Stanford

Colin Ophus

Associate Professor of Materials Science and Engineering and Center Fellow at the Precourt Institute for Energy

Bio

BIO

Colin Ophus is an Associate Professor in the Department of Materials Science and Engineering and a Center Fellow at the Precourt Institute for Energy, Stanford University. He previously worked as a Staff Scientist at the National Center for Electron Microscopy (NCEM), part of the Molecular Foundry, at Lawrence Berkeley Lab. He was awarded a US Department of Energy (DOE) Early Career award in 2018, and the Burton medal from the Microscopy Society of America (MSA) in 2018. His research focuses on experimental methods, reconstruction algorithms, and software codes for simulation, analysis, and instrument design of transmission electron microscopy (TEM) and scanning TEM (STEM).

Colin advocates for open science and his group has developed open-source scientific software including as the Prismatic STEM simulation code and py4DSTEM analysis toolkit. He has taught many workshops around the world on topics ranging from scientific visualization to large scale data analysis. He also is the founder and editor-in-chief for a new journal based on interactive science communication named Elemental Microscopy.

ACADEMIC APPOINTMENTS

- Associate Professor, Materials Science and Engineering
- Center Fellow, Precourt Institute for Energy

HONORS AND AWARDS

- Burton Medal in Physical Sciences, Microscopy Society of America (2022)
- Early Career Research Award, US Department of Energy (2018)

LINKS

- Colin Ophus Lab: http://colab.stanford.edu/
- Elemental Microscopy: https://www.elementalmicroscopy.com/
- Google Scholar: https://scholar.google.com/citations?hl=en&user=h5MPYJAAAAAJ&view_op=list_works&sortby=pubdate

Teaching

COURSES

2025-26

- STEMentors: Thermodynamic Evaluation of Green Energy Technologies: MATSCI 144S (Win)
- Thermodynamic Evaluation of Green Energy Technologies: MATSCI 144 (Win)
- Transmission Electron Microscopy Analysis and Simulation: MATSCI 327 (Spr)

2024-25

- Thermodynamic Evaluation of Green Energy Technologies: MATSCI 144 (Win)
- Transmission Electron Microscopy Analysis and Simulation: MATSCI 327 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Pin-Hung Chung, Daniel Custer

Postdoctoral Faculty Sponsor

Karen Ehrhardt, Arthur McCray, Dasol Yoon

Doctoral Dissertation Advisor (AC)

Corrie Barnes, Sangjoon Bob Lee, Cedric Lim, Caitlyn Obrero

Doctoral Dissertation Co-Advisor (AC)

Guoliang Hu, Nicholas Marchese, Will Millsaps

Publications

PUBLICATIONS

- **A large interlaboratory electron diffraction study of monolayer graphene** *2D MATERIALS*
  Tillotson, E., Thornley, W., Talbott, W., Eggeman, A. S., Kriuchkova, D., Sullivan-Allsop, S., Smith, M., Liu, X., Slattery, A., Yap, P., Losic, D., Xu, Z., Wang, et al
  2026; 13 (2)

- **Polyolefin blends with co-continuous architectures enabled by dynamic covalent crosslinking.** *Science advances*
  Neidhart, E. K., Ribet, S. M., Lee, T. A., Kearney, L., Bustillo, K. C., Dailing, E. A., Hua, M., Ophus, C., Fricke, S. N., Song, A. Y., Reimer, J. A., Alexanian, E. J., Atkin, et al
  2026; 12 (20): eaee2328

- **Seed-Mediated Colloidal Synthesis of Multimetallic and High-Entropy Alloy Nanocrystal Libraries with Enhanced Catalytic Performance.** *Journal of the American Chemical Society*
  Oh, J., Han, S., Gardner, E. J., Parekh, R., Dannar, A., Chung, P. H., Zheng, K., Mian, A., Bustillo, K. C., Reece, C., Frenkel, A. I., Ophus, C., Lizandara-Pueyo, et al
  2026

- **Defect-assisted refinement of nanoscale alpha in titanium alloys** *COMMUNICATIONS MATERIALS*
  Ackerman, A. K., Savitzky, B. H., Ophus, C., Danaie, M., Karamched, P., Dye, D.
  2026; 7 (1)

