



Matthias Kling

Director, PULSE Institute, Professor of Photon Science and, by courtesy, of Applied Physics

Photon Science Directorate

Bio

BIO

Matthias Kling is an expert in ultrafast science, serving as Professor of Photon Science and Applied Physics (by courtesy) at Stanford University and Director of the Stanford PULSE Institute at SLAC National Accelerator Laboratory. With a background spanning physics, laser physics, and physical chemistry, he earned degrees from the Universities of Göttingen and Jena before completing postdoctoral research at UC Berkeley and AMOLF in Amsterdam. From 2007 to 2021, he led a research group within the Laboratory of Attosecond Physics at the Max Planck Institute of Quantum Optics and held faculty positions at Kansas State University and the University of Munich. Matthias joined SLAC and Stanford in 2021. He has been serving as Director of the Science and R&D Division at the Linac Coherent Light Source (LCLS) until 2026, when he became the third Director of the Stanford PULSE Institute. Matthias' research interests include ultrafast x-ray science, petahertz electronics, nanophotonics, and laser physics.

ACADEMIC APPOINTMENTS

- Professor, Photon Science Directorate
- Member, Bio-X
- Principal Investigator, Stanford PULSE Institute

ADMINISTRATIVE APPOINTMENTS

- Director, Stanford PULSE Institute, (2026- present)
- Professor of Photon Science & Applied Physics (by courtesy), Stanford University, (2021- present)
- Director, Science and R&D Division, LCLS, SLAC, (2021-2026)
- Max Planck Fellow, Max Planck Institute of Quantum Optics, Germany, (2019-2023)
- Professor of Physics, LMU Munich, Germany, (2013-2021)
- Assistant Professor of Physics, Kansas-State University, (2009-2013)
- Max Planck Group Leader, Max Planck Institute of Quantum Optics, Germany, (2007-2013)

HONORS AND AWARDS

- Oppenheimer Fellow, DOE National Laboratories (2025)
- OPTICA Fellow, OPTICA (2024)
- APS Fellow, American Physical Society (2019)
- Max Planck Fellow, Max Planck Society (2019)
- ERC Starting Grant, European Research Council (2013)
- Early Career Award, Department of Energy (2012)

- Heisenberg Fellow, German Research Foundation (2012)
- Nernst-Haber Bodenstein Prize, German Bunsen Society (2012)
- Roentgen Prize, Giessen University (2011)
- Emmy-Noether Fellow, German Research Foundation (2007)
- Marie-Curie Fellow, European Research Council (2004)
- Feodor-Lynen Fellow, Alexander von Humboldt foundation (2003)

PROFESSIONAL EDUCATION

- Ph.D., University of Goettingen, Germany , Physical Chemistry (2002)
- Certificate, Jena University, Germany , Laser Physics (2000)
- Diploma, University of Goettingen, Germany , Physics (1998)

LINKS

- Ultrafast Electronics and Nanophotonics Group: <https://uen.stanford.edu>
- LCLS/SLAC: <https://lcls.slac.stanford.edu/>
- Stanford PULSE Institute: <https://ultrafast.stanford.edu/>
- SLAC National Laboratory: <https://www6.slac.stanford.edu/>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

The fastest timescale of electron motion within nanostructures is attoseconds (1 attosecond = 10^{-18} seconds). We have pioneered the field attosecond nanophotonics and are currently conducting research to extend the state-of-the-art to multi-dimensional spectroscopies, x-ray emission and scattering using intense attosecond XFEL pulses. We aim to explore the dynamics of many-electron effects, including correlation-driven and collective effects.

A particularly important open question is the transition from many-body quantum physics to classical dynamics. This will largely impact applications of nanosystems in optoelectronic devices used in ultrafast electronics and computing. As an example, ultrafast plasmonic circuitry can overcome current limitations in resistive electronics and might open an avenue towards quantum computing at ambient temperature.

We also address the question, how aerosolized particles can enable and catalyze light-induced chemical processes. Reaction nanoscopy is a powerful method that is developed in our group for analyzing the surface chemistry on aerosols with nanometer spatial and femtosecond temporal resolution.

We aim to advance this technique to solve fundamental questions in astro- and atmospheric chemistry. Among these are the mechanisms of chemical transformations under extreme conditions, where such particles are exposed to high-intensity or high-energy radiation.

We aim to develop, expand, and exploit field-resolved spectroscopies towards higher frequencies in the THz and PHz domains. Opening up these frequency ranges will enable sensitivity to a manifold of vibrational and electronic transitions in organic electronics and 2D-materials. Field-resolved spectroscopy is a powerful technique that permits addressing the sub-cycle response of a solid to a lightfield. Exploring and controlling many-body excitations and scattering dynamics opens a path for optimized energy conversion in optoelectronic devices. The sub-cycle control of a device builds the basis for lightwave electronics, which may push the speed of computing to its ultimate limit.

We engage in the development of high-average and high-peak power ultrashort light sources. These include optical-parametric chirped pulse amplifiers (OPCPAs) driven by high-power fiber, thin-disk and Innoslab amplifiers. We focus on ultrashort few-cycle pulse generation in the visible and mid-infrared spectral region with stable and controllable electric field waveforms. The R&D efforts also include nonlinear tools for pulse characterization. Such

capabilities are instrumental in addition to the facility-based light sources in our research on ultrafast nanophotonics, lightwave electronics, and ultrafast x-ray science.

Teaching

COURSES

2024-25

- Electrons and Photons: APPPHYS 201, PHOTON 201 (Spr)

2023-24

- Synchrotron Radiation and Free Electron Lasers: Principles and Applications.: APPPHYS 325 (Aut)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Aaron Ghrist, Erik Isele

Postdoctoral Faculty Sponsor

Jonah Adelman, Chance Ornelas-Skarin

Doctoral Dissertation Advisor (AC)

Harrison Pasquinilli, Samuel Sahel-Schackis, Selene She, Kazuki Tayama, Shao Ci Wu

Doctoral (Program)

Sean O'Tool

Publications

PUBLICATIONS

- **Trihydrogen Formation on Gold Nanoparticles in Strong Laser Fields.** *Nano letters*
Dagar, R., Zhang, W., Rosenberger, P., Neuhaus, M., Bergues, B., Costa Vera, C., Kling, M. F.
2026
- **Imaging Valence Electron Rearrangement in a Chemical Reaction Using Hard X-Ray Scattering.** *Physical review letters*
Gabalski, I., Green, A., Lenzen, P., Allum, F., Bain, M., Bhattacharyya, S., Britton, M. A., Champenois, E. G., Cheng, X., Cryan, J. P., Driver, T., Forbes, R., Garratt, et al
2025; 135 (8): 083001
- **Imaging Valence Electron Rearrangement in a Chemical Reaction Using Hard X-Ray Scattering** *PHYSICAL REVIEW LETTERS*
Gabalski, I., Green, A., Lenzen, P., Allum, F., Bain, M., Bhattacharyya, S., Britton, M. A., Champenois, E. G., Cheng, X., Cryan, J. P., Driver, T., Forbes, R., Garratt, et al
2025; 135 (8)
- **Characterizing few-cycle UV resonant dispersive waves through direct field sampling** *OPTICS LETTERS*
Larsen, K. A., Lantigua, C., Kincaid, C., Allum, F., Britton, M., Castellanos, J., Kaufman, B., Neuhaus, M., Sylla, F., Kim, K., Bradforth, S. E., Kling, M. F., Robinson, et al
2025; 50 (16): 4962-4965
- **Multi-millijoule hollow-core fiber compression of short-wave infrared pulses to a single cycle** *OPTICS EXPRESS*
Bloechl, J., Kuthe, M. F., Schroeder, H., Azzeer, A. M., Nubbemeyer, T., Kling, M. F.
2025; 33 (13): 28071-28080
- **Light field-controlled PHz currents in intrinsic metals.** *Science advances*
Fehér, B., Hanus, V., Li, W., Pápa, Z., Budai, J., Paul, P., Szeghalmi, A., Wang, Z., Kling, M. F., Dombi, P.
2025; 11 (26): eadv5406

