





Wah Chiu

Professor of Photon Science, Bioengineering and of Microbiology and Immunology
Photon Science Directorate

 NIH Biosketch available Online

 Curriculum Vitae available Online

CONTACT INFORMATION

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Bio

BIO

Wah Chiu received his BA in Physics (1969) and PhD in Biophysics (1975) from the University of California, Berkeley. He is a professor in the Department of Bioengineering, Department of Microbiology and Immunology and the SLAC National Accelerator Laboratory at Stanford University. He is a pioneer in methodology development for electron cryo-microscopy. His work has made multiple transformational contributions in developing single particle electron cryo-microscopy as a tool for the structural determination of molecular machines towards atomic resolution.

For three decades, Dr. Chiu directs a NIH funded 3DEM Resource Center. He has solved many cryo-EM structures including viruses, chaperonins, membrane proteins, ion channels, cytoskeleton protein complexes, protein-DNA complexes, DNA and RNA in collaboration with many scientists around the world. His 3DEM Resource Center continues to establish high standard testing and characterization protocols for cryoEM instrumentation and to develop new image processing and modeling algorithms for cryo-EM structure determination.

Dr. Chiu's research, collaboration and training efforts have been recognized by his elected membership to the Academia Sinica, Taiwan (2008) and the United States National Academy of Sciences (2012) in addition to several honors including the Distinguished Science Award from the Microscopy Society of America (2014) and the Honorary Doctorate of Philosophy from the University of Helsinki, Finland (2014).

ACADEMIC APPOINTMENTS

- Professor, Photon Science Directorate
- Professor, Bioengineering
- Professor, Microbiology & Immunology
- Member, Bio-X
- Faculty Fellow, Stanford ChEM-H
- Member, Wu Tsai Neurosciences Institute

HONORS AND AWARDS

- Elected Member, United States National Academy of Sciences (2012)

- Elected Academician, Academia Sinica, Taiwan (2008)
- Distinguished Scientist Award for the Biological Sciences, Microscopy Society of America (2014)
- Honorary Doctorate of Philosophy, University of Helsinki, Finland (2014)
- Barbara and Corbin J. Robertson Jr. Presidential Award for Excellence in Education, Baylor College of Medicine (2015)
- Elected Member, The Academy of Medicine, Engineering, and Science of Texas (2013)
- Distinguished Faculty Award, Baylor College of Medicine Alumni Association (2013)
- Distinguished Service Professorship, Baylor College of Medicine (2010)
- Achievement Award, Society of Chinese Bioscientists in America Houston Chapter (2011)
- Presidential Award, American Academy of Nanomedicine (2006)
- Research Fellow, Japan Society for the Promotion of Science (1999)
- Alexander von Humboldt Research Prize, Alexander von Humboldt Foundation (1996)
- Guggenheim Fellow, Guggenheim Foundation (1986)
- Presidential Scholar, Electron Microscopy Society of America (1974)
- Award of Merit, Oakland City Council (1972)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Scientific Advisory Board, Biozentrum, Universität Basel, Basel, Switzerland (2016 - present)
- Member, Scientific Advisory Board, BioXFEL Center, University of Buffalo (2014 - present)
- Member, Scientific Advisory Board, Institute of Biological Chemistry Institute, Academia Sinica, Taiwan (2011 - present)
- Member, Advisory Committee, World-wide Protein Data Bank (wwPDB) (2010 - present)
- Member, Scientific Advisory Board, RCSB Protein Data Bank (2005 - present)
- Member, Panel for SystemsX, Research Council of the Swiss National Science Foundation (2007 - 2016)
- Member, Scientific Advisory Board, Division of Structural Biology, St. Jude Children's Research Hospital (2015 - 2016)
- Member, Scientific Advisory Board, Max Planck Institute of Biochemistry in Martinsried, Germany (2013 - 2017)
- Chair, Expert Panel for Biomedical Engineering & Life Sciences Cluster, Singapore Ministry of Education (2012 - 2015)
- Member, Scientific Advisory Board, Michael E. DeBakey VA Medical Center, Houston (2012 - 2017)

PROFESSIONAL EDUCATION

- Ph.D., University of California, Berkeley , Biophysics (1975)
- B.A., University of California, Berkeley , Physics (1969)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My research include methodology improvements in single particle cryo-EM for atomic resolution structure determination of molecules and molecular machines, as well as in cryo-ET of cells and organelles towards subnanometer resolutions. We have collaborations with many researchers around the country and outside USA on understanding biological processes such as protein folding, virus assembly and disassembly, pathogen-host interactions, signal transduction, transport across cytosol and membrane.