- **Identifying Strain Stacking Boundaries between Multiphase Domains in Atomically Thin Two-Dimensional Magnets.** *ACS nano*
  Bhusal, H. P., Tanaka, K., Zeltmann, S., Hanley, C., Ophus, C., Bustillo, K. C., Ribet, S. M., Gonzalez, C. A., Zhen, B., Ciston, J., Ge, Z., Lashley, J. C., Zettl, et al
  2026

- **Beyond Contrast Transfer: Spectral SNR as a Finite-Dose Metric for STEM Phase Retrieval.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Varnavides, G., Bekkevold, J. M., Ribet, S. M., McCray, A. R., Scott, M. C., Jones, L., Ophus, C.
  2026; 32 (2)

- **Relaxing Direct Ptychography Sampling Requirements via Parallax Imaging Insights.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Varnavides, G., Bekkevold, J. M., Ribet, S. M., Scott, M. C., Jones, L., Ophus, C.
  2026; 32 (2)

- **Strain mapping of three-dimensionally structured two-dimensional materials** *SCIENCE ADVANCES*

Mireles, A., Park, J., Sung, S., Shi, C., Shin, B., Lou, J., Ophus, C., Hovden, R., Kang, K., Han, Y.
2026; 12 (9): eadz7908

- **Atomic-Scale Moiré and Electronic Structure Analysis of Twisted Epitaxial MoS2-Au-MoS2 Heterostructures.** *Nano letters*
  Cui, Y., Xu, K., Ren, P., Yuan, L., Czaja, P., Barnum, A., Sarkar, P., Altman, A., Bustillo, K., Kundu, S., Ramdas, A., Wang, X., Wan, et al
  2026
- **Comparing multislice projections of MD simulations with cryo-EM exposes structural prediction errors.** *Biophysical journal*
  Mohammed, A., Lincoff, J., Natale, A., Ophus, C., Grabe, M., Frost, A., Moss, F. R.
  2026
- **Locating the atoms at the hard-soft interface of gold nanoparticles** *NATURE COMMUNICATIONS*
  Li, W., Esser, B. D., Tong, W., Chen, Z., Liew, Z., Varnavides, G., Yadav, A., Ophus, C., Mulvaney, P., Zheng, C., Findlay, S. D., Petersen, T., Funston, et al
  2026; 17 (1): 1363
- **Spatial Correlations of Charge Density Wave Order across the Transition in 2H-NbSe_{2}.** *Physical review letters*
  Hong, S., Oh, J., Park, J., Cho, W., Lee, S., Ophus, C., Kim, Y., Yang, H., Lee, S., Yang, Y.
  2026; 136 (1): 016504
- **Accelerating electron diffraction analysis using graph neural networks and attention mechanisms** *NPJ COMPUTATIONAL MATERIALS*
  Nathani, A., McCray, A. R. C., Liu, Y., Ding, H., Kazempoor, P., Xu, S., Ophus, C., Ghamarian, I.
  2026; 12 (1)
- **Spatial Correlations of Charge Density Wave Order across the Transition in 2H-NbSe2** *PHYSICAL REVIEW LETTERS*
  Hong, S., Oh, J., Park, J., Cho, W., Lee, S., Ophus, C., Kim, Y., Yang, H., Lee, S., Yang, Y.
  2026; 136 (1)
- **Multislice-Based Nonlinear Phase Retrieval for High-resolution Cryo-Electron Tomography**
  Lee, J., Song, S. W., Cho, M., Varnavides, G., Ribet, S. M., Ophus, C., Scott, M. C., Whittaker, M. L.
  edited by Liu, Y., Park, Y.
  SPIE-INT SOC OPTICAL ENGINEERING.2026
- **Fabrication and characterization of boron-terminated tetravacancies in monolayer hBN using STEM, EELS and electron ptychography.** *Ultramicroscopy*
  Byrne, D. O., Ribet, S. M., Kepaptsoglou, D., Ramasse, Q. M., Ophus, C., Allen, F. I.
  2025; 282: 114305
- **PhaseT3M: 3D imaging at 1.6 Å resolution via electron cryo-tomography with nonlinear phase retrieval.** *Nature communications*
  Lee, J., Song, S. W., Cho, M. G., Varnavides, G., Ribet, S. M., Ophus, C., Scott, M. C., Whittaker, M. L.
  2025
- **Comparing Multislice Projections of MD Simulations with CryoEM Exposes Membrane Prediction Errors.** *bioRxiv : the preprint server for biology*
  Mohammed, A., Lincoff, J., Natale, A., Ophus, C., Grabe, M., Frost, A., Moss, F. R.
  2025
- **Multi-angle Precession Electron Diffraction (MAPED): A Versatile Approach to 4D-STEM Precession.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Ribet, S. M., Dhall, R., Ophus, C., Bustillo, K. C.
  2025; 31 (6)
- **Quantitative Structure Determination from Experimental Four-Dimensional Scanning Transmission Electron Microscopy via the Scattering Matrix.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Terzoudis-Lumsden, E. W., Sadri, A., Weyland, M., Bourgeois, L., Ribet, S. M., Varnavides, G., Ophus, C., Petersen, T. C., Findlay, S. D.
  2025; 31 (6)
- **Kinetically Controlled Seed-Mediated Synthesis of Colloidal Copper Nanotetrahedra with Intricate Internal Structure.** *Journal of the American Chemical Society*