- **Attosecond inner-shell lasing at ångström wavelengths.** *Nature*
Linker, T. M., Halavanau, A., Kroll, T., Benediktovitch, A., Zhang, Y., Michine, Y., Chuchurka, S., Abhari, Z., Ronchetti, D., Fransson, T., Weninger, C., Fuller, F. D., Aquila, et al
2025
- **Stable high-energy proton acceleration with water-leaf targets driven by intense laser pulses** *PHYSICAL REVIEW RESEARCH*
He, L. R., Bachhammer, M., Balling, F., Biswas, S., Doyle, L., Gerlach, S., Hofrichter, I., Kharbedia, M., Liese, J., De Marco, M., Pohle, T., Prasselsperger, A., Schmidt, et al
2025; 7 (2)
- **Imaging the photochemistry of cyclobutanone using ultrafast electron diffraction: Experimental results.** *The Journal of chemical physics*
Green, A. E., Liu, Y., Allum, F., Graßl, M., Lenzen, P., Ashfold, M. N., Bhattacharyya, S., Cheng, X., Centurion, M., Crane, S. W., Forbes, R., Goff, N. A., Huang, et al
2025; 162 (18)
- **Burn parameters affect PAH emissions at conditions relevant for prescribed fires** *ATMOSPHERIC POLLUTION RESEARCH*
Topperwien, K., Vignat, G., Feinberg, A. J., Daube, C., Alton, M. W., Fortner, E. C., Canagaratna, M. R., Kling, M. F., Johnson, M., Nadeau, K., Herndon, S., Jayne, J. T., Ihme, et al
2025; 16 (5)
- **Attosecond XUV laser triggers smallest, shortest dance of electrons ever recorded** *LASER FOCUS WORLD*
Biswas, S., Kling, M.
2025; 61 (4): 14-17
- **Generation of fast photoelectrons in strong-field emission from metal nanoparticles** *NANOPHOTONICS*
Saydanzad, E., Powell, J., Renner, T., Summers, A., Rolles, D., Trallero-Herrero, C., Kling, M. F., Rudenko, A., Thumm, U.
2025
- **Generation of fast photoelectrons in strong-field emission from metal nanoparticles.** *Nanophotonics (Berlin, Germany)*
Saydanzad, E., Powell, J., Renner, T., Summers, A., Rolles, D., Trallero-Herrero, C., Kling, M. F., Rudenko, A., Thumm, U.
2025; 14 (9): 1355-1364
- **Ionization effects in single-shot carrier-envelope phase detection with gas-gap devices** *APPLIED PHYSICS LETTERS*
Blochl, J., Seeger, M. F., Schroeder, H., Zhan, M., Guggenmos, A., Nubbemeyer, T., Kling, M. F., Bergues, B.
2025; 126 (13)
- **Correlation-driven attosecond photoemission delay in the plasmonic excitation of C60 fullerene.** *Science advances*
Biswas, S., Trabattoni, A., Rupp, P., Magrakvelidze, M., Madjet, M. E., De Giovannini, U., Castrovilli, M. C., Galli, M., Liu, Q., Månsson, E. P., Schötz, J., Wanie, V., Wnuk, et al
2025; 11 (7): eads0494
- **Probing Electronic Coherence between Core-Level Vacancies at Different Atomic Sites** *PHYSICAL REVIEW X*
Wang, J., Driver, T.
2025; 15: 011008
- **Roadmap on basic research needs for laser technology** *JOURNAL OF OPTICS*
Kling, M. F., Menoni, C. S., Geddes, C., Galvanauskas, A., Albert, F., Kiani, L., Chini, M., Baker, L., Nelson, K. A., Young, L., Moses, J., Carbajo, S., Demos, et al
2025; 27 (1)
- **Petahertz electronics** *NATURE REVIEWS PHYSICS*
Heide, C., Keathley, P. D., Kling, M. F.
2024
- **Catalysis in Extreme Field Environments: A Case Study of Strongly Ionized SiO₂Nanoparticle Surfaces.** *Journal of the American Chemical Society*
Linker, T. M., Dagar, R., Feinberg, A., Sahel-Schackis, S., Nomura, K., Nakano, A., Shimojo, F., Vashishta, P., Bergmann, U., Kling, M. F., Summers, A. M.
2024
- **Tracking surface charge dynamics on single nanoparticles.** *Science advances*

Dagar, R., Zhang, W., Rosenberger, P., Linker, T. M., Sousa-Castillo, A., Neuhaus, M., Mitra, S., Biswas, S., Feinberg, A., Summers, A. M., Nakano, A., Vashishta, P., Shimojo, et al

2024; 10 (32): eadp1890

● **Attosecond delays in X-ray molecular ionization.** *Nature*

Driver, T., Moutney, M., Wang, J., Ortmann, L., Al-Haddad, A., Berrah, N., Bostedt, C., Champenois, E. G., DiMauro, L. F., Duris, J., Garratt, D., Glowina, J. M., Guo, et al

2024; 632 (8026): 762-767

● **Waveform retrieval for ultrafast applications based on convolutional neural networks** *APL MACHINE LEARNING*

Altwaijry, N., Coffee, R., Kling, M. F.

