudley R. Herschbach Teaching Award, Harvard University 2012
Awarded to the best graduate student teaching fellow in Dept. of Chemistry & Chemical Biology

National Science Scholarship (Ph.D.), A*STAR 2009

Richard P. Schuster Memorial Prize, Caltech 2008
Awarded to the best graduating senior in Division of Chemistry & Chemical Engineering

Upper Class Merit Award (Carnation Scholarship), Caltech 2006, 2007

Chairman's Honors List, A*STAR 2005 – 2007

Phi Tau Phi Scholastic Honor Society of America Scholarship 2007

Summer Undergraduate Research Fellowship (Arthur R. Adams Fellow), Caltech 2007

University College London Scholars Program, Caltech 2006

Summer Undergraduate Research Fellowship (Samuel & Frances Krown Fellow), Caltech 2006

National Science Scholarship (B.S.), A*STAR 2004

World 15th Place, American Invitational Mathematics Examination 2003

Gold Medal and Team Champion, Singapore Chemistry Olympiad 2002

Gold Medals and Team Champion, Singapore Mathematical Olympiad 1999 – 2003

GRANTS AND FUNDING

Academic Research Fund (AcRF) Tier 2 Grant, Ministry of Education, Singapore 2023 – 2027
MOE-T2EP30222-0010; Role: PI; Amount: S$1,317,987.00

Academic Research Fund (AcRF) Tier 3 Grant, Ministry of Education, Singapore 2021 – 2026
MOET32020-0001; Role: Team PI; Amount: S$8,424,000.00 (My share: S$787,356.00)

Academic Research Fund (AcRF) Tier 1 Grant, Ministry of Education, Singapore 2024 – 2025
Role: PI; Amount: S$82,500.00

Competitive Research Programme (CRP), National Research Foundation, Singapore 2021 – 2025
NRF-CRP25-2020-0001; Role: Team PI; Amount: S$5,164,900.00 (My share: S$561,340.00)

Academic Research Fund (AcRF) Tier 1 Grant, Ministry of Education, Singapore 2022 – 2024
Role: PI; Amount: S$250,000.00

Young Individual Research Grant, National Medical Research Council, Singapore 2019 – 2023
MOH-000227; Role: PI; Amount: S$300,000.00

NUS Presidential Young Professorship start-up funding, NUS 2019 – 2023
Role: PI; Amount: S$1,250,000.00

PUBLICATIONS

Book/book chapter

Zhao, Z. W., Xie, X. S. *Problems and Solutions to Life at the Single-Molecule Level: A Physical Chemistry Perspective* (under contract with Oxford University Press).

Ng, W. S., Sielaff, H., **Zhao, Z. W.** "Phase Separation in Chromatin-based Intranuclear Processes." In *Droplets of Life: Membrane-less Organelles, Biomolecular Condensates, and Biological Liquid-Liquid Phase Separation*, ed. Vladimir Uversky, pp. 461–483. London/San Diego/Cambridge/Oxford: Academic Press (an imprint of Elsevier), 2023.

Papers (total citations $>$ **1,850** as of Oct 2024, according to Google Scholar)
*: co-first authorship; §: corresponding/co-corresponding authorship

At NUS

Longo, M., Ahmed, S. M., Chen, Y., Tsai, C.-L., Namjoshi, S., Wang, X., Perera, R. L., Arvai, A., Lee, M., Kong, L. R., Engl, W., Ng., W. S., **Zhao, Z. W.**, Venkitaraman, A. R.§, Schlacher, K.§, Tainer. J. A.§ BRCA2 C-terminal clamp restructures RAD51 dimers to bind B-DNA for replication fork stability. Under review.

Sielaff, H.§, **Zhao, Z. W.**§ Visualizing, quantifying and mapping chromatin remodelers at work with single-molecule and single-cell imaging. *Intl. J. Biochem. Cell Biol.* **176**, 106667 (2024).

Engl, W.*, Kunstar, A.*, Chen, S.*, Ng, W. S., Sielaff, H., **Zhao, Z. W.**§ Single-molecule imaging of SWI/SNF chromatin remodelers reveals bromodomain-mediated and cancer-mutants-specific landscape of multi-modal DNA-binding dynamics. *Nature Commun.* **15**, 7646 (2024).

