

Stanford



Matthias C. Hoffmann

Lead Scientist, SLAC National Accelerator Laboratory

Bio

BIO

Education

Physik Diplom 2001, University of Freiburg, Germany,

Studies in Physics, Technical University of Denmark, Lyngby, Denmark,

Dr. rer. Nat. in Physics 2006, University of Freiburg, Germany

Appointments

2006-2009, Massachusetts Institute of Technology, Cambridge, MA, Postdoctoral Associate

2009-2011 Research Scientist, Center for Free Electron Laser Science, Hamburg, Germany

2011-present SLAC National Accelerator Lab, Staff Scientist, LCLS,

CURRENT ROLE AT STANFORD

Staff scientist in the LCLS Laser Science and Technology Division.

Develops and supports THz pump-X-ray probe experiments at LCLS and in-house research on ultrafast spectroscopy with intense THz pulses.

Professional

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- Senior Member, Optical Society of America (2016 - present)

Publications

PUBLICATIONS

- **Terawatt-scale attosecond X-ray pulses from a cascaded superradiant free-electron laser** *NATURE PHOTONICS*
Franz, P., Li, S., Driver, T., Robles, R. R., Cesar, D., Isele, E., Guo, Z., Wang, J., Duris, J. P., Larsen, K., Glowonia, J. M., Cheng, X., Hoffmann, et al
2024
- **Giant Terahertz Birefringence in an Ultrathin Anisotropic Semimetal.** *Nano letters*

- Sie, E. J., Othman, M. A., Nyby, C. M., Pemmaraju, D., Garcia, C. A., Wang, Y., Guzelurk, B., Xia, C., Xiao, J., Poletayev, A., Ofori-Okai, B. K., Hoffmann, M. C., Park, et al
2024
- **Terahertz electric-field-driven dynamical multiferroicity in SrTiO₃.** *Nature*
Basini, M., Pancaldi, M., Wehinger, B., Udina, M., Unikandanunni, V., Tadano, T., Hoffmann, M. C., Balatsky, A. V., Bonetti, S.
2024; 628 (8008): 534-539
 - **Improved temporal resolution in ultrafast electron diffraction measurements through THz compression and time-stamping.** *Structural dynamics (Melville, N.Y.)*
Othman, M. A., Gabriel, A. E., Snively, E. C., Kozina, M. E., Shen, X., Ji, F., Lewis, S., Weathersby, S., Vasireddy, P., Luo, D., Wang, X., Hoffmann, M. C., Nanni, et al
2024; 11 (2): 024311
 - **Monitoring the Evolution of Relative Product Populations at Early Times during a Photochemical Reaction.** *Journal of the American Chemical Society*
Figueira Nunes, J. P., Ibele, L. M., Pathak, S., Attar, A. R., Bhattacharyya, S., Boll, R., Borne, K., Centurion, M., Erk, B., Lin, M., Forbes, R. J., Goff, N., Hansen, et al
2024
 - **Publisher Correction: The persistence of memory in ionic conduction probed by nonlinear optics.** *Nature*
Poletayev, A. D., Hoffmann, M. C., Dawson, J. A., Teitelbaum, S. W., Trigo, M., Islam, M. S., Lindenberg, A. M.
2024
 - **The persistence of memory in ionic conduction probed by nonlinear optics.** *Nature*
Poletayev, A. D., Hoffmann, M. C., Dawson, J. A., Teitelbaum, S. W., Trigo, M., Islam, M. S., Lindenberg, A. M.
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 - **Femtosecond Electronic and Hydrogen Structural Dynamics in Ammonia Imaged with Ultrafast Electron Diffraction.** *Physical review letters*
Champenois, E. G., List, N. H., Ware, M., Britton, M., Bucksbaum, P. H., Cheng, X., Centurion, M., Cryan, J. P., Forbes, R., Gabalski, I., Hegazy, K., Hoffmann, M. C., Howard, et al
2023; 131 (14): 143001
 - **Ultrafast X-Ray Scattering Reveals Composite Amplitude Collective Mode in the Weyl Charge Density Wave Material (TaSe₄)₂I.** *Physical review letters*
Nguyen, Q. L., Duncan, R. A., Orenstein, G., Huang, Y., Krapivin, V., de la Peña, G., Ornelas-Skarin, C., Reis, D. A., Abbamonte, P., Bettler, S., Chollet, M., Hoffmann, M. C., Hurley, et al
2023; 131 (7): 076901
 - **The 2023 terahertz science and technology roadmap** *JOURNAL OF PHYSICS D-APPLIED PHYSICS*
Leitenstorfer, A., Moskalenko, A. S., Kampfrath, T., Kono, J., Castro-Camus, E., Peng, K., Qureshi, N., Turchinovich, D., Tanaka, K., Markelz, A. G., Havenith, M., Hough, C., Joyce, et al
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 - **Rehybridization dynamics into the pericyclic minimum of an electrocyclic reaction imaged in real-time.** *Nature communications*
Liu, Y., Sanchez, D. M., Ware, M. R., Champenois, E. G., Yang, J., Nunes, J. P., Attar, A., Centurion, M., Cryan, J. P., Forbes, R., Hegazy, K., Hoffmann, M. C., Ji, et al
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 - **Measurement of femtosecond dynamics of ultrafast electron beams through terahertz compression and time-stamping** *APPLIED PHYSICS LETTERS*
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 - **Terahertz-Driven Local Dipolar Correlation in a Quantum Paraelectric.** *Physical review letters*
Cheng, B., Kramer, P. L., Shen, Z. X., Hoffmann, M. C.
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 - **Ultrafast Optomechanical Strain in Layered GeS.** *Nano letters*
Luo, D., Zhang, B., Sie, E. J., Nyby, C. M., Fan, Q., Shen, X., Reid, A. H., Hoffmann, M. C., Weathersby, S., Wen, J., Qian, X., Wang, X., Lindenberg, et al
2023