PROJECTS

- Cryo-EM of Molecular Machines - Stanford University (1/1/2018 - present)
- Unified Data Resource for 3DEM - Stanford University (1/1/2018)

- From structure to therapy for Huntington's disease - Stanford University (1/1/2018)
- Pathogen-Host interactions studied by cryo-EM and cryo-ET - Stanford University (1/1/2018 - present)
- DNA and RAN Origami Characterization - Stanford University (1/1/2018)
- Atomic resolution single particle cryoEM - Stanford University

Teaching

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Chih-Ta Chien, Shanshan Li, Boxue Ma, Guan Chin Su, Stella Y. Sun, Rahel Woldeyes, Gong Her Wu

Doctoral Dissertation Advisor (AC)

David Chmielewski, Yanyan Zhao, Weijiang Zhou

Postdoctoral Research Mentor

Guan Chin Su, Rahel Woldeyes

Doctoral (Program)

Grace Zhong

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Bioengineering (Phd Program)
- Biophysics (Phd Program)
- Microbiology and Immunology (Phd Program)

Publications

PUBLICATIONS

- **Cryo-EM structures of *Helicobacter pylori* vacuolating cytotoxin A oligomeric assemblies at near-atomic resolution** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Zhang, K., Zhang, H., Li, S., Pintilie, G. D., Mou, T., Gao, Y., Zhang, Q., van den Bedeme, H., Schmid, M. F., Au, S., Chiu, W.
2019; 116 (14): 6800–6805
- **Coupling of ssRNA cleavage with DNase activity in type III-A CRISPR-Csm revealed by cryo-EM and biochemistry** *CELL RESEARCH*
Guo, M., Zhang, K., Zhu, Y., Pintilie, G. D., Guan, X., Li, S., Schmid, M. F., Ma, Z., Chiu, W., Huang, Z.
2019; 29 (4): 305–12
- **The 3.5-Å CryoEM Structure of Nanodisc-Reconstituted Yeast Vacuolar ATPase Vo Proton Channel.** *Mol Cell*
Roh, S. H., Stam, N. J., Hryc, C. F., Couoh-Cardel, S., Pintilie, G., Chiu, W., Wilkens, S.
2018; 69 (6): 993-1004
- **Accurate model annotation of a near-atomic resolution cryo-EM map** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Hryc, C. F., Chen, D., Afonine, P. V., Jakana, J., Wang, Z., Haase-Pettingell, C., Jiang, W., Adams, P. D., King, J. A., Schmid, M. F., Chiu, W.
2017; 114 (12): 3103-3108
- **The Chaperonin TRiC/CCT Associates with Prefoldin through a Conserved Electrostatic Interface Essential for Cellular Proteostasis** *CELL*
Gestaut, D., Roh, S., Ma, B., Pintilie, G., Joachimiak, L. A., Leitner, A., Walzthoeni, T., Aebersold, R., Chiu, W., Frydman, J.
2019; 177 (3): 751–+
- **Redox Engineering of Cytochrome c using DNA Nanostructure-Based Charged Encapsulation and Spatial Control** *ACS APPLIED MATERIALS & INTERFACES*
Ge, Z., Su, Z., Simmons, C. R., Li, J., Jiang, S., Li, W., Yang, Y., Liu, Y., Chiu, W., Fan, C., Yan, H.