Pu, R.*, Zhan, Q.*,§, Peng, X., Liu, S., Guo, X., Liang, L., Qin, X., **Zhao, Z. W.**, Liu, X.§ Super-resolution microscopy enabled by high-efficiency surface-migration emission depletion. *Nature Commun.* **13**, 6636 (2022).

Ng, W. S., Sielaff, H., **Zhao, Z. W.**§ Phase separation-mediated chromatin organization and dynamics: From imaging-based quantitative characterizations to functional implications. *Int. J. Mol. Sci.* **23**, 8039 (2022).

Sielaff, H.§, Basu, S.§, **Zhao, Z. W.**§ Imaging approaches to unravel chromatin organization and nuclear dynamics. *Front. Mol. Biosci.* **9**, 929370 (2022) (editorial commentary).

Liu, H., Peck, X. Y., Chong, Y. K., Ng, W. S., Engl, W., Raghuvamsi, P. V., **Zhao, Z. W.**, Anand, G. S., Zhou, Y., Sivaraman, J., Xu, Q.§, Wong, S.-M.§ Identification of putative binding interface of PI(3,5)P_2 lipid on rice black-streaked dwarf virus (RBSDV) P10 protein. *Virology* **570**, 81–95 (2022).

Goh, J. J. L.*, Chou, N.*, Seow, W. Y., Ha, N., Cheng, C. P. P., Chang, Y.-C., **Zhao, Z. W.**, Chen, K. H.§ Highly specific multiplexed RNA imaging in tissues with split-FISH. *Nature Methods* **17**, 689–693 (2020).

Featured on *GenomeWeb*.

Su, Q. P.*,§, **Zhao, Z. W.***,§, Meng, L., Ding, M., Zhang, W., Li, Y., Liu, M., Li, R., Gao, Y.-Q., Xie, X. S.§, Sun, Y.§ Superresolution imaging reveals spatiotemporal propagation of human

replication foci mediated by CTCF-organized chromatin structures. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 15036–15046 (2020).

Featured on *BioArt; EurekAlert!/AAAS; Nanowerk; News Break; NUS News–In Focus; Peking University; Phys.org*; *Scienmag*.

Prior to NUS

Manning, S. A., Dent, L. G., Kondo, S., **Zhao, Z. W.**, Plachta, N., Harvey, K. F.§ Dynamic fluctuations in subcellular localization of the Hippo pathway effector Yorkie *in vivo*. *Curr. Biol.* **28**, 1651–1660 (2018).

White, M. D.*, **Zhao, Z. W.***, Plachta, N.§ *In vivo* imaging of single mammalian cells in development and disease. *Trends Mol. Med.* **24**, 278–293 (2018) (**cover article**).

Zhao, Z. W.*, White, M. D.*, Alverez, Y. D.*, Zenker, J.*, Bissiere, S., Plachta, N.§ Quantifying transcription factor–DNA binding in single cells *in vivo* with photoactivatable fluorescence correlation spectroscopy. *Nature Protoc.* **12**, 1458–1471 (2017).

Zhao, Z. W., White, M. D., Bissiere, S., Levi, V., Plachta, N.§ Quantitative imaging of mammalian transcriptional dynamics: From single cells to whole embryos. *BMC Biol.* **14**, 115 (2016).

White, M. D.*, Angiolini, J. F.*, Alverez, Y. D.*, Kaur, G.*, **Zhao, Z. W.**, Mocskos, E., Bruno, L., Bissiere, S., Levi, V.§, Plachta, N.§ Long-lived binding of Sox2 to DNA predicts cell fate in the four-cell mouse embryo. *Cell* **165**, 75–87 (2016) (**cover article**).

Featured on *Cell cover*; *Medical Xpress*; *Straits Times*; *The Scientist*.

Zhao, Z. W., Xie, X. S.§, Ge, H.§ Nonequilibrium relaxation of conformational dynamics facilitates catalytic reaction in an elastic network model of T7 DNA polymerase. *J. Phys. Chem. B* **120**, 2869–2877 (2016).

Zhao, Z. W.*, Roy, R.*, Gebhardt, J. C. M.*, Suter, D. M.*, Chapman, A. R., Xie, X. S.§ Spatial organization of RNA polymerase II inside a mammalian cell nucleus revealed by reflected light-sheet superresolution microscopy. *Proc. Natl. Acad. Sci. U.S.A.* **111**, 681–686 (2014).