- **Lightwave-driven electron emission for polarity-sensitive terahertz beam profiling** *APL PHOTONICS*
Lange, S., Hoffmann, M. C., Jepsen, P.
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- **Terahertz Pump/X-ray Probe Experiments At LCLS**
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- **Spatiotemporal Imaging of Near-Fields from a Tilted Pulse Front THz Source**
Gabriel, A. E., Othman, M. K., Hoffmann, M. C., Nanni, E. A., IEEE
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- **Ultrafast modification of the electronic structure of a correlated insulator** *PHYSICAL REVIEW RESEARCH*
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- **Observation of photo-induced plasmon-phonon coupling in PbTe via ultrafast x-ray scattering.** *Structural dynamics (Melville, N.Y.)*
Jiang, M. P., Fahy, S., Hauber, A., Murray, E. D., Savic, I., Bray, C., Clark, J. N., Henighan, T., Kozina, M., Lindenberg, A. M., Zalden, P., Chollet, M., Glowina, et al
2022; 9 (2): 024301
- **Ultrafast electron dynamics in platinum and gold thin films driven by optical and terahertz fields** *APPLIED PHYSICS LETTERS*
Unikandanunni, V., Rigoni, F., Hoffmann, M. C., Vavassori, P., Urazhdin, S., Bonetti, S.
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- **Spatiotemporal Measurement of THz Near-Fields Using Electro-Optic Sampling**
Gabriel, A. E., Othman, M. K., Hoffmann, M. C., Nanni, E. A., IEEE
IEEE.2022
- **Subterahertz collective dynamics of polar vortices.** *Nature*
Li, Q., Stoica, V. A., Pasciak, M., Zhu, Y., Yuan, Y., Yang, T., McCarter, M. R., Das, S., Yadav, A. K., Park, S., Dai, C., Lee, H. J., Ahn, et al
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- **Ultrafast structural dynamics of strongly-THz-driven materials**
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- **Enabling high repetition rate nonlinear THz science with a kilowatt-class sub-100 fs laser source** *OPTICS EXPRESS*
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- **Ultrafast Dynamics of a Terahertz Dual-Fed Relativistic Electron Bunch Compressor**
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- **THz-driven bunch compression for varying electron beam energy**
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- **Generation of high-field single-cycle terahertz pulses at 100 kHz**
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- **Nonlinear Magnetization Dynamics Driven by Strong Terahertz Fields.** *Physical review letters*
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- **Dynamical Slowing-Down in an Ultrafast Photoinduced Phase Transition.** *Physical review letters*
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- **Dynamical Slowing-Down in an Ultrafast Photoinduced Phase Transition** *PHYSICAL REVIEW LETTERS*
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- **Parallel-plate waveguides for terahertz-driven MeV electron bunch compression** *OPTICS EXPRESS*
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- **An ultrafast symmetry switch in a Weyl semimetal.** *Nature*
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- **THz-driven bunch compression and timing stabilization of a relativistic electron beam**
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IEEE.2019
- **Parallel-Plate THz Waveguides for Relativistic Electron Bunch Compression**
Othman, M. K., Hoffmann, M. C., Li, R., Nanni, E. A., Wang, X. J., IEEE
IEEE.2019
- **Terahertz Kerr Effect in beta-Alumina Ion Conductors**
Poletayev, A. D., Hoffmann, M. C., Teitelbaum, S. W., Trigo, M., Chueh, W. C., Lindenberg, A. M., IEEE
IEEE.2019
- **THz-Pump UED-Probe on a Topological Weyl Semimetal**
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- **Phonon-Suppressed Auger Scattering of Charge Carriers in Defective Two-Dimensional Transition Metal Dichalcogenides.** *Nano letters*
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- **An Ultrafast Symmetry Switch in a Weyl Semimetal** *Nature*
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- **Terahertz-pump Experiments On Complex Solids at X-ray FELs**
Hoffmann, M. C., Kozina, M. E., Razeghi, M., Baranov, A. N.
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Jay, R. M., Norell, J., Eckert, S., Hantschmann, M., Beyre, M., Kennedy, B., Quevedo, W., Schlotter, W. F., Dakovski, G. L., Miniti, M. P., Hoffmann, M. C., Mitra, A., Moeller, et al
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- **Development of a THz Pump MeV Ultrafast Electron Diffraction Probe Apparatus**
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- **Single-Shot Electro-Optic Measurement of Mid-Infrared Pulses**