Jeong, S., Wu, M., Skalla, R. X., Paranzino, B., Kichigin, A., Zhu, B., Butrum-Griffith, A. N., Zhan, X., Zhong, Y., Yan, C., Pelz, P., Ophus, C., Rechberger, et al
2025

- **Design Principles in Engineering of Multigrain Nanocatalysts via Multiscale Electronic Structure Characterization** *CHEMISTRY OF MATERIALS*
  Cho, M., Ophus, C., Lee, J., Park, I., Chung, D., Kim, J., Kim, D., Sung, Y., Kang, K., Scott, M. C., Alivisatos, A., Hyeon, T., Oh, et al
  2025
- **3D strain field reconstruction by inversion of dynamical scattering** *APPLIED PHYSICS LETTERS*
  Niermann, L., Niermann, T., Song, C., Ophus, C.
  2025; 127 (11)
- **Atomic-scale 3D structural dynamics and functional degradation of Pt alloy nanocatalysts during the oxygen reduction reaction.** *Nature communications*
  Jeong, C., Lee, J., Jo, H., Lee, K., Lee, S., Ophus, C., Ercius, P., Cho, E., Yang, Y.
  2025; 16 (1): 8026
- **BEACON-automated aberration correction for scanning transmission electron microscopy using Bayesian optimization** *NPJ COMPUTATIONAL MATERIALS*
  Pattison, A. J., Ribet, S. M., Noack, M. M., Varnavides, G., Park, K., Kirkland, E. J., Park, J., Ophus, C., Ercius, P.
  2025; 11 (1)
- **Neutral but Impactful: Gallium Cluster-Induced Nanopores from Beam-Blanked Gallium Ion Sources.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Byrne, D. O., Ribet, S. M., Bustillo, K. C., Ophus, C., Allen, F. I.
  2025; 31 (4)
- **Intermetallic dispersion-strengthened ferritic superalloys with exceptional resistance to radiation-induced hardening** *ACTA MATERIALIA*
  Ma, K., Ferreiros, P. A., Pfeifer, T. W., Abernethy, R. G., von Tiedemann, S., Peng, N., Greaves, G., Ophus, C., Sun, K., Mir, A. H., Wang, L., Huang, S., Zhao, et al
  2025; 293
- **Mapping strain and structural heterogeneities around bubbles in amorphous ionically conductive Bi2O3** *MATERIALS & DESIGN*
  Kennedy, E., Ribet, S. M., Winter, I. S., Kohnert, C. A., Wang, Y., Bustillo, K. C., Ophus, C., Derby, B. K.
  2025; 256
- **Observation of nanoparticle coalescence during core-shell metallic nanowire growth in colloids via nanoscale imaging.** *Nature communications*
  Yang, D., Zhang, X., Yang, R., Zou, B., Huang, R., Ophus, C., Song, C., Cheng, S., Kim, J., Xiong, H., Wu, X., Li, M., Wang, et al
  2025; 16 (1): 4795
- **Quantitative phase retrieval and characterization of magnetic nanostructures via Lorentz (scanning) transmission electron microscopy** *JOURNAL OF PHYSICS-CONDENSED MATTER*
  Mendoza, K. L., Ni, H., Varnavides, G., Chi, M., Ophus, C., Petford-Long, A., Phatak, C.
  2025; 37 (20)
- **Atomic-Scale Mechanisms of Nucleation and Stabilization in CuCrO₂ and CuFeO₂ Delafossite Thin Films on Al₂O₃** *ADVANCED MATERIALS INTERFACES*
  Scheid, A., Song, Q., Ribet, S., Ophus, C., Suyolcu, Y., Schlom, D. G., Heil, T., van Aken, P. A.
  2025
- **Decoding the interstitial/vacancy nature of dislocation loops with their morphological fingerprints in face-centered cubic structure.** *Science advances*
  Ma, K., Guo, L., Dartois, A., Meslin, E., Ophus, C., Décamps, B., Fraczkiewicz, A., Knowles, A. J., Wang, L., Tissot, O., Prima, F., Gao, F., Deng, et al
  2025; 11 (15): eadq4070
- **Accelerating iterative ptychography with an integrated neural network.** *Journal of microscopy*
  McCray, A. R., Ribet, S. M., Varnavides, G., Ophus, C.
  2025

- **Complexions at the iron-magnetite interface** *NATURE COMMUNICATIONS*
  Zhou, X., Bienvenu, B., Wu, Y., da Silva, A., Ophus, C., Raabe, D.
  2025; 16 (1): 2705

- **Template Matching Approach for Automated Determination of Crystal Phase and Orientation of Grains in 4D-STEM Precession Electron Diffraction Data for Hafnium Zirconium Oxide Ferroelectric Thin Films.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Diebold, A. C., Ophus, C., Kordijazi, A., Consiglio, S., Lombardo, S., Triyoso, D., Tapily, K., Mian, A., Shankar, N. B., Morávek, T., Chandran, N., Stroud, R., Leusink, et al
  2025; 31 (2)

- **Dynamics and structure of the B2→B19' phase transformation in NiTi revealed through in situ 4D-STEM** *MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING*
  Donohue, J., Mills, S. H., Savitzky, B. H., Zeltmann, S. E., Ophus, C., Minor, A. M.
  2025; 926

- **Strain release by 3D atomic misfit in fivefold twinned icosahedral nanoparticles with amorphization and dislocations** *NATURE COMMUNICATIONS*
  Sun, Z., Zhang, Y., Li, Z., Xie, Z., Dai, Y., Du, X., Ophus, C., Zhou, J.
  2025; 16 (1): 1595

- **Tailored topotactic chemistry unlocks heterostructures of magnetic intercalation compounds.** *Nature communications*
  Husremović, S., Gonzalez, O., Goodge, B. H., Xie, L. S., Kong, Z., Zhang, W., Ryu, S. H., Ribet, S. M., Fender, S. S., Bustillo, K. C., Song, C., Ciston, J., Taniguchi, et al
  2025; 16 (1): 1208

- **A Gaussian Parameterization for Direct Atomic Structure Identification in Electron Tomography**
  Singh, N. M., Chien, T., McCray, A. R. C., Ophus, C., Waller, L., IEEE
  IEEE.2025

- **Accelerating the Electrochemical Formation of the δ Phase in Manganese-Rich Rocksalt Cathodes** *ADVANCED MATERIALS*
  Holstun, T., Mishra, T. P., Huang, L., Hau, H., Anand, S., Yang, X., Ophus, C., Bustillo, K., Ma, L., Ehrlich, S., Ceder, G.
  2024: e2412871

- **Reducing crystal symmetry to generate out-of-plane Dzyaloshinskii-Moriya interaction** *NATURE COMMUNICATIONS*
  Niu, H., Kwon, H., Ma, T., Cheng, Z., Ophus, C., Miao, B., Sun, L., Wu, Y., Liu, K., Parkin, S. S. P., Won, C., Schmid, A. K., Ding, et al
  2024; 15 (1): 10199