2019; 11 (15): 13874–80

- **Structure of Calcarisporiella thermophila Hsp104 Disaggregase that Antagonizes Diverse Proteotoxic Misfolding Events** *STRUCTURE*
Michalska, K., Zhang, K., March, Z. M., Hatzos-Skintges, C., Pintilie, G., Bigelow, L., Castellano, L. M., Miles, L. J., Jackrel, M. E., Chuang, E., Jedrzejczak, R., Shorter, J., Chiu, et al
2019; 27 (3): 449+
- **Structures of TRPV2 in distinct conformations provide insight into role of the pore turret** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
Dosey, T. L., Wang, Z., Fan, G., Zhang, Z., Serysheva, I. I., Chiu, W., Wensel, T. G.
2019; 26 (1): 40+
- **Assessment of structural features in Cryo-EM density maps using SSE and side chain Z-scores** *JOURNAL OF STRUCTURAL BIOLOGY*
Pintilie, G., Chiu, W.
2018; 204 (3): 564–71
- **Evaluation system and web infrastructure for the second cryo-EM model challenge** *JOURNAL OF STRUCTURAL BIOLOGY*
Kryshafovich, A., Adams, P. D., Lawson, C. L., Chiu, W.
2018; 204 (1): 96–108
- **Electron Cryo-microscopy Structure of Ebola Virus Nucleoprotein Reveals a Mechanism for Nucleocapsid-like Assembly** *Cell*
Su, Z., et al
2018; 172 (5): 966-978
- **10.1016/j.jmb.2018.08.013 Visualizing Individual RuBisCO and Its Assembly into Carboxysomes in Marine Cyanobacteria by Cryo-Electron Tomography**
Dai, W.
2018
- **10.1016/j.chom.2018.07.018 Neutralizing Antibodies Inhibit Chikungunya Virus Budding at the Plasma Membrane**
Jin, J., Galaz-Montoya, J., et al
2018; 24 (3): 417-428
- **Structure of the 30 kDa HIV-1 RNA Dimerization Signal by a Hybrid Cryo-EM, NMR, and Molecular Dynamics Approach** *Structure of the 30 kDa HIV-1 RNA Dimerization Signal by a Hybrid Cryo-EM, NMR, and Molecular Dynamics Approach*
Zhang, K., Keane, S. C., Su, Z., Robaliev, R., Chen, M., Sciandra, C. A., Marchant, J., Heng, X., Schmid, M. F., Case, D. A., Ludtke, S. J., Summers, M. F., Chiu, et al
2018; 26 (3): 490-498
- **SuRVoS: Super-Region Volume Segmentation workbench** *JOURNAL OF STRUCTURAL BIOLOGY*
Luengo, I., Darrow, M. C., Spink, M. C., Sun, Y., Dai, W., He, C. Y., Chiu, W., Pridmore, T., Ashton, A. W., Duke, E. M., Basham, M., French, A. P.
2017; 198 (1): 43-53
- **An allosteric transport mechanism for the AcrAB-TolC multidrug efflux pump** *ELIFE*
Wang, Z., Fan, G., Hryc, C. F., Blaza, J. N., Serysheva, I. I., Schmid, M. F., Chiu, W., Luisi, B. F., Du, D.
2017; 6
- **Visualizing Adsorption of Cyanophage P-SSP7 onto Marine Prochlorococcus** *SCIENTIFIC REPORTS*
Murata, K., Zhang, Q., Galaz-Montoya, J. G., Fu, C., Coleman, M. L., Osborne, M. S., Schmid, M. F., Sullivan, M. B., Chisholm, S. W., Chiu, W.
2017; 7
- **Subunit conformational variation within individual GroEL oligomers resolved by Cryo-EM** *Proc Natl Acad Sci U S A*
Roh, S. H., Hryc, C. F., Jeong, H. H., Fei, H. H., Jakana, J., Lorimer, G. H., Chiu, W.
2017; 114 (31): 8259-8264
- **Control of the structural landscape and neuronal proteotoxicity of mutant Huntingtin by domains flanking the polyQ tract.** *eLife*
Shen, K., Calamini, B., Fauerbach, J. A., Ma, B., Shahmoradian, S. H., Serrano Lachapel, I. L., Chiu, W., Lo, D. C., Frydman, J.
2016; 5
- **Resolution and Probabilistic Models of Components in CryoEM Maps of Mature P22 Bacteriophage** *BIOPHYSICAL JOURNAL*
Pintilie, G., Chen, D., Haase-Pettingell, C. A., King, J. A., Chiu, W.
2016; 110 (4): 827-839