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● **Anti-reflection coating design for metallic terahertz meta-materials**

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● **Self-referenced single-shot THz detection** *OPTICS EXPRESS*

Russell, B. K., Ofori-Okai, B. K., Chen, Z., Hoffmann, M. C., Tsui, Y. Y., Glenzer, S. H.
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● **The 2017 terahertz science and technology roadmap** *JOURNAL OF PHYSICS D-APPLIED PHYSICS*

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● **Single-shot terahertz time-domain spectroscopy in pulsed high magnetic fields** *OPTICS EXPRESS*

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● **Femtosecond X-ray magnetic circular dichroism absorption spectroscopy at an X-ray free electron laser** *REVIEW OF SCIENTIFIC INSTRUMENTS*

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● **Excitation of Coherent Oscillations in Underdoped Cuprate Superconductors by Intense THz Pulses**

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● **Direct observation of lattice motion driven by strong THz pulses**

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● **Ultrafast Terahertz Gating of the Polarization and Giant Nonlinear Optical Response in BiFeO₃ Thin Films** *ADVANCED MATERIALS*

Chen, F., Goodfellow, J., Liu, S., Grinberg, I., Hoffmann, M. C., Damodaran, A. R., Zhu, Y., Zalden, P., Zhang, X., Takeuchi, I., Rappe, A. M., Martin, L. W., Wen, et al
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● **Ultrafast Terahertz Gating of the Polarization and Giant Nonlinear Optical Response in BiFeO₃ Thin Films.** *Advanced materials (Deerfield Beach, Fla.)*

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● **Enhanced coherent oscillations in the superconducting state of underdoped YBa₂Cu₃O_{6+x} induced via ultrafast terahertz excitation** *PHYSICAL REVIEW B*

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- **Nonlinear THz Optics and Control in Complex Solids**
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- **Intense THz pulses for condensed matter physics**
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- **Terahertz Nonlinear Optics in Semiconductors**
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SPIE-INT SOC OPTICAL ENGINEERING.2013
- **Self-phase modulation of a single-cycle terahertz pulse by nonlinear free-carrier response in a semiconductor** *PHYSICAL REVIEW B*
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- **THz Electro-absorption Effect in Quantum Dots**

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- **Semiconductor saturable absorbers for ultrafast terahertz signals** *APPLIED PHYSICS LETTERS*

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