

Zhanybek Alpichshev CV

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EDUCATION **Stanford University**, Stanford, CA
Ph.D., 2012, Physics,
Advisor: Aharon Kapitulnik
Thesis: *STM and STS studies of electronic states near macroscopic defects in Bi_2Te_3 and Bi_2Se_3*
Moscow Institute of Physics and Technology (MIPT), Moscow, Russia
B.S., 2005, Department of General and Applied Physics,
Landau Institute of Theoretical Physics

PUBLICATIONS

- *9. “The origin of exciton mass in a frustrated Mott insulator Na_2IrO_3 ”
Zhanybek Alpichshev, E. J. Sie, F. Mahmood, G. Cao, N. Gedik, arXiv:1610.09350 (2016) (*to be submitted*) [link](#)
8. “Disorder enabled band structure engineering of a topological insulator surface”
Y. Xu, J. Chiu, L. Miao, H. He, Zhanybek Alpichshev, A. Kapitulnik, R. R. Biswas, L. A. Wray, (*accepted to **Nature Communications***)
7. “Selective scattering between Floquet-Bloch and Volkov states in a topological insulator”
F. Mahmood, C.-K. Chan, Zhanybek Alpