

NIKOLAUS GRIGORIEFF

Professor, University of Massachusetts Medical School
Investigator, Howard Hughes Medical Institute
368 Plantation Street, AS4-2049, Worcester, MA 01605, USA
Tel. +1-774-455-6682, Fax +1-508-721-7027
Email: niko@grigorieff.org

ACADEMIC EDUCATION

- 1985 - 1989 Technische Universität Berlin, Germany
• Vordiplom in physics (first grade)
- 1989 - 1993 University of Bristol, UK
• M.Sc. & Ph.D. in physics (semiconducting materials and devices, electron microscopy)

EXPERIENCE

- 1988 - 1989 Technische Universität Berlin, Germany
• Tutor with teaching responsibilities
• Student representative on faculty board, joint responsibility for faculty policies and degree course design
- 1991 - 1993 University of Bristol, UK
• Demonstrator in undergraduate project laboratory, responsible for student supervision and grading
- 1993 - 1998 MRC Laboratory of Molecular Biology, Cambridge, UK
• Postdoctoral research assistant
• Supervisor for research student, responsible for project design and supervision
- 1996 - 1998 Darwin College, Cambridge, UK
• Organizer of scientific seminars
- 1999 - 2013 Brandeis University, Waltham, MA
• Assistant Professor (1999), Associate Professor (2004), Full Professor (2006)
- 2013 - 2018 Janelia Research Campus, Ashburn, VA
• Group leader
- 2018 - present University of Massachusetts Medical School, Worcester, MA
• Professor

AWARDS, FELLOWSHIPS AND APPOINTMENTS

- 1988-90 Award from the Studienstiftung des Deutschen Volkes (national student award based on university nomination and interview)
- 1989 Award from DAAD (German Academic Exchange Service)
- 1990-93 Student grant from British Telecommunications plc.
- 1995-96 Research fellowship from Deutsche Forschungsgemeinschaft
- 1996-98 Research fellowship at Darwin College, Cambridge, England
- 2000-present Investigatorship, Howard Hughes Medical Institute
- 2004-05 Research fellowship from the Humboldt Foundation
- 2015-present Editor, eLife Sciences
- 2021 Election to the National Academy of Sciences, USA

RESEARCH ARTICLES

Grigorieff, N., Cherns, D., Yates, M. J., Hockly, M., Perrin, S. D. & Aylett, M. R. (1993). Electron microscopy of ultra-thin buried layers in InP and InGaAs. *Phil. Mag.* **68**, 121–136.

Grigorieff, N., Cherns, D., Preston, A. R. & Yates, M. J. (1995). Models for termination of crystal boundaries in the theory of transmission electron diffraction and comparison with experimental data. *Acta Cryst.* **A51**, 343–350.

Grigorieff, N., Beckmann, E. & Zemlin, F. (1995). Lipid location in deoxycholate-treated purple membrane at 2.6 Å. *J. Mol. Biol.* **254**, 404–415.

Grigorieff, N. & Henderson, R. (1995). Diffuse scattering in electron diffraction data from protein crystals. *Ultramicroscopy* **60**, 295–309.

Grigorieff, N., Ceska, T. A., Downing, K. H., Baldwin, J. M. & Henderson, R. (1996). Electron-crystallographic refinement of the structure of bacteriorhodopsin. *J. Mol. Biol.* **259**, 393–421.

Grigorieff, N. & Henderson, R. (1996). Comparison of calculated and observed dynamical diffraction from purple membrane: implications. *Ultramicroscopy* **65**, 101–107.

Grigorieff, N. (1998). Three-dimensional structure of bovine NADH:ubiquinone oxidoreductase (complex I) at 22 Å in ice. *J. Mol. Biol.* **277**, 1033–1046.

Smith, C. J., Grigorieff, N. & Pearse, B. M. F. (1998). Clathrin coats at 21 Å resolution - A cellular assembly designed to recycle multiple membrane receptors. *EMBO J.* **17**, 4943–4953.

Lam, Y.-M., Grigorieff, N. & Goldbeck-Wood, G. (1999) Direct visualisation of micelles of pluronic block copolymers in aqueous solution by cryo-TEM. *Phys. Chem. Chem. Phys.* **1**, 3331–3334.

Grigorieff, N. & Grigorieff, R. D. (1999). Asymptotisches Verhalten des Erwartungswertes für den größten Wert bei n unabhängigen Beobachtungen einer normalverteilten Variablen. *Reprint-Reihe Fachbereich Mathematik, Technische Universität Berlin* Nr. 647.

Grigorieff, N. (2000) Resolution Measurement in Structures Derived from Single Particles. *Acta Cryst.* **D56**, 1270–1277.

Mindell, J. A., Maduke, M., Miller, C. & Grigorieff, N. (2001). Projection structure of a ClC-type chloride channel at 6.5 Å resolution. *Nature* **409**, 219–223.

Sokolova, O., Kolmakova-Partensky, L. & Grigorieff, N. (2001). Three-dimensional structure of a voltage-gated potassium channel at 2.5 nm resolution. *Structure* **9**, 215–220.

Pirrucello, M.M., N. Grigorieff, and J.A. Mindell, (2002) Electron diffraction of a bacterial ClC-type chloride channel. *Novartis Found Symp.* **245**, 193–203.

McGovern, S. L., Caselli, E., Grigorieff, N. & Shoichet, B. K. (2002) A common mechanism underlying promiscuous inhibitors from virtual and high-throughput screening. *J. Med. Chem.* **45**, 1712–1722.

Jurica, M. S., Licklider, L. J., Gygi, S. P., Grigorieff, N. & Moore, M. J. (2002) Purification and characterization of native spliceosomes suitable for three-dimensional structural studies. *RNA* **8**, 426–439.

- Mindell, J. A. & Grigorieff, N. (2003) Accurate determination of local defocus and specimen tilt in electron microscopy. *J. Struct. Biol.* **142**, 334–347.
- Furst, J., Sutton, R. B., Chen, J., Brunger, A. T. & Grigorieff, N. (2003) Electron Cryo-Microscopy Structure of N-ethyl Maleimide Sensitive Factor at 11 Å Resolution. *EMBO J.* **22**, 4365–4374.
- Wolf, M., Eberhart, A., Glossmann, H., Striessnig, J. & Grigorieff, N. (2003) Visualization of the Domain Structure of an L-Type Ca^{2+} Channel Using Electron Cryo-Microscopy. *J. Mol. Biol.* **332**, 171–182.
- Sokolova, O., Accardi, A., Gutierrez, D., Lau, A., Rigney, M. & Grigorieff, N. (2003). Conformational changes in the C-terminus of *Shaker* K^+ channel, bound to the rat Kv β 2-subunit. *PNAS* **100**, 12607–12612.
- Chen, J. Z., Furst, J., Chapman, M. S. & Grigorieff, N. (2003) Low-resolution structure refinement in electron microscopy. *J. Struct. Biol.* **144**, 144–151.
- Jurica, M. S., Sousa, D., Moore, M. J. & Grigorieff, N. (2004) Three-dimensional structure of C complex spliceosomes by electron microscopy. *Nat. Struct. Mol. Biol.* **11**, 265–269.
- Kim, L. A., Furst, J., Butler, M., Xu, S., Grigorieff, N. & Goldstein, S. A. N. (2004) Subunit Composition of Kv4.2-KChIP2 Potassium Channel. *J. Biol. Chem.* **279**, 5549–5554.
- Kim, L. A., Furst, J., Gutierrez, D., Butler, M., Xu, S., Goldstein, S. A. N. & Grigorieff, N. (2004) Three-Dimensional Structure of Kv4.2-KChIP2 Channels by Electron Microscopy at 21 Å. *Neuron* **41**, 513–519.
- Stewart, A. & Grigorieff, N. (2004) Noise bias in the refinement of structures derived from single particles. *Ultramicroscopy* **102**, 67–84.
- Fotin, A., Cheng, Y., Sliz, P., Grigorieff, N., Harrison, S. C., Kirchhausen, T., & Walz, T. (2004) Molecular model for a complete clathrin lattice from electron cryomicroscopy. *Nature* **432**, 573–579.
- Fotin, A., Cheng, Y., Grigorieff, N., Walz, T., Harrison, S. C. & Kirchhausen, T. (2004) Structure of an auxilin-bound clathrin coat and its implications for the mechanism of uncoating. *Nature* **432**, 649–653.
- Rodal, A. A., Sokolova, O., Robins, D. B., Daugherty, K. M., Hippenmeyer, S., Riezman, H., Grigorieff, N. & Goode, B. L. (2005) Conformational changes in the Arp2/3 complex leading to actin nucleation. *Nat. Struct. Mol. Biol.* **12**, 26–31.
- Cheng, Y., Wolf, E., Larvie, M., Zak, O., Aisen, P., Grigorieff, N., C. Harrison, S. C. & Walz, T. (2006) Single Particle Reconstructions of the Transferrin–transferrin receptor complex obtained with different specimen preparation techniques. *J. Mol. Biol.* **355**, 1048–1065.
- Wolf, M., DeRosier, D. J. & Grigorieff, N. (2006) Ewald sphere correction for single particle electron microscopy. *Ultramicroscopy* **106**, 376–382.
- Stroupe, M. E., Tange, T. Ø., Thomas, D. R., Moore, M. J. & Grigorieff, N. (2006) The three-dimensional architecture of the EJC core. *J. Mol. Biol.* **360**, 743–749.

Fotin, A., Kirchhausen, T., Grigorieff, N., Harrison, S. C., Walz, T. & Cheng, Y. (2006) Structure determination of clathrin coats to subnanometer resolution by single particle cryo-electron microscopy. *J. Struct. Biol.* **156**, 453–460.

Sachse, C., Xu, C., Wieligmann, K., Diekmann, S., Grigorieff, N. & Fändrich, M. (2006) Quaternary structure of a mature amyloid fibril from Alzheimer's A β (1-40) peptide. *J. Mol. Biol.* **362**, 347–354.

Grigorieff, N. (2007) FREALIGN: High-resolution refinement of single particle structures. *J. Struct. Biol.* **157**, 117–125.

Chen, J. Z. & Grigorieff, N. (2007) SIGNATURE: A single-particle selection system for molecular electron microscopy. *J. Struct. Biol.* **157**, 168–173.

Sousa, D. & Grigorieff, N. (2007) Ab initio resolution measurement for single particle structures. *J. Struct. Biol.* **157**, 201–210.

Sachse, C., Chen, J. Z., Coureux, P.-D., Stroupe, M. E., Fändrich, M. & Grigorieff, N. (2007) High-resolution electron microscopy of helical specimens: a fresh look at tobacco mosaic virus. *J. Mol. Biol.* **371**, 812–835.

Zeng, X., Stahlberg, H. & Grigorieff, N. (2007) A maximum likelihood approach to two-dimensional crystals. *J. Struct. Biol.* **160**, 362–374.

Chen, J. Z., Sachse, C., Xu, C., Mielke, T., Spahn, C. M. T. & Grigorieff, N. (2008) A Dose-Rate Effect in Single-Particle Electron Microscope. *J. Struct. Biol.* **161**, 92–100.

Zhang, X., Settembre, E., Xu, C., Dormitzer, P. R., Bellamy, R., Harrison, S. C. & Grigorieff, N. (2008) Near-atomic resolution using electron cryo-microscopy and single particle reconstruction. *PNAS* **105**, 1867–1872.

Zolotarev, A. S., Unnikrishnan, M., Shmukler, B. E., Clark, J. S., Vondorp, D. H., Grigorieff, N., Rubin, E. J. & Alper, S. L. (2008) Increased sulfate uptake by *E. coli* overexpressing the SLC26-related SulP protein Rv1739c from *Mycobacterium tuberculosis*. *Comp. Biochem. Physiol. A* **149**, 255–266.

Sachse, C., Fändrich, M. & Grigorieff, N. (2008) Paired β -sheet structure of an A β (1-40) amyloid fibril revealed by electron microscopy. *PNAS* **105**, 7462–7466.

Stroupe, M. E., Xu, C., Goode, B. L. & Grigorieff, N. (2009) Actin filament labels for localizing protein components in large complexes viewed by electron microscopy. *RNA* **15**, 244–248.

Meinhardt, J., Sachse, C., Hortschansky, P., Grigorieff, N. & Fändrich, M. (2009) A β (1-40) fibril polymorphism implies diverse interaction patterns in amyloid fibril. *J. Mol. Biol.* **386**, 869–877.

Dementieva, I. S., Tereshko, V., McCrossan, Y. A., Solomaha, E., Araki, D., Xu, C., Grigorieff, N. & Goldstein, S. A. N. (2009) Pentameric assembly of potassium channel tetramerization domain-containing protein 5 (KCTD5). *J. Mol. Biol.* **387**, 175–191.

Chen, J. Z., Settembre, E., Aoki, S. T., Zhang, X., Bellamy, A. R., Dormitzer, P. R., Harrison, S. C. & Grigorieff, N. (2009) Molecular interactions in rotavirus assembly and uncoating seen by high-resolution cryo-EM. *PNAS* **106**, 10644–10648.

Schmidt, M., Sachse, C., Richter, W., Xu, C., Fändrich, M. & Grigorieff, N. (2009) Comparison of Alzheimer A β (1-40) and A β (1-42) amyloid fibrils reveals similar protofilament structures. *PNAS* **106**, 19813–19818.

Sachse, C., Grigorieff, N. & Fändrich, M. (2010) Nanoscale flexibility parameters of Alzheimer amyloid fibrils determined using electron cryo-microscopy. *Angew. Chem. Int. Ed.* **49**, 1321–1323.

Xing, Y., Böcking, T., Wolf, M., Grigorieff, N., Kirchhausen, T. & Harrison, S. C. (2010) Structure of clathrin coat with bound Hsc70 and auxilin: mechanism of Hsc70-facilitated disassembly. *EMBO J.* **29**, 655–665.

Wolf, M., Garcea, R. L., Grigorieff, N. & Harrison, S. C. (2010) Subunit interactions in bovine papillomavirus. *PNAS* **107**, 6298–6303.

Okada, K., Bartolini, F., Deaconescu, A. M., Moseley, J. B., Dogic, Z., Grigorieff, N., Gundersen, G. G. & Goode, B. L. (2010) Adenomatous polyposis coli protein nucleates actin assembly and synergizes with the formin mDia1. *J. Cell Biol.* **189**, 1087–1096.

Li, X., Grigorieff, N. & Cheng, Y. (2010) GPU-enabled FREALIGN: accelerating single particle 3D reconstruction and refinement in Fourier space on graphic processors. *J. Struct. Biol.* **172**, 407–412.

Alushin, G., Ramey, V., Pasqualato, S., Ball, D., Grigorieff, N., Musacchio, A. & Nogales, N. (2010) The Ndc80 kinetochore complex forms oligomeric arrays along microtubules. *Nature* **467**, 805–810.

Settembre, E., Chen, J. Z., Dormitzer, P. R., Grigorieff, N. & Harrison, S. C. (2011) Atomic model of an infectious rotavirus particle. *EMBO J.* **30**, 408–416.

Sindelar, C. V. & Grigorieff, N. (2011) An adaptation of the Wiener filter suitable for analyzing images of isolated single particles. *J. Struct. Biol.* **176**, 60–74.

Lewandowski, J. R., van der Wel, P. C., Rigney, M., Grigorieff, N. & Griffin, R. G. (2011) Structural complexity of a composite amyloid fibril. *J. Am. Chem. Soc.* **133**, 14686–14698.

Henderson, R., Chen, S., Chen, J. Z., Grigorieff, N., Passmore, L. A., Ciccarelli, L., Rubinstein, J. L., Crowther, R. A., Stewart, P. L. & Rosenthal, P. B. (2011) Tilt-pair analysis of images from a range of different specimens in single-particle electron cryomicroscopy. *J. Mol. Biol.* **413**, 1028–1046.

Henderson, R., Sali, A., Baker, M. L., Carragher, B., Devkota, B., Downing, K. H., Egelman, E. H., Feng, Z., Frank, J., Grigorieff, N., Jiang, W., Ludtke, S. J., Medalia, O., Penczek, P. A., Rosenthal, P. B., Rossmann, M. G., Schmid, M. F., Schröder, G. F., Steven, A. C., Stokes, D. L., Westbrook, J. D., Wriggers, W., Yang, H., Young, J., Berman, H. M., Chiu, W., Kleywegt, G. J. & Lawson, C. L. (2012) Outcome of the first electron microscopy validation task force meeting. *Structure* **20**, 205–214.

Deaconescu, A. M., Sevostyanova, A., Artsimovitch, I. & Grigorieff, N. (2012) Nucleotide excision repair (NER) machinery recruitment by the transcription-repair coupling factor involves unmasking of a conserved intramolecular interface. *PNAS* **109**, 3353–3358.

Brilot, A. F., Chen, J. Z., Cheng, A., Pan, J., Harrison, S. C., Potter, C. S., Carragher, B., Henderson, R., Grigorieff, N. (2012) Beam-induced motion of vitrified specimen on holey carbon film. *J. Struct. Biol.* **177**, 630–637.

Sindelar, C. V. & Grigorieff, N. (2012) Optimal noise reduction in 3D reconstructions of single particles using a volume-normalized filter. *J. Struct. Biol.* **180**, 26–38.

Veesler, D., Quispe, J., Grigorieff, N., Potter, C. S., Carragher, B. & Johnson, J. E. (2012) Maturation in action: cryoEM study of a viral capsid caught during expansion. *Structure* **20**, 1384–1390.

Campbell, M. G., Cheng, A., Brilot, A. F., Moeller, A., Lyumkis, D., Veesler, D., Pan, J., Harrison, S. C., Potter, C. S., Carragher, B. & Grigorieff, N. (2012) Movies of ice-embedded particles enhance resolution in electron cryo-microscopy. *Structure* **20**, 1823–1828.

Estrozi, L. F., Settembre, E. C., Goret, G., McClain, B., Zhang, X., Chen, J. Z., Grigorieff, N. & Harrison, S.C. (2013) Location of the dsRNA-dependent polymerase, VP1, in rotavirus particles. *J. Mol. Biol.* **425**, 124–132.

Lyumkis, D., Brilot, A. F., Theobald, D. L. & Grigorieff, N. (2013) Likelihood-based classification of cryo-EM images using FREALIGN. *J. Struct. Biol.* **183**, 377–388.

Brilot, A. F., Korostelev, A. A., Ermolenko, D. N. & Grigorieff, N. (2013) Structure of the ribosome with elongation factor G trapped in the pre-translocation state. *PNAS* **110**, 20994–20999.

Ruskin, R. S., Yu, Z. & Grigorieff, N. (2013) Quantitative characterization of electron detectors for transmission electron microscopy. *J. Struct. Biol.* **184**, 385–393.

Rohou, A. & Grigorieff, N. (2014) FREALIX: model-based refinement of helical filament structures from electron micrographs. *J. Struct. Biol.* **186**, 234–244.

Svidritskiy, E., Brilot, A. F., Koh, C. S., Grigorieff, N. & Korostelev, A. A. (2014) Structures of yeast 80S ribosome-tRNA complexes in the rotated and nonrotated conformations. *Structure* **22**, 1210–1218.

Koh, C. S., Brilot, A. F., Grigorieff, N. & Korostelev, A. A. (2014) Taura syndrome virus IRES initiates translation by binding its tRNA-mRNA-like structural element in the ribosomal decoding center. *PNAS* **111**, 9139–9144.

Szyk, A., Deaconescu, A. M., Spector, J., Goodman, B., Valenstein, M. L., Ziolkowska, N. E., Kormendi, V., Grigorieff, N. & Roll-Mecak, A. (2014) Molecular basis for age-dependent microtubule acetylation by tubulin acetyltransferase. *Cell* **157**, 1405–1415.

Grant, T. & Grigorieff, N. (2015) Measuring the optimal exposure for single particle cryo-EM using a 2.6 Å reconstruction of rotavirus VP6. *eLife* **4**, e06980, 1–19.

Liang, B., Li, Z., Jenni, S., Rameh, A. A., Morin, B. M., Grant, T., Grigorieff, N., Harrison, S. C. & Whelan, S. P. J. (2015) Structure of the L-protein of vesicular stomatitis virus from electron cryomicroscopy. *Cell* **162**, 314–327.

Grant, T. & Grigorieff, N. (2015) Automatic estimation and correction of anisotropic magnification distortion in electron microscopes. *J. Struct. Biol.* **192**, 204–208.

Rohou, A. & Grigorieff, N. (2015) CTFFIND4: Fast and accurate defocus estimation from electron micrographs. *J. Struct. Biol.* **192**, 216–221.

Chiu, P.-L., Li, X., Li, Z., Beckett, B., Brilot, A. F., Grigorieff, N., Agard, D. A., Cheng, Y. & Walz, T. (2015) Evaluation of super-resolution performance of the K2 electron-counting camera using 2D crystals of aquaporin-0. *J. Struct. Biol.* **192**, 163–173.

Schmidt, M., Rohou, A., Lasker, K., Yadav, J. K., Schiene-Fischer, C., Fändrich, M. & Grigorieff, N. (2015) Peptide Dimer Structure in an A β (1-42) Fibril Visualized with Cryo-EM. *PNAS* **112**, 11858–11863.

Zhou, A., Rohou, A., Schep, D. G., Bason, J. V., Montgomery, M. G., Walker, J. E., Grigorieff, N. & Rubinstein, J. L. (2015) Structure and conformational states of the bovine mitochondrial ATP synthase by cryo-EM. *eLife* **4**, e10180, 1–15.

Abeyrathne, P. D., Koh C. S., Grant, T., Grigorieff N. & Korostelev A. A. (2016) Ensemble cryo-EM uncovers inchworm-like translocation of a viral IRES through the ribosome. *eLife* **5**, e14874, 1–31.

Schmidt, A., Annamalai, K., Schmidt, M., Grigorieff, N. & Fändrich, M. (2016) Cryo-EM reveals the steric zipper structure of a light chain-derived amyloid fibril. *PNAS* **113**, 6200–6205.

Laxmikanthan, G., Xu, C., Brilot, A. F., Warren, D., Steele, L., Seah, N., Tong, W., Grigorieff, N., Landy, A. & Van Duyne, G. D. (2016) Structure of a Holliday junction complex reveals mechanisms governing a highly regulated DNA transaction. *eLife* **5**, e14313, 1–23.

Tajima, N., Karakas, E., Grant, T., Simorowski, N., Diaz-Avalos, R., Grigorieff, N. & Furukawa, H. (2016) Activation of NMDA receptors and the mechanism of inhibition by ifenprodil. *Nature* **534**, 63–68.

Grigorieff, N. (2016) Frealign: An exploratory tool for single particle cryo-EM. *Methods Enzymol.* **579**, 191–226.

Loveland, A. B., Bah, E., Madireddy, R., Zhang, Y., Brilot, A. F., Grigorieff, N. & Korostelev, A. A. (2016) Ribosome•RelA structures reveal the mechanism of stringent response activation. *eLife* **5**, e17029, 1–23.

Oldham, M. L., Grigorieff, N., & Chen, J. (2016) Structure of the transporter associated with antigen processing trapped by herpes simplex virus. *eLife* **5**, e21829, 1–16.

Liu, Y., Pan, J., Cai, Y., Grigorieff, N., Harrison, S. C. & Chen, B. (2017) Conformational states of a soluble, uncleaved HIV-1 envelope trimer. *J. Virol.* **91**, e00175–17, 1–15.

Demo, G., Svidritskiy, E., Madireddy, R., Diaz-Avalos, R., Grant, T., Grigorieff, N., Sousa, D. & Korostelev, A. A. (2017) Mechanism of ribosome rescue by ArfA and RF2. *eLife* **6**, e23687, 1–18.

Loveland, A. B., Demo, G., Grigorieff, N. & Korostelev, A. A. (2017) Ensemble cryo-EM elucidates the mechanism of translation fidelity. *Nature* **546**, 113–117.

Rickgauer, J. P., Grigorieff, N. & Denk, W. (2017) Single-protein detection in crowded molecular environments in cryo-EM images. *eLife* **6**, e25648, 1–22.

Liu, Y., Pan, J., Jenni, S., Raymond, D. D., Caradonna, T., Do, K. T., Schmidt, A. G., Grigorieff, N. & Harrison, S. C. (2017) CryoEM structure of an influenza virus receptor-binding site antibody-antigen interface. *J. Mol. Biol.* **429**, 1829–1839.

Abeyrathne, P. D. & Grigorieff, N. (2017) Expression, purification, and contaminant detection for structural studies of *Ralstonia metallidurans* ClC protein rm1. *PLoS One* **12**, e0180163, 1–23.

Demo, G., Rasouly, A., Vasilyev, N., Svetlov, V., Loveland, A. B., Diaz-Avalos, R., Grigorieff, N., Nudler, E. & Korostelev, A. A. (2017) Structure of RNA polymerase bound to ribosomal 30S subunit. *eLife* **6**, e28560, 1–17.

Close, W., Neumann, M., Schmidt, A., Hora, M., Annamalai, K., Schmidt, M., Reif, B., Schmidt, V., Grigorieff, N. & Fändrich, M. (2018) Physical basis of amyloid fibril polymorphism. *Nat. Commun.* **9**, 699, 1–7.

Grant, T., Rohou, A. & Grigorieff, N. (2018) *cis*TEM, User-friendly software for single-particle image processing. *eLife* **7**, e35383, 1–24.

Bartesaghi, A., Aguerrebere, C., Falconieri, V., Banerjee, S., Earl, L. A., Zhu, X., Grigorieff, N., Milne, J. L. S., Sapiro, G., Wu, X. & Subramaniam, S. (2018) Atomic resolution cryo-EM structure of β -galactosidase. *Structure* **26**, 848–856.

Regan, M. C., Grant, T., McDaniel, M. J., Karakas, E., Zhang, J., Traynelis, S. F., Grigorieff, N. & Furukawa, H. (2018) Structural mechanism of functional modulation by gene splicing in NMDA receptors. *Neuron* **98**, 521–529.

Vemu, A., Szczesna, E., Zehr, E. A., Spector, J. O., Grigorieff, N., Deaconescu, A. M. & Roll-Mecak, A. (2018) Severing enzymes amplify microtubule arrays through lattice GTP-tubulin incorporation. *Science* **361**, 768–779.

Zhang, C., Cantara, W., Jeon, Y., Musier-Forsyth, K., Grigorieff, N. & Lyumkis, D. (2019) Analysis of discrete local variability and structural covariance in macromolecular assemblies using cryo-EM and focused classification. *Ultramicroscopy* **203**, 170–180.

Liberta, F., Loerch, S., Rennegarbe, M., Schierhorn, A., Westermarck, P., Westermarck, G. T., Hazenberg, B. P. C., Grigorieff, N., Fändrich, M. & Schmidt, M. (2019) Cryo-EM fibril structures from systemic AA amyloidosis reveal the species complementarity of pathological amyloids. *Nat. Comm.* **10**, 1104, 1–10.

Jung, J., Grant, T., Thomas, D. R., Diehnelt, C. W., Grigorieff, N. & Joshua-Tor, L. (2019) High-resolution cryo-EM structures of outbreak strain human norovirus shells reveal size variations. *PNAS* **116**, 12828–12832.

Jenni, S., Salgado, E. N., Herrmann, T., Li, Z., Grant, T., Grigorieff, N., Trapani, S., Estrozi, L. F. & Harrison, S. C. (2019) In situ structure of rotavirus VP1 RNA-dependent RNA polymerase. *J. Mol. Biol.* **431**, 3124–3138.

Song, K., Shang, Z., Fu, X., Lou, X., Grigorieff, N. & Nicastro, D. (2019) In situ structure determination at nanometer 1 resolution using TYGRESS. *Nat. Methods* **17**, 201–208.

Syrjanen, J. L., Michalski, K., Chou, T.-H., Grant, T., Rao, S., Simorowski, N., Tucker, S. J., Grigorieff, N. & Furukawa, H. (2020) Structure and assembly of calcium homeostasis modulator proteins. *Nat. Struct. Mol. Biol.* **27**, 150–159.

Jenni, S., Bloyet, L.-M., Diaz-Avalos, R., Liang, B., Whelan, S. P. J., Grigorieff, N. & Harrison, S. C. (2020) Structure of the Vesicular Stomatitis Virus L protein in complex with its phosphoprotein cofactor. *Cell Reports* **30**, 53–60.

Bao, C., Loerch, S., Ling, C., Korostelev, A. A., Grigorieff, N. & Ermolenko, D. N. (2020) mRNA stem-loops can pause the ribosome by hindering A-site tRNA binding. *eLife* **9**, e55799, 1–27.

Lucas, B. A., Himes, B. A., Xue, L., Grant, T., Mahamid, J. & Grigorieff, N. (2021) Locating macromolecular assemblies in cells by 2D template matching with *cis*TEM. *eLife* **10**, e68946. 1–25.

Himes, B. A. & Grigorieff, N. (2021) Cryo-TEM simulations of amorphous radiation-sensitive samples using multislice wave propagation. *IUCrJ* **8**, 943–953.

Elferich, J., Schirotti, G., Scadden, D. & Grigorieff, N. (2022) Defocus corrected large area cryo-EM (DeCo-LACE) for label-free detection of molecules across entire cell sections. *eLife* **11**, e80980, 1–24.

Lucas, B. A., Zhang, K., Loerch, S. & Grigorieff, N. (2022) In situ single particle classification reveals distinct 60S maturation intermediates in cells. *eLife* **11**, e79272, 1–24.