2024; 2 (2)

● **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., Glowina, J. M., Cheng, X., Hoffmann, et al

2024

● **Light-wave-controlled Haldane model in monolayer hexagonal boron nitride.** *Nature*

Mitra, S., Jiménez-Galán, Á., Aulich, M., Neuhaus, M., Silva, R. E., Pervak, V., Kling, M. F., Biswas, S.

2024

● **Experimental demonstration of attosecond pump-probe spectroscopy with an X-ray free-electron laser** *NATURE PHOTONICS*

Guo, Z., Driver, T., Beauvarlet, S., Cesar, D., Duris, J., Franz, P. L., Alexander, O., Bohler, D., Bostedt, C., Averbukh, V., Cheng, X., Dimauro, L. F., Doumy, et al

2024

● **Far-Field Petahertz Sampling of Plasmonic Fields.** *Nano letters*

Wong, K. F., Li, W., Wang, Z., Wan, V., Månsson, E., Hoeing, D., Blöchl, J., Nubbemeyer, T., Azzeer, A., Trabattoni, A., Lange, H., Calegari, F., Kling, et al

2024

● **Sensitivity Enhancement in Photoconductive Light Field Sampling** *ADVANCED OPTICAL MATERIALS*

Altwaijry, N., Qasim, M., Zimin, D., Karpowicz, N., Kling, M. F.

2024

● **Propagation effects in polarization-gated attosecond soft-X-ray pulse generation.** *Optics express*

Mitra, S., Schotz, J., Zhang, C., Hyuk Ko, D., Chang, Z., Corkum, P. B., Staudte, A., Kling, M. F.

2024; 32 (2): 1151-1160

● **From Ultrafast Light-Induced Currents to Spatially-Resolved Field Sampling**

Bloechl, J., Schoetz, J., Bergues, B., Kling, M. F.

edited by Chini, M., Argenti, L., Fang, L.

SPRINGER INTERNATIONAL PUBLISHING AG.2024: 177-186

● **49 W carrier-envelope-phase-stable few-cycle 2.1 & mu;m OPCPA at 10 kHz** *OPTICS EXPRESS*

Seeger, M. F., Kammerer, D., Bloechl, J., Neuhaus, M., Pervak, V., Nubbemeyer, T., Kling, M. F.

2023; 31 (15): 24821-24834

● **Resonance Effect in Brunel Harmonic Generation in Thin Film Organic Semiconductors** *ADVANCED OPTICAL MATERIALS*

Li, W., Saleh, A., Sharma, M., Huenecke, C., Sierka, M., Neuhaus, M., Hedewig, L., Bergues, B., Alharbi, M., ALQahtani, H., Azzeer, A. M., Graefe, S., Kling, et al

2023

● **Enhanced cutoff energies for direct and rescattered strong-field photoelectron emission of plasmonic nanoparticles.** *Nanophotonics (Berlin, Germany)*

Saydanzad, E., Powell, J., Summers, A., Robotjazi, S. J., Trallero-Herrero, C., Kling, M. F., Rudenko, A., Thumm, U.

2023; 12 (10): 1931-1942

● **Reaction nanoscopy of ion emission from sub-wavelength propanediol droplets.** *Nanophotonics (Berlin, Germany)*

Rosenberger, P., Dagar, R., Zhang, W., Majumdar, A., Neuhaus, M., Ihme, M., Bergues, B., Kling, M. F.