- **Streaming Large-Scale Microscopy Data to a Supercomputing Facility** *MICROSCOPY AND MICROANALYSIS*
  Welborn, S. S., Harris, C., Ribet, S. M., Varnavides, G., Ophus, C., Enders, B., Ercius, P.
  2024

- **The atomic-level structure and stability of interfaces of Pt nanoparticles in alumina: An experimental and computational evaluation** *ACTA MATERIALIA*
  Clauser, A. L., Sarfo, K., Ophus, C., Ciston, J., Giulian, R., Arnadottir, L., Santala, M. K.
  2024; 281

- **Grain boundary engineering for efficient and durable electrocatalysis.** *Nature communications*
  Geng, X., Vega-Paredes, M., Wang, Z., Ophus, C., Lu, P., Ma, Y., Zhang, S., Scheu, C., Liebscher, C. H., Gault, B.
  2024; 15 (1): 8534

- **The hierarchical structure of organic mixed ionic-electronic conductors and its evolution in water.** *Nature materials*
  Tsarfati, Y., Bustillo, K. C., Savitzky, B. H., Balhorn, L., Quill, T. J., Marks, A., Donohue, J., Zeltmann, S. E., Takacs, C. J., Giovannitti, A., McCulloch, I., Ophus, C., Minor, et al
  2024

- **Random forest prediction of crystal structure from electron diffraction patterns incorporating multiple scattering** *PHYSICAL REVIEW MATERIALS*
  Gleason, S. P., Rakowski, A., Ribet, S. M., Zeltmann, S. E., Savitzky, B. H., Henderson, M., Ciston, J., Ophus, C.
  2024; 8 (9)