Pitsawong, W., Pádua, R. A. P., Grant, T., Hoemberger, M., Otten, R., Bradshaw, N., Grigorieff, N. & Kern, D. (2023) From primordial clocks to circadian oscillators. *Nature* **616**, 183–189.

Zhang, K., Lucas, B. A. & Grigorieff, N. (2023) Exploring the limits of 2D template matching for detecting targets in cellular cryo-EM images. *Microsc. Microanal.* **29**, 931.

Lucas, B. A. & Grigorieff, N. (2023) Quantification of gallium cryo-FIB milling damage in biological lamella. *PNAS* **120**, e2301852120, 1–9.

Lucas, B. A., Himes, B. A. & Grigorieff, N. (2023) Baited reconstruction with 2D template matching for high-resolution structure determination in vitro and in vivo without template bias. *eLife* **12**, e90486, 1–16.

Elferich, J., Kong, L., Zottig, X. & Grigorieff, N. (2024) CTFFIND5 provides improved insight into quality, tilt and thickness of TEM samples. *eLife* **13**, RP97227, 1–22.

Zhang, K., Cossio, P., Rangan, A. V., Lucas, B. A. & Grigorieff, N. (2025) A new statistical metric for robust target detection in cryo-EM using 2DTM. *IUCrJ* **12**, 155–176.

Dingeldein, L., Silva-Sanchez, D., Evans, L., D'Imprima, E., Grigorieff, N., Covino, R. & Cossio, P. (2025) Amortized template-matching of molecular conformations from cryo-electron microscopy images using simulation-based inference. *PNAS*, **122**, e2420158122, 1-10

Huang, Q. J., Kim, R., Song, K., Grigorieff, N., Munro, J. B., Schiffer, C. A. & Somasundaran, M. (2025) Virion-associated influenza hemagglutinin clusters upon sialic acid binding visualized by cryo-electron tomography. *PNAS* **122**, e2426427122, 1–9.

Woollard, G., Zhou, W., Thiede, E. T., Lin, C., Grigorieff, N., Cossio, P., Dao Duc, K. & Hanson, S. M. (2025) InstaMap: instant-NGP for cryo-EM density maps. *Acta Cryst. D* **81**, 147–169.

Elferich, J., Kaminek, M., Kong, L., Odriozola, A., Kukulski, W., Zuber, B. & Grigorieff, N. (2025) In-situ high-resolution cryo-EM reconstructions from CEMOVIS. *IUCrJ* **12**, 502–510.

Kong, L., Zottig, X., Elferich, J. & Grigorieff, N. (2025) Unbend: Correction of local beam-induced sample motion in cryo-EM images using a 3D spline model. *eLife* **14**, RP109119, 1-21.

Serrano, A., Puerner, C., Chevalier, L., Plumb, E., Elferich, J., Diggs, S., Sinn, L. R., Grigorieff, N., Ralser, M., Delarue, M., Bassilana, M. & Arkowitz R. A. (2026) Decreased cytoplasmic crowding via inhibition of ribosome biogenesis can trigger *Candida albicans* filamentous growth. *Nat. Microbiol.* **11**, 169–179.

Seraj, Z., Zottig, X., Huang, C.-Y., Loveland, A. B., Diggs, S., Sholi, E., Grigorieff, N. & Korostelev, A. A. (2026) In extracto cryo-EM reveals eEF2 as a major hibernation factor on 60S and 80S particles. *eLife* **15**, RP110114, 1-28.

PRE-PRINTS

Zehr, E. A., Rohou, A., Liu, Y., Verba, K. A., Pogliano, J., Grigorieff, N. & Agard, D. A. (2018) Mechanistic origins of dynamic instability in filaments from the phage tubulin, PhuZ. *bioRxiv* doi.org/10.1101/311498.

Liberta, F., Loerch, S., Rennegarbe, M., Schierhorn, A., Westermarck, P., Westermarck, G. T., Grigorieff, N., Fändrich, M. & Schmidt, M. (2018) Cryo-EM structure of an amyloid fibril from systemic amyloidosis. *bioRxiv* doi.org/10.1101/357129.

Song, K., Shang, Z., Fu, X., Lou, X., Grigorieff, N. & Nicastro, D. (2018) Structure of the ciliary axoneme at nanometer resolution reconstructed by TYGRESS. *bioRxiv* doi.org/10.1101/363317.

Zhang, C., Cantara, W., Jeon, Y., Musier-Forsyth, K., Grigorieff, N. & Lyumkis, D. (2018) Analysis of local variability and allostery in macromolecular assemblies using cryo-EM and focused classification. *bioRxiv* doi.org/10.1101/365940.

Syrjanen, J. L., Michalski, K., Chou, T.-H., Grant, T., Rao, S., Simorowski, N., Tucker, S. J., Grigorieff, N. & Furukawa, H. (2019) Structure and assembly of calcium homeostasis modulator proteins. *bioRxiv* doi.org/10.1101/857698.

Jenni, S., Bloyet, L.-M., Diaz-Avalos, R., Liang, B., Whelan, S. P. J., Grigorieff, N. & Harrison, S. C. (2019) Structure of the vesicular stomatitis virus L protein in complex with its phosphoprotein cofactor. *bioRxiv* doi.org/10.1101/792960.

Bao, C., Loerch, S., Ling, C., Korostelev, A. A., Grigorieff, N. & Ermolenko, D. N. (2019) mRNA stem-loops can pause the ribosome by hindering A-site tRNA binding. *bioRxiv* doi.org/10.1101/2020.02.05.936120.

Lucas, B. A., Himes, B. A., Xue, L., Grant, T., Mahamid, J. & Grigorieff, N. (2021) Locating macromolecular assemblies in cells by 2D template matching with *cis*TEM. *bioRxiv* doi.org/10.1101/2021.04.20.440648.

Himes, B. A. & Grigorieff, N. (2021) Cryo-TEM simulations of amorphous radiation-sensitive samples using multislice wave propagation. *bioRxiv* doi.org/10.1101/2021.02.19.431636.