2023; 12 (10): 1823-1831

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- **Enhanced cutoff energies for direct and rescattered strong-field photoelectron emission of plasmonic nanoparticles** *NANOPHOTONICS*
Saydanzad, E., Powell, J., Summers, A., Robatjazi, S., Trallero-Herrero, C., Kling, M. F., Rudenko, A., Thumm, U.
2023
 - **Reaction nanoscopy of ion emission from sub-wavelength propanediol droplets** *NANOPHOTONICS*
Rosenberger, P., Dagar, R., Zhang, W., Majumdar, A., Neuhaus, M., Ihme, M., Bergues, B., Kling, M. F.
2023
 - **Linear and Nonlinear Optical Properties of Iridium Nanoparticles Grown via Atomic Layer Deposition** *COATINGS*
Schmitt, P., Paul, P., Li, W., Wang, Z., David, C., Daryakar, N., Hanemann, K., Felde, N., Munser, A., Kling, M. F., Schroeder, S., Tuennermann, A., Szeghalmi, et al
2023; 13 (4)
 - **Light-Induced Subnanometric Modulation of a Single-Molecule Electron Source.** *Physical review letters*
Yanagisawa, H., Bohn, M., Kitoh-Nishioka, H., Goschin, F., Kling, M. F.
2023; 130 (10): 106204
 - **Ion microscopy with evolutionary-algorithm-based autofocusing** *ENGINEERING RESEARCH EXPRESS*
Haniel, F. E., Hedewig, L., Schroeder, H., Kling, M. F., Bergues, B.
2023; 5 (1)
 - **Broadband Photoconductive Sampling in Gallium Phosphide** *ADVANCED OPTICAL MATERIALS*
Altwayry, N., Qasim, M., Mamaikin, M., Schoetz, J., Golyari, K., Heynck, M., Ridente, E., Yakovlev, V. S., Karpowicz, N., Kling, M. F.
2023
 - **Ultrafast quantum dynamics driven by the strong space-charge field of a relativistic electron beam** *OPTICA*
Cesar, D., Acharya, A., Cryan, J. P., Kartsev, A., Kling, M. F., Lindenberg, A. M., Pemmaraju, C. D., Poletayev, A. D., Yakovlev, V. S., Marinelli, A.
2023; 10 (1): 1-10
 - **Strong-field physics with nanospheres** *ADVANCES IN PHYSICS-X*
Seiffert, L., Zharebtsov, S., Kling, M. F., Fennel, T.
2022; 7 (1)
 - **Relaxation dynamics in excited helium nanodroplets probed with high resolution, time-resolved photoelectron spectroscopy** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
LaForge, A. C., Asmussen, J. D., Bastian, B., Bonanomi, M., Callegari, C., De, S., Di Fraia, M., Gorman, L., Hartweg, S., Krishnan, S. R., Kling, M. F., Mishra, D., Mandal, et al
2022: 28844-28852
 - **Strong-Field Control of Plasmonic Properties in Core-Shell Nanoparticles** *ACS PHOTONICS*
Powell, J. A., Li, J., Summers, A., Robatjazi, S., Davino, M., Rupp, P., Saydanzad, E., Sorensen, C. M., Rolles, D., Kling, M. F., Trallero, C., Thumm, U., Rudenko, et al
2022
 - **Complementary dispersive mirror pair produced in one coating run based on desired non-uniformity** *OPTICS EXPRESS*
Chen, Y., Li, W., Wang, Z., Hahner, D., Kling, M. F., Pervak, V.
2022; 30 (18): 32074-32083
 - **Spatiotemporal sampling of near-petahertz vortex fields** *OPTICA*
Bloechl, J., Schoetz, J., Maliakkal, A., Sreibere, N., Wang, Z., Rosenberger, P., Hommelhoff, P., Staudte, A., Corkum, P. B., Bergues, B., Kling, M. F.
2022; 9 (7): 755-761
 - **Imaging elliptically polarized infrared near-fields on nanoparticles by strong-field dissociation of functional surface groups** *EUROPEAN PHYSICAL JOURNAL D*
Rosenberger, P., Dagar, R., Zhang, W., Sousa-Castillo, A., Neuhaus, M., Cortes, E., Maier, S. A., Costa-Vera, C., Kling, M. F., Bergues, B.
2022; 76 (6)
 - **All-optical nanoscopic spatial control of molecular reaction yields on nanoparticles** *OPTICA*
Zhang, W., Dagar, R., Rosenberger, P., Sousa-Castillo, A., Neuhaus, M., Li, W., Khan, S. A., Alnaser, A. S., Cortes, E., Maier, S. A., Costa-Vera, C., Kling, M. F., Bergues, et al

2022; 9 (5): 551-560

- **Fifth-order nonlinear optical response of Alq(3) thin films** *RESULTS IN PHYSICS*
Saleh, A., Li, W., ALQahtani, H., Neuhaus, M., Alshehri, A., Bergues, B., Alharbi, M., Kling, M. F., Azzeer, A. M., Wang, Z., Alharbi, A. F.
2022; 37
- **Few-femtosecond resolved imaging of laser-driven nanoplasma expansion** *NEW JOURNAL OF PHYSICS*
Peltz, C., Powell, J. A., Rupp, P., Summers, A., Gorkhover, T., Gallei, M., Halfpap, Antonsson, E., Langer, B., Trallero-Herrero, C., Graf, C., Ray, D., Liu, Q., et al
2022; 24 (4)
- **Electro-optic characterization of synthesized infrared-visible light fields** *NATURE COMMUNICATIONS*
Ridente, E., Mamaikin, M., Altwaijry, N., Zimin, D., Kling, M. F., Pervak, V., Weidman, M., Krausz, F., Karpowicz, N.
2022; 13 (1): 1111
- **The emergence of macroscopic currents in photoconductive sampling of optical fields.** *Nature communications*
Schotz, J., Maliakkal, A., Blochl, J., Zimin, D., Wang, Z., Rosenberger, P., Alharbi, M., Azzeer, A. M., Weidman, M., Yakovlev, V. S., Bergues, B., Kling, M. F.
2022; 13 (1): 962
- **Attosecond coherent electron motion in Auger-Meitner decay.** *Science (New York, N.Y.)*
Li, S., Driver, T., Rosenberger, P., Champenois, E. G., Duris, J., Al-Haddad, A., Averbukh, V., Barnard, J. C., Berrah, N., Bostedt, C., Bucksbaum, P. H., Coffee, R. N., DiMauro, et al
1800: eabj2096
- **Efficient nonlinear compression of a thin-disk oscillator to 8.5 fs at 55 W average power** *OPTICS LETTERS*
Barbiero, G., Wang, H., Grassl, M., Groebmeyer, S., Kimbaras, D., Neuhaus, M., Pervak, V., Nubbemeyer, T., Fattahi, H., Kling, M. F.
2021; 46 (21): 5304-5307
- **Onset of charge interaction in strong-field photoemission from nanometric needle tips** *NANOPHOTONICS*
Schoetz, J., Seiffert, L., Maliakkal, A., Bloechl, J., Zimin, D., Rosenberger, P., Bergues, B., Hommelhoff, P., Krausz, F., Fennel, T., Kling, M. F.
2021; 10 (14): 3769-3775
- **Tunable isolated attosecond X-ray pulses with gigawatt peak power from a free-electron laser** *NATURE PHOTONICS*
Duris, J., Li, S., Driver, T., Champenois, E. G., MacArthur, J. P., Lutman, A. A., Zhang, Z., Rosenberger, P., Aldrich, J. W., Coffee, R., Coslovich, G., Decker, F., Glowina, et al
2020; 14 (1): 30-+
- **Attosecond transient absorption spooktroscopy: a ghost imaging approach to ultrafast absorption spectroscopy.** *Physical chemistry chemical physics : PCCP*
Driver, T., Li, S., Champenois, E. G., Duris, J., Ratner, D., Lane, T. J., Rosenberger, P., Al-Haddad, A., Averbukh, V., Barnard, T., Berrah, N., Bostedt, C., Bucksbaum, et al
2019
- **Generation and Characterization of Attosecond Pulses from an X-ray Free-electron Laser**
Li, S., Rosenberger, P., Champenois, E. G., Driver, T., Bucksbaum, P. H., Coffee, R., Gatton, A., Hartmann, G., Helml, W., Huang, Z., Knurr, J., Kling, M. F., Lin, et al
IEEE.2019
- **Roadmap on plasmonics** *JOURNAL OF OPTICS*
Stockman, M. I., Kneipp, K., Bozhevolnyi, S. I., Saha, S., Dutta, A., Ndukaife, J., Kinsey, N., Reddy, H., Guler, U., Shalaev, V. M., Boltasseva, A., Gholipour, B., Krishnamoorthy, et al
2018; 20 (4)