Bio

Dr. Shambhu Ghimire is a principal investigator at Stanford PULSE Institute in SLAC National Accelerator Laboratory. Ghimire leads the Attosecond X-ray Photonics Group. He is a recipient of the Young Investigator award from the Office of Science, U.S. Department of Energy. His research interests are on strong-field and attosecond electron dynamics. He received his PhD in physics from Kansas State University in 2007 and went to University of Michigan for a post-doc work before joining SLAC in 2009.

CURRENT ROLE AT STANFORD
Principal Investigator in a DOE-funded research area: High-order Harmonic Generation (HHG)

INSTITUTE AFFILIATIONS
• Member, Stanford PULSE Institute

HONORS AND AWARDS

EDUCATION AND CERTIFICATIONS
• Ph.D, Kansas State University , Physics (2007)
• Post-doctoral, University of Michigan , Ultrafast Science (2009)

LINKS
• Research Group Page: https://ultrafast.stanford.edu/hhg-frontier-high-order-harmonic-generation
• Full publication list: https://scholar.google.com/citations?user=u7__4foAAAAJ&hl=en

Professional

PROFESSIONAL INTERESTS
My research interests are in ultrafast condensed matter, atomic, molecular and optical physics. In our experiments, we use high-intensity ultrafast laser systems in table-top settings, as well as X-ray free-electron lasers such as the Linac Coherent Light Source (LCLS). Recently, we are studying non-linear optical response of quantum materials such as two-dimensional crystals, topological insulators and Weyl semi-metals. We are particularly interested in the regime where the strength of the light-field approaches the interatomic binding strengths in these materials. In this regime, the typical approximations of conventional nonlinear optics breakdown spectacularly, and we enter into the regime of strong-field physics and attosecond science. In this regime, materials respond to the intense laser-field by producing
its high-order harmonics. We first identified this regime by observing high-order harmonics from zinc oxide crystals subjected to intense mid-infrared laser fields in 2010. Since then there has been a lot of exciting work in the field, which includes the use of microscopic generation mechanism to probe valence charge distributions, electronic band structure, Berry curvature, and topological phase transitions.

Publications

PUBLICATIONS

- Proposal for High-Energy Cutoff Extension of Optical Harmonics of Solid Materials Using the Example of a One-Dimensional ZnO Crystal. Physical review letters
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- Probing topological phase transitions using high-harmonic generation NATURE PHOTONICS
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- Probing electron-hole coherence in strongly driven 2D materials using high-harmonic generation OPTICA
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- Probing attosecond phenomena in solids NATURE PHOTONICS
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- All-Optical Probe of Three-Dimensional Topological Insulators Based on High-Harmonic Generation by Circularly Polarized Laser Fields. Nano letters
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- Strong-field physics in three-dimensional topological insulators PHYSICAL REVIEW A
  Baykusheva, D., Chacon, A., Kim, D., Kim, D., Reis, D. A., Ghimire, S.
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- The effect of photo-carrier doping on the generation of high harmonics from MoS2
  IEEE.2021

- Attosecond synchronization of extreme ultraviolet high harmonics from crystals JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS
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- Attosecond science based on high harmonic generation from gases and solids. Nature communications
  Li, J., Lu, J., Chew, A., Han, S., Li, J., Wu, Y., Wang, H., Ghimire, S., Chang, Z.
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- Strong-field physics in three-dimensional topological insulators Strong-field physics in three-dimensional topological insulators
  Baykusheva, D., et al
  2020

- High-harmonic generation from an epsilon-near-zero material NATURE PHYSICS
  2019; 15 (10): 1022+-

- Interferometry of dipole phase in high harmonics from solids NATURE PHOTONICS
  Lu, J., Cunningham, E. F., You, Y., Reis, D. A., Ghimire, S.
  2019; 13 (2): 96+-