- **Improved Peak Detection and Deconvolution of Native Electrospray Mass Spectra from Large Protein Complexes** *JOURNAL OF THE AMERICAN SOCIETY FOR MASS SPECTROMETRY*
Lu, J., Trnka, M. J., Roh, S., Robinson, P. J., Shiau, C., Fujimori, D. G., Chiu, W., Burlingame, A. L., Guan, S.
2015; 26 (12): 2141-2151
- **Gating machinery of InsP(3)R channels revealed by electron cryomicroscopy** *NATURE*
Fan, G., Baker, M. L., Wang, Z., Baker, M. R., Sinyagovskiy, P. A., Chiu, W., Ludtke, S. J., Serysheva, I. I.
2015; 527 (7578): 336-?
- **Outcome of the First wwPDB Hybrid/Integrative Methods Task Force Workshop** *STRUCTURE*
Sali, A., Berman, H. M., Schwede, T., Trewhella, J., Kleywegt, G., Burley, S. K., Markley, J., Nakamura, H., Adams, P., Bonvin, A. M., Chiu, W., Dal Peraro, M., Di Maio, et al
2015; 23 (7): 1156-1167
- **CTF Challenge: Result summary** *JOURNAL OF STRUCTURAL BIOLOGY*
Marabini, R., Carragher, B., Chen, S., Chen, J., Cheng, A., Downing, K. H., Frank, J., Grassucci, R. A., Heymann, J. B., Jiang, W., Jonic, S., Liao, H. Y., Ludtke, et al
2015; 190 (3): 348-359
- **An atomic model of bromo mosaic virus using direct electron detection and real-space optimization** *NATURE COMMUNICATIONS*
Wang, Z., Hryc, C. F., Bammes, B., Afonine, P. V., Jakana, J., Chen, D., Liu, X., Baker, M. L., Kao, C., Ludtke, S. J., Schmid, M. F., Adams, P. D., Chiu, et al
2014; 5
- **Modulation of STAT3 folding and function by TRiC/CCT chaperonin.** *PLoS biology*
Kasembeli, M., Lau, W. C., Roh, S., Eckols, T. K., Frydman, J., Chiu, W., Tweardy, D. J.
2014; 12 (4)
- **Validated near-atomic resolution structure of bacteriophage epsilon15 derived from cryo-EM and modeling** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Baker, M. L., Hryc, C. F., Zhang, Q., Wu, W., Jakana, J., Haase-Pettingell, C., Afonine, P. V., Adams, P. D., King, J. A., Jiang, W., Chiu, W.
2013; 110 (30): 12301-12306
- **TRiC's tricks inhibit huntingtin aggregation** *ELIFE*
Shahmoradian, S. H., Galaz-Montoya, J. G., Schmid, M. F., Cong, Y., Ma, B., Spiess, C., Frydman, J., Ludtke, S. J., Chiu, W.
2013; 2
- **Cryo-EM model validation using independent map reconstructions.** *Protein science*
DiMaio, F., Zhang, J., Chiu, W., Baker, D.
2013; 22 (6): 865-868
- **The Molecular Architecture of the Eukaryotic Chaperonin TRiC/CCT** *STRUCTURE*
Leitner, A., Joachimiak, L. A., Bracher, A., Moenkemeyer, L., Walzthoeni, T., Chen, B., Pechmann, S., Holmes, S., Cong, Y., Ma, B., Ludtke, S., Chiu, W., Hartl, et al
2012; 20 (5): 814-825
- **Symmetry-free cryo-EM structures of the chaperonin TRiC along its ATPase-driven conformational cycle** *EMBO JOURNAL*
Cong, Y., Schroeder, G. F., Meyer, A. S., Jakana, J., Ma, B., Dougherty, M. T., Schmid, M. F., Reissmann, S., Levitt, M., Ludtke, S. L., Frydman, J., Chiu, W.
2012; 31 (3): 720-730
- **Cryo-EM Structure of a Group II Chaperonin in the Prehydrolysis ATP-Bound State Leading to Lid Closure** *STRUCTURE*
Zhang, J., Ma, B., DiMaio, F., Douglas, N. R., Joachimiak, L. A., Baker, D., Frydman, J., Levitt, M., Chiu, W.
2011; 19 (5): 633-639
- **Dual Action of ATP Hydrolysis Couples Lid Closure to Substrate Release into the Group II Chaperonin Chamber** *CELL*
Douglas, N. R., Reissmann, S., Zhang, J., Chen, B., Jakana, J., Kumar, R., Chiu, W., Frydman, J.
2011; 144 (2): 240-252
- **MOTIF-EM: an automated computational tool for identifying conserved regions in CryoEM structures** *BIOINFORMATICS*
Saha, M., Levitt, M., Chiu, W.
2010; 26 (12): i301-i309