Zhao, Z. W., Gebhardt, J. C. M., Suter, D. M., Xie, X. S.§ Reply to "Convergence of chromatin binding estimates in live cells". *Nature Methods* **10**, 692 (2013).

Gebhardt, J. C. M.*, Suter, D. M.*, Roy, R., **Zhao, Z. W.**, Chapman, A. R., Basu, S., Maniatis, T., Xie, X. S.§ Single-molecule imaging of transcription factor binding to DNA in live mammalian cells. *Nature Methods* **10**, 421–426 (2013).

Ong, S.-M., **Zhao**, **Z.**, Arooz, T., Zhao, D., Zhang, S., Du, T., Wasser, M., van Noort, D., Yu. H.§ Engineering a scaffold-free 3D tumor model for *in vitro* drug penetration studies. *Biomaterials* **31**, 1180–1190 (2010).

Zhang, C.*, **Zhao, Z.***, Rahim, N. A. A., van Noort, D.§, Yu. H.§ Towards a human-on-chip: Culturing multiple cell types on a chip with compartmentalized microenvironments. *Lab Chip* **9**, 3185–3192 (2009) (**inside cover article**).

Pletneva, E. V., **Zhao**, **Z.**, Kimura, T., Petrova, K., Gray, H. B.§, Winkler. J. R.§ Probing the cytochrome c' folding landscape. *J. Inorg. Biochem.* **101**, 1768–1775 (2007).

PATENT

Chen, K. H., Goh, J. J. L., Chou, S. N., Seow, W. Y., Ha, N., Goh, C, **Zhao, Z. W.** Nucleic acid probes. Filed 24 Jun, 2020 (International application number: PCT/SG2020/050353).

TEACHING

At NUS

CM3131 | Applications of Physical Chemistry AY2023/2024 – present (yearly)

Student rating: 4.6/5.0

Selected students feedback:

- "Prof. Winston has shown to be one of the most competent teachers."
- "I could tell that he really cared for the learning and the well–being of the students… He also monitored our learning journey throughout the module well as he adjusted the concepts taught appropriately according to the students' learning abilities."
- "He was very effective in delivering the content of his lectures and ensured that the concepts learnt were easy to understand, despite the difficulty of the concepts taught. He also made multiple links to the previous concepts taught not only in the same module, but also from the previous 2k modules."
- "Prof Winston could explain his topics extremely well and was good as breaking down the problems given in the tutorial in smaller chunks to help us better understand what was actually going on."
- "Always explained the steps to tutorial questions in great detail and clarity, ensuring that we were able to follow his reasoning and would not hesitate to pause or go back to make sure we were still with him."
- "He provides very useful feedback and never fails to address questions."

CM4236 | Spectroscopy and Imaging in Biophysical Chemistry AY2020/2021 – present (yearly)

Student rating: 4.9/5.0 (twice); 4.8/5.0 (twice)

Selected students feedback:

- "He is definitely one of the most inspiring and effective lecturers I have ever met."
- "One of the best professors that I have encountered in my time in NUS. He makes tough content easier to understand and constantly checks in with us during lecture to ensure that the class is following him…Overall, a lecturer that I will remember fondly."
- "One of the few classes I genuinely looked forward to during my uni(versity) years."
- "Slides and module content were top–notch...Really amazing considering it's a 'new' module and ran alone by Prof. Zhao."
- "…I really appreciate his teaching style that has made this module challenging but manageable."
- "Prof. Zhao is really the nicest professor I have encountered in my time in NUS… He accommodates students' requests and (is) able to empathize with us and our workload and adjusts deadlines appropriately when needed, which I'm sure everyone in class appreciates."
- "…Very nice to know that there are teachers who care about us in this way."
- "He is a really caring and considerate prof. He tries his best to help us learn by adapting his homeworks and lectures. Also very encouraging and provides help whenever needed. Plus, he is like running one man show of a new mod(ule) – which is pretty darn impressive given how comprehensive and excellent quality his content is."

CM3225 | Biomolecules AY2019/2020

Student rating: 4.4/5.0

Selected students feedback:

- "Explanations are very clear…. let us see the big picture."
- "…This is especially hard to do over Zoom, and we really appreciate the efforts taken to replicate real life lectures as much as possible."