- Crystal orientation-dependent polarization state of high-order harmonics OPTICS LETTERS
You, Y., Lu, J., Cunningham, E. F., Roedel, C., Ghimire, S.
2019; 44 (3): 530–33

• High-harmonic generation from solids  *NATURE PHYSICS*
Ghimire, S., Reis, D. A.
2019; 15 (1): 10–16

• High-Harmonic Generation from Topological Insulators
IEEE.2019

• Probing periodic potential of crystals via strong-field re-scattering  *JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS*
You, Y., Cunningham, E., Reis, D. A., Ghimire, S.
2018; 51 (11)

• Locking the waveform with a quartz crystal  *NATURE PHOTONICS*
Ghimire, S.
2018; 12 (5): 256–57

• Polarimetry of High Harmonics in Bulk Crystals
You, Y., Cunningham, E., Rodel, C., Reis, D. A., Ghimire, S., IEEE
IEEE.2018

• Emission Phase of Extreme Ultraviolet High Harmonics from Bulk Crystals
Lu, J., You, Y., Reis, D. A., Ghimire, S., IEEE
IEEE.2018

• Orientation dependence of temporal and spectral properties of high-order harmonics in solids  *PHYSICAL REVIEW A*
Wu, M., You, Y., Ghimire, S., Reis, D. A., Browne, D. A., Schafer, K. J., Gaarde, M. B.
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• High-harmonic generation in amorphous solids  *NATURE COMMUNICATIONS*
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• Laser waveform control of extreme ultraviolet high harmonics from solids  *OPTICS LETTERS*
You, Y. S., Wu, M., Yin, Y., Chew, A., Ren, X., Gholam-Mirzaei, S., Browne, D. A., Chini, M., Chang, Z., Schafer, K. J., Gaarde, M. B., Ghimire, S.
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• Anisotropic high-harmonic generation in bulk crystals  *NATURE PHYSICS*
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• High-harmonic generation from an atomically thin semiconductor  *NATURE PHYSICS*
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• Phase-coherence of high-order harmonics from bulk crystals using homodyne detection
Cunningham, E., You, Y., Reis, D. A., Ghimire, S., IEEE
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• High-order harmonics from bulk and 2D crystals
IEEE.2017

• Waveform control of high-harmonic generation in solids
IEEE.2017

• Nonsequential two-photon absorption from the K shell in solid zirconium  *PHYSICAL REVIEW A*
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- Solid-state harmonics beyond the atomic limit *NATURE*
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- High harmonics from solids probe Angstrom scale structure
  You, Y., Reis, D. A., Ghimire, S., IEEE
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- Anomalous nonlinear X-ray Compton scattering *NATURE PHYSICS*
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- High-harmonic generation from Bloch electrons in solids *PHYSICAL REVIEW A*
  Wu, M., Ghimire, S., Reis, D. A., Schafer, K. J., Gaarde, M. B.
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- Strong-field and attosecond physics in solids *JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS*
  2014; 47 (20)

- Measurement of coherence Lengths of Below Threshold Harmonics in Solid Argon
  Ndabashimiye, G., Ghimire, S., Nicholson, D., Reis, D. A., IEEE
  IEEE.2013

- Generation and propagation of high-order harmonics in crystals *PHYSICAL REVIEW A*
  2012; 85 (4)

- Scaling of High-Order Harmonic Generation in the Long Wavelength Limit of a Strong Laser Field *IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS*
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- High-order harmonic generation in solid argon *Conference on Lasers and Electro-Optics (CLEO)*
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- Redshift in the Optical Absorption of ZnO Single Crystals in the Presence of an Intense Midinfrared Laser Field *PHYSICAL REVIEW LETTERS*
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  2011; 99 (14)

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- Observation of high-order harmonic generation in a bulk crystal *NATURE PHYSICS*
  Ghimire, S., DiChiara, A. D., Sistrunk, E., Agostini, P., DiMauro, L. F., Reis, D. A.
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