- **Earth-abundant Li-ion cathode materials with nanoengineered microstructures.** *Nature nanotechnology*
  Hau, H., Mishra, T., Ophus, C., Huang, T., Bustilo, K., Sun, Y., Yang, X., Holstun, T., Zhao, X., Wang, S., Ha, Y., Lee, G., Song, et al
  2024
- **Integrated rocksalt-polyanion cathodes with excess lithium and stabilized cycling** *NATURE ENERGY*
  Huang, Y., Dong, Y., Yang, Y., Liu, T., Yoon, M., Li, S., Wang, B., Zheng, E., Lee, J., Sun, Y., Han, Y., Ciston, J., Ophus, et al
  2024
- **Considerations for extracting moiré-level strain from dark field intensities in transmission electron microscopy** *JOURNAL OF APPLIED PHYSICS*
  Craig, I. M., Van Winkle, M., Ophus, C., Bediako, D.
  2024; 136 (7)
- **Electronic structure along Sm2Co3Ge5 twin boundaries** *ACTA MATERIALIA*
  Kennedy, E., Kyrk, T. M., Ophus, C., McCandless, G. T., Chan, J. Y., Scott, M. C.
  2024; 270
- **Encoding multistate charge order and chirality in endotaxial heterostructures** *NATURE COMMUNICATIONS*
  Husremovic, S., Goodge, B. H., Erodici, M. P., Inzani, K., Mier, A., Ribet, S. M., Bustillo, K. C., Taniguchi, T., Watanabe, K., Ophus, C., Griffin, S. M., Bediako, D.
  2023; 14 (1): 6031
- **Structural Study of Hydrated Organic Mixed Ionic Electronic Conductors Using Cryogenic 4D-STEM.** *Microscopy and microanalysis : the official journal of Microscopy Society of America, Microbeam Analysis Society, Microscopical Society of Canada*
  Tsarfati, Y., Bustillo, K. C., Savitzky, B. H., Ophus, C., McCulloch, I., Salleo, A., Minor, A. M.
  2023; 29 (Supplement_1): 264-265
- **Multimodal Characterization of Crystal Structure and Formation in Rubrene Thin Films Reveals Erasure of Orientational Discontinuities** *ADVANCED FUNCTIONAL MATERIALS*
  Tan, J. A. A., Dull, J. T. T., Zeltmann, S. E. E., Tulyagankhodjaev, J. A. A., Johnson, H. M. M., Liebman-Pelaez, A., Folie, B. D. D., Donges, S. A. A., Khatib, O., Raybin, J. G. G., Roberts, T. D. D., Hamerlynck, L. M. M., Tanner, et al
  2023
- **Spatially resolved structural order in low-temperature liquid electrolyte.** *Science advances*
  Xie, Y., Wang, J., Savitzky, B. H., Chen, Z., Wang, Y., Betzler, S., Bustillo, K., Persson, K., Cui, Y., Wang, L. W., Ophus, C., Ercius, P., Zheng, et al
  2023; 9 (2): eadc9721
- **Correlative image learning of chemo-mechanics in phase-transforming solids.** *Nature materials*
  Deng, H. D., Zhao, H., Jin, N., Hughes, L., Savitzky, B. H., Ophus, C., Fraggedakis, D., Borbely, A., Yu, Y., Lomeli, E. G., Yan, R., Liu, J., Shapiro, et al
  2022
- **Simultaneous Successive Twinning Captured by Atomic Electron Tomography** *ACS NANO*
  Pelz, P. M., Groschner, C., Bruefach, A., Satariano, A., Ophus, C., Scott, M. C.
  2022; 16 (1): 588-596
- **Correlative analysis of structure and chemistry of LixFePO(4) platelets using 4D-STEM and X-ray ptychography** *MATERIALS TODAY*
  Hughes, L. A., Savitzky, B. H., Deng, H. D., Jin, N. L., Lomeli, E. G., Yu, Y., Shapiro, D. A., Herring, P., Anapolsky, A., Chueh, W. C., Ophus, C., Minor, A. M.
  2022; 52: 102-111
- **The chain of chirality transfer in tellurium nanocrystals** *SCIENCE*
  Ben-Moshe, A., da Silva, A., Mueller, A., Abu-Odeh, A., Harrison, P., Waelder, J., Niroui, F., Ophus, C., Minor, A. M., Asta, M., Theis, W., Ercius, P., Alivisatos, et al
  2021; 372 (6543): 729-+
- **Atomic structures determined from digitally defined nanocrystalline regions** *IUCRJ*
  Gallagher-Jones, M., Bustillo, K. C., Ophus, C., Richards, L. S., Ciston, J., Lee, S., Minor, A. M., Rodriguez, J. A.
  2020; 7: 490-499
- **Design and synthesis of multigrain nanocrystals via geometric misfit strain.** *Nature*

Oh, M. H., Cho, M. G., Chung, D. Y., Park, I. n., Kwon, Y. P., Ophus, C. n., Kim, D. n., Kim, M. G., Jeong, B. n., Gu, X. W., Jo, J. n., Yoo, J. M., Hong, et al

2020; 577 (7790): 359–63

- **Short-range order and its impact on the CrCoNi medium-entropy alloy.** *Nature*

  Zhang, R. n., Zhao, S. n., Ding, J. n., Chong, Y. n., Jia, T. n., Ophus, C. n., Asta, M. n., Ritchie, R. O., Minor, A. M.

  2020; 581 (7808): 283–87

- **The Materials Research Platform: Defining the Requirements from User Stories** *MATTER*

  Aykol, M., Hummelshoj, J. S., Anapolsky, A., Aoyagi, K., Bazant, M. Z., Bligaard, T., Braatz, R. D., Broderick, S., Cogswell, D., Dagdelen, J., Drisdell, W., Garcia, E., Garikipati, et al

  2019; 1 (6): 1433–38

- **Diffraction imaging of nanocrystalline structures in organic semiconductor molecular thin films.** *Nature materials*

  Panova, O. n., Ophus, C. n., Takacs, C. J., Bustillo, K. C., Balhorn, L. n., Salleo, A. n., Balsara, N. n., Minor, A. M.

  2019

- **Multi-pass transmission electron microscopy** *SCIENTIFIC REPORTS*

  Juffmann, T., Koppell, S. A., Klopfer, B. B., Ophus, C., Glaeser, R. M., Kasevich, M. A.

  2017; 7