MB5104 | An Integrative Approach to Understand Cell Function AY2022/2023

Guest Lecturer

Prior to NUS

Chem 161 | Statistical Thermodynamics, Harvard University AY2013/2014

Teaching Fellow; Student rating: 4.8/5.0

Chem 163 | Frontiers in Biophysics, Harvard University AYs2010 – 2013
Teaching Fellow (taught three times); Student rating: 5.0/5.0 (twice)

Chem 24a & b | Introduction to Biophysical Chemistry, Caltech AYs2006 – 2008
Teaching Assistant (taught twice)

MENTORING

At NUS

Research Fellows

Kaiyu Jin (Department of Chemistry)	2024 – present
Goran Biukovic (Department of Chemistry)	2022 – present
Wilfried Engl (Department of Chemistry)	2020 – present
Aliz Kunstar (Department of Chemistry)	2020 – present
Hendrik Sielaff (Department of Chemistry)	2020 – present

Research Associates/Assistants/Apprentices

Hong Zi Mian (Research Assistant, Department of Chemistry)	2023 – 2024
Chen Siyi (Research Associate, Department of Chemistry)	2020 – 2023
Kuo Xuan (Research Apprentice, Department of Chemistry)	2020 – 2021
Nurul Diyana Bte Rosli (Research Apprentice, Department of Chemistry)	2020 – 2021
Ng Woei Shyuan (Research Assistant, Department of Chemistry)	2019 – 2020

Ph.D. students

Kyna Khoo (Department of Chemistry)	2023 – present
Cui Yinuo (Department of Chemistry; Dean's Graduate Fellow)	2023 – present
Kuo Xuan (Mechanobiology Institute, co-supervised with Tony Kanchanawong)	2021 – present
Ng Woei Shyuan (Department of Chemistry)	2020 – present

Master students

Xinyue Cui (M.Sc. in Chemical Sciences)	2024 – 2025
Zihui Lu (M.Sc. in Chemical Sciences)	2024 – 2025
Wentao Zeng (M.Sc. in Chemical Sciences)	2024 – 2025
Zhou Songsong (M.Sc. in Chemical Sciences)	2022 – 2023

Undergraduate students

Clarissa Widyantoro (FYP student, Department of Chemistry)	2023 – 2024
Ryan Seow (FYP student, Department of Chemistry)	2023 – 2024
Hasna Firdaus Aryantha (NUS Amgen Scholars Program, Bandung Institute of Technology, Indonesia)	2023
Jasmine Kiley (NUS Amgen Scholars Program, Tulane University, U.S.A.)	2022
Nicole Sim Jiaxuan (FYP student, Department of Chemistry)	2021 – 2022
Serene Fong Siew Min (FYP student, Department of Chemistry)	2019 – 2020

Ph.D./M.Sc. thesis advisory/examination committees

Yang Rongrong (Ph.D. thesis advisory committee, Department of Chemistry)	2024 – present

Li Hangfeng (Ph.D. thesis advisory committee, Mechanobiology Institute) 2023 – present
Lau Jun Wei (Ph.D. thesis advisory committee, Department of Chemistry) 2022 – present
Sui Mingyu (Ph.D. thesis advisory committee, Department of Chemistry) 2022 – present
Huang Zengxin (Ph.D. thesis advisory committee, Mechanobiology Institute) 2022 – present
Chen Jiaye (Ph.D. thesis advisory committee, Department of Chemistry) 2021 – present
Joel Ng (Ph.D. thesis examination panel, Department of Biological Sciences) 2024
Daniel Aik (Ph.D. thesis examination panel, Department of Chemistry) 2024
Kavitha Rajasekhar (M.Sc. thesis examination panel, Department of Biological Sciences) 2022
Saradha Venkatachalapathy (Ph.D. thesis examination panel, Mechanobiology Institute) 2021
Zhou Yu (Ph.D. thesis examination panel, Department of Physics) 2021

Prior to NUS

Xu Peihao (H3 Research Attachment student, Institute of Molecular and Cell Biology) 2017
Julie C. Chang (Undergraduate student, Harvard University) 2013 – 2014