- **4.0-angstrom resolution cryo-EM structure of the mammalian chaperonin TRiC/CCT reveals its unique subunit arrangement** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Cong, Y., Baker, M. L., Jakana, J., Woolford, D., Miller, E. J., Reissmann, S., Kumar, R. N., Redding-Johanson, A. M., Batth, T. S., Mukhopadhyay, A., Ludtke, S. J., Frydman, J., Chiu, et al
2010; 107 (11): 4967-4972
- **Mechanism of folding chamber closure in a group II chaperonin** *NATURE*
Zhang, J., Baker, M. L., Schroeder, G. F., Douglas, N. R., Reissmann, S., Jakana, J., Dougherty, M., Fu, C. J., Levitt, M., Ludtke, S. J., Frydman, J., Chiu, W.
2010; 463 (7279): 379-U130
- **Estimating contrast transfer function and associated parameters by constrained non-linear optimization** *JOURNAL OF MICROSCOPY*
Yang, C., Jiang, W., Chen, D., Adiga, U., Ng, E. G., Chiu, W.
2009; 233 (3): 391-403
- **Mechanism of lid closure in the eukaryotic chaperonin TRiC/CCT** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
Booth, C. R., Meyer, A. S., Cong, Y., Topf, M., Sali, A., Ludtke, S. J., Chiu, W., Frydman, J.
2008; 15 (7): 746-753
- **Essential function of the built-in lid in the allosteric regulation of eukaryotic and archaeal chaperonins** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
Reissmann, S., Parnot, C., Booth, C. R., Chiu, W., Frydman, J.
2007; 14 (5): 432-440
- **Conformational changes in Sindbis virions resulting from exposure to low pH and interactions with cells suggest that cell penetration may occur at the cell surface in the absence of membrane fusion** *VIROLOGY*
Paredes, A. M., Ferreira, D., Horton, M., Saad, A., Tsuruta, H., Johnston, R., Klimstra, W., Ryman, K., Hernandez, R., Chiu, W., Brown, D. T.
2004; 324 (2): 373-386
- **Electron cryo-microscopy of VAT, the archaeal p97/CDC48 homologue from Thermoplasma acidophilum** *JOURNAL OF MOLECULAR BIOLOGY*
Rockel, B., Jakana, J., Chiu, W., Baumeister, W.
2002; 317 (5): 673-681
- **Fourier amplitude decay of electron cryomicroscopic images of single particles and effects on structure determination** *JOURNAL OF STRUCTURAL BIOLOGY*
Saad, A., Ludtke, S. J., Jakana, J., Rixon, F. J., Tsuruta, H., Chiu, W.
2001; 133 (1): 32-42
- **Scaling structure factor amplitudes in electron cryomicroscopy using X-ray solution scattering** *JOURNAL OF STRUCTURAL BIOLOGY*
Schmid, M. F., Sherman, M. B., Matsudaira, P., Tsuruta, H., Chiu, W.
1999; 128 (1): 51-57
- **Solution X-ray scattering-based estimation of electron cryomicroscopy imaging parameters for reconstruction of virus particles** *BIOPHYSICAL JOURNAL*
Thuman-Commike, P. A., Tsuruta, H., Greene, B., Prevelige, P. E., KING, J., Chiu, W.
1999; 76 (4): 2249-2261
- **COLD STAGE DESIGN FOR HIGH-RESOLUTION ELECTRON-MICROSCOPY OF BIOLOGICAL-MATERIALS** *ELECTRON MICROSCOPY REVIEWS*
Downing, K. H., Chiu, W.
1990; 3 (2): 213-226
- **ALIGNMENT AND MERGING OF ELECTRON-MICROSCOPE IMAGES OF FROZEN HYDRATED CRYSTALS OF THE T4 DNA HELIX DESTABILIZING PROTEIN GP32-STAR-I** *BIOPHYSICAL JOURNAL*
Grant, R. A., Schmid, M. F., Chiu, W., DEATHERAGE, J. F., Hosoda, J.
1986; 49 (1): 251-258
- **STRUCTURAL-ANALYSIS OF T4 DNA HELIX DESTABILIZING PROTEIN (GP32-STAR-I) CRYSTAL BY ELECTRON-MICROSCOPY** *JOURNAL OF MOLECULAR BIOLOGY*
Cohen, H., Chiu, W., Cohen, H. A., Chiu, W.
1983; 169 (1): 235-248
- **STRUCTURE OF THE SURFACE-LAYER PROTEIN OF THE OUTER-MEMBRANE OF SPIRILLUM-SERPENS** *JOURNAL OF ULTRASTRUCTURE RESEARCH*

Glaeser, R. M., Chiu, W., Grano, D.
1979; 66 (3): 235-242

● **FACTORS AFFECTING HIGH-RESOLUTION FIXED-BEAM TRANSMISSION ELECTRON-MICROSCOPY** *ULTRAMICROSCOPY*

Chiu, W., Glaeser, R. M.
1977; 2 (2-3): 207-217

● **SINGLE ATOM IMAGE-CONTRAST - CONVENTIONAL DARK-FIELD AND BRIGHT-FIELD ELECTRON-MICROSCOPY** *JOURNAL OF MICROSCOPY-OXFORD*

Chiu, W., Glaeser, R. M.
1975; 103 (JAN): 33-54