Lucas, B. A., Zhang, K., Loerch, S. & Grigorieff, N. (2022) In situ single particle classification reveals distinct 60S maturation intermediates in cells. *bioRxiv* doi.org/10.1101/2022.04.10.487797.

Elferich, J., Schirolli, G., Scadden, D. & Grigorieff, N. (2022) Defocus corrected large area cryo-EM (DeCo-LACE) for label-free detection of molecules across entire cell sections. *bioRxiv* doi.org/10.1101/2022.06.13.4959697.

Pitsawong, W., Pádua, R. A. P., Grant, T., Hoemberger, M., Otten, R., Bradshaw, N., Grigorieff, N. & Kern, D. (2022) From primordial clocks to circadian oscillators. *bioRxiv* doi.org/10.1101/2022.11.28.518275.

Lucas, B. A. & Grigorieff, N. (2023) Quantification of gallium cryo-FIB milling damage in biological lamella. *bioRxiv* doi.org/10.1101/2023.02.01.526705.

Lucas, B. A., Himes, B. A. & Grigorieff, N. (2023) Baited reconstruction with 2D template matching for high-resolution structure determination in vitro and in vivo without template bias. *bioRxiv* doi.org/10.1101/2023.07.03.547552.

Elferich, J., Kong, L., Zottig, X. & Grigorieff, N. (2024) CTFFIND5 provides improved insight into quality, tilt and thickness of TEM samples. *bioRxiv* doi.org/10.1101/2024.02.26.582023.

Dingeldein, L., Silva-Sanchez, D., Evans, L., D'Imprima, E., Grigorieff, N., Covino, R. & Cossio, P. (2024) Amortized template-matching of molecular conformations from cryo-electron microscopy images using simulation-based inference. *bioRxiv* doi.org/10.1101/2024.07.23.604154.

Zhang, K., Cossio, P., Rangan, A. V., Lucas, B. A. & Grigorieff, N. (2024) New statistical metric for robust target detection in cryo-EM using 2DTM. *bioRxiv* doi.org/10.1101/2024.10.01.616095.

Huang, Q. J., Kim, R., Song, K., Grigorieff, N., Munro, J. B., Schiffer, C. A. & Somasundaran, M. (2024) Virion-associated influenza hemagglutinin clusters upon sialic acid binding visualized by cryo-electron tomography. *bioRxiv* doi.org/10.1101/2024.10.15.618557.

Serrano, A., Puerner, C., Chevalier, L., Plumb, E., Elferich, J., Diggs, S., Sinn, L. R., Grigorieff, N., Ralser, M., Delarue, M., Bassilana, M. & Arkowitz R. A. (2024) Dynamic cytoplasmic fluidity during morphogenesis in a human fungal pathogen. *Nat. Microbiol.* **11**, 169–179.

Serrano, A., Puerner, C., Plumb, E., Chevalier, L., Elferich, J., Sinn, L. R., Grigorieff, N., Ralser, M., Delarue, M., Bassilana, M. & Arkowitz R. A. (2024) Dynamic cytoplasmic fluidity during morphogenesis in a human fungal pathogen. *bioRxiv* doi.org/10.1101/2024.11.16.623909.

Elferich, J., Kaminek, M., Kong, L., Odriozola, A., Kukulski, W., Zuber, B. & Grigorieff, N. (2025) In-situ high-resolution cryo-EM reconstructions from CEMOVIS. *bioRxiv* doi.org/10.1101/2025.03.29.646093.

Kong, L., Zottig, X., Elferich, J. & Grigorieff, N. (2025) Unbend: Correction of local beam-induced sample motion in cryo-EM images using a 3D spline model. *bioRxiv* doi.org/10.1101/2025.09.05.674398.

Seraj, Z., Zottig, X., Huang, C.-Y., Loveland, A. B., Diggs, S., Sholi, E., Grigorieff, N. & Korostelev, A. A. (2025) In extracto cryo-EM reveals eEF2 as a major hibernation factor on 60S and 80S particles. *bioRxiv* doi.org/10.1101/2025.11.25.690450.

Astore, M. A., Woollard, G., Silva-Sanchez, D., Zhou, W., Kopylov, M., Dao Duc, K., Lederman, R. R., Li, Y., Zhou, Y., Yuan, J., Ye, F., Gu, Q., Vuillemot, R., Jonic, S., Dang, L., Ludtke, S. J., Bridges, H., Liu, S., McLean, M., Peretroukhin, V., Schwab, J., Cruz-Chú, E. R., Schwander, P., Gilles, M. A., Singer, A., Herreros, D., Carazo, J.-M., Sorzano, C. O. S., Feathers, J. R., Zhong, E. D., Grigorieff, N., Cossio, P. & Hanson, S. M. (2025) The inaugural Flatiron Institute cryo-EM conformational heterogeneity challenge. *bioRxiv* doi.org/10.1101/2025.07.18.665582.

Zhang, K., Grant, T. & Grigorieff, N. (2025) Improved cryo-EM reconstruction of sub-50 kDa complexes using 2D template matching. *bioRxiv* doi.org/10.1101/2025.09.11.675606.

Zottig, X., Huang, C.-Y., Seraj, Z., Grigorieff, N. & Korostelev, A. A. (2025) Structural basis for non-AUG translation regulation by 5MPs. *bioRxiv* doi.org/10.64898/2025.12.28.696766.

REVIEWS

Walz, T. & Grigorieff, N. (1998) Electron crystallography of two-dimensional crystals of membrane proteins. *J. Struct. Biol.* **121**, 142–161.

Grigorieff, N. (1999) Structure of the respiratory NADH:ubiquinone oxidoreductase (complex I). *Curr. Opin. Struct. Biol.* **9**, 476–483.

Nogales, E. & Grigorieff, N. (2001) Molecular machines: Putting the pieces together. *J. Cell Biol.* **152**, F1–F10.

Sachse, C., Grigorieff, N. & Fändrich, M. (2009) Elektronenmikroskopie an Alzheimer-Fibrillen. *Bioforum* **32**, 26–28.