CONFERENCE AND SEMINAR PRESENTATIONS

Annual Meeting of East Asia Single-Molecule Biological Sciences, Busan, Korea Nov 2024
21st International Union of Pure and Applied Biophysics (IUPAB) Conference, Kyoto, Japan June 2024
Super-Resolution Summit, Singapore June 2024
Society for Cell Biology Singapore (SCBS) Annual Conference 2024, Singapore May 2024
11th International Conference on Chemical and Biological Sciences (ICCBS), Tokyo Institute of Technology, Tokyo, Japan Apr 2024
Biophysical Society 68th Annual Meeting, Philadelphia, U.S.A. Feb 2024
International Conference on Biological Physics (ICBP) 2023, Seoul, Korea Aug 2023
Focus on Microscopy (FOM) 2023, Porto, Portugal Apr 2023
9th Annual Conference of AnalytiX-2023, Sapporo, Japan Jan 2023
2022 East Asian Single-Molecule Biophysics Symposium, virtual Oct 2022
6th International Anatomical Sciences and Cell Biology Conference Microscopy Workshop, virtual Feb 2022
3rd International Conference on Nanoscopy (ICON), virtual Nov 2021
13th European Biophysics Conference, Vienna, Austria & virtual Jul 2021
Focus on Microscopy (FOM) 2021, virtual Mar 2021
SPIE BiOS Conference: *Single Molecule Spectroscopy and Superresolution Imaging*, virtual Mar 2021
Biophysical Society 65th Annual Meeting, virtual Feb 2021
3rd Tritium Workshop, Singapore National Institute of Chemistry, virtual Sep 2020
National Workshop on Fluorescence and Raman Spectroscopy, Hyderabad, India Dec 2019
Mechanobiology Institute, National University of Singapore Nov 2019
Cell Symposia: *Single Cells: Technology to Biology*, Singapore Feb 2019
18th International Congress of Developmental Biology, Singapore Jun 2017

Cold Spring Harbor Laboratory Meeting: *Nuclear Organization and Function*, Cold Spring Harbor, U.S.A. May 2016

Harvard Medical School Epigenetics Symposium, Boston, U.S.A. Dec 2014

Cold Spring Harbor Asia Meeting: *New Advances in Optical Imaging of Live Cells and Organisms*, Suzhou, China Aug 2013

Biophysical Society 57th Annual Meeting, Philadelphia, U.S.A. Feb 2013

EMBO | EMBL Symposium: *The Complex Life of mRNA*, Heidelberg, Germany Oct 2012

4th Combined Scientific Meeting of the Life Sciences, Singapore Jan 2003

JOURNAL/GRANT REVIEWING/EDITING

Review Editor, *Frontiers in Chemical Biology* 2022 – present

Invited Topic Editor, *Frontiers in Molecular Biosciences* 2020 – 2022

Ad hoc reviewer for: *Analytical Chemistry, Biophysical Journal, Cell, Genes, Journal of Physical Chemistry, Micron, Nano Letters, Nanoscale, Nature, Nature Communications, NPJ Imaging, Science Advances, Trends in Genetics*

Invited grant reviewer for: *Austrian Science Fund (FWF)* (declined)

ADMINISTRATIVE SERVICES

Sub-director, NUS Suzhou Research Institute "3+1+1" Program in Chemistry and TJU-NUS Double-Master's Degree Program in Chemistry, Department of Chemistry 2023 – present

Member, Committee on M.Sc. in Chemical Sciences, Department of Chemistry 2022 – present

Member, Committee on Graduate Education, Department of Chemistry 2021 – present

Member, Committee on Student Life, Department of Chemistry 2020 – present

Member, Committee on College of Humanities & Sciences, Department of Chemistry 2020 – 2021

Member, University Research Committee Expert Panel, NUS 2019

PROFESSIONAL SERVICES/OUTREACH ACTIVITIES

Judge, Science Mentorship Programme (SMP), Faculty of Science, NUS 2023

Judge, 26th Chemistry • Communication Challenge: *Chemistry for Singapore 2030 and Beyond*, NUS Chemistry 2021

Speaker, *Advancing the Frontiers of Science and Technology with Chemistry* E-outreach, NUS Chemistry 2021 (twice)

Judge, A*STAR Talent Search (ATS), A*STAR 2020

Speaker, NUS-ACS Student Chapter Graduate Studies Talk 2020

Selection panelist for nominees to 70th Lindau Nobel Laureate Meeting, National Research Foundation, Singapore 2019

Poster judge, 2nd Chemistry National Meeting Singapore (ChnmSG 2019), Singapore National Institute of Chemistry 2019