Fändrich, M., Meinhardt, J. & Grigorieff, N. (2009) Structural polymorphism of Alzheimer A β and other amyloid fibrils. *Prion* **3**, 89–93.

Grigorieff, N. & Harrison, S. C. (2011) Near-atomic resolution reconstructions of icosahedral viruses from electron cryo-microscopy. *Curr. Opin. Struct. Biol.* **21**, 265–273.

Fändrich, M., Schmidt, M. & Grigorieff, N. (2011) Recent progress in understanding Alzheimer's β -amyloid structures. *Trends Biochem. Sci.* **36**, 338–345.

Deaconescu, A. M., Artsimovitch, I. & Grigorieff, N. (2012) Interplay of DNA repair with transcription: from structures to mechanisms. *Trends Biochem. Sci.* **37**, 543–552.

Grigorieff, N. (2013) Direct detection pays off for electron cryo-microscopy. *eLife* **2**, e00573, 1–3.

Grigorieff, N. (2015) Paper of the year award 2015. *J. Struct. Biol.* **189**, 161–162.

Cheng, Y., Grigorieff, N., Penczek, P. A. & Walz, T. (2015) A Primer to single-particle cryo-electron microscopy. *Cell* **161**, 438–449.

PATENTS

Rotavirus particles with chimeric surface proteins. Authors: Dormitzer, P. R., Grigorieff, N., Harrison, S. C., Pan, J., Settembre, E. Patent numbers: US 10,192,025 B2 (2019), EP 3,019,518 B1 (2019), CA 2,916,827 C (2021).

Methods and systems for imaging interactions between particles and fragments. Authors: Himes, B. A., Lucas, B. A., Grigorieff, N. Patent numbers: PCT/US2023/067479 (2023, pending).

OTHER RESEARCH PUBLICATIONS WITH GRIGORIEFF LAB MEMBERS

Kutter, S., Eichner, T., Deaconescu, A. M. & Kern, D. (2016) Regulation of Microtubule Assembly by Tau and not by Pin1. *J. Mol. Biol.* **428**, 1742–1759.

Abeyrathne, P. D., Chami, M., & Stahlberg, H. (2016) Biochemical and biophysical approaches to study the structure and function of the chloride channel (ClC) family of proteins. *Biochimie* **128–129**, 154–162.

Mazhab-Jafari, M. T., Rohou, A., Schmidt, C., Bueler, S. A., Benlekbir, S., Robinson, C. V. & Rubinstein, J. L. (2016) Atomic model for the membrane-embedded VO motor of a eukaryotic V-ATPase. *Nature* **539**, 118–122.

Coudray, N., Seyler, S., Lasala, R., Zhang, Z., Clark, K. M., Dumont, M. E., Rohou, A., Beckstein, O. & Stokes, D. L. (2016) Structure of the SLC4 transporter Bor1p in an inward-facing conformation. *Protein Sci.* **26**, 130–145.

Zehr, E., Szyk, A., Piszczek, G., Szczesna, E., Zuo, X. & Roll-Mecak, A. (2017) Katanin spiral and ring structures shed light on power stroke for microtubule severing. *Nat. Struct. Mol. Biol.* **24**, 717–725.

Loerch, S., De La Peña, J. B., Song, J., Pancrazio, J. J., Price, T. J. & Campbell, Z. T. (2019) Translational controls in pain. *Oxford Handbook of Neuronal Protein Synthesis*, doi.org/10.1093/oxfordhb/9780190686307.013.22.

De La Peña, J. B., Barragan-Iglesias, P., Lou, T.-F., Prakash, N., Loerch, S., Shukla, T., Basavarajappa, L., Song, J., Megat, S., Moy, J., Wanghzou, A., Ray, P., Hoyt, K., Steward, O., Price, T. J., Shepherd, J. D. & Campbell, Z. T. (2021) Intercellular Arc signaling regulates vasodilation. *J. Neurosci.* **41**, 7712–7726.

Smith, P. R., Loerch, S., Kunder, N., Stanowick, A. D., Lou, T.-F. & Campbell, Z. T. (2021) Functionally distinct roles for eEF2K in the control of ribosome availability and p-body abundance. *Nat. Commun.* **12**, 6789, 1–16.

Munshi, S., Neupane, K., Ileperuma, S. M., Halma, M. T. J., Kelly, J. A., Halpern, C. F., Dinman, J. D., Loerch, S. & Woodside, M. T. (2022) Identifying inhibitors of -1 programmed ribosomal frameshifting in a broad spectrum of coronaviruses. *Viruses* **14**, 177, 1–14.

Lucas, B. (2023) Visualizing everything, everywhere, all at once: Cryo-EM and the new field of structureomics. *Curr. Opinion Struct. Biol.* **81**, 102620.

Matsui, A., Spangler, C. J., Elferich, J., Shiozaki, M., Jean, N., Zhao, X., Qin, M., Zhong, H., Yu, Z. & Gouaux, E. (2024) Cryo-electron tomographic investigation of native hippocampal glutamatergic synapses. *bioRxiv* doi.org/10.1101/2024.04.01.587595.

Clark, S., Mitra, J., Elferich, J., Goehring, A., Ge, J., Ha, T. & Gouaux E. (2023) Single molecule studies of the native hair cell mechanosensory transduction complex. *bioRxiv* doi.org/10.1101/2023.12.11.571162.

Matsui, A., Spangler, C., Elferich, J., Shiozaki, M., Jean, N., Zhao, X., Qin, M., Zhong, H., Yu, Z. & Gouaux E. (2024) Cryo-electron tomographic investigation of native hippocampal glutamatergic synapses. *eLife* **13**, RP98458, 1–18.

Kim, H., Spangler, C., Matsui, A., Elferich, J., Kim, J., Roseborough, A., Nyman, M., Lahtinen, T. M. & Gouaux E. (2025) Cryo-electron tomographic investigation of native hippocampal glutamatergic synapses. *PNAS* **122**, e2524034122, 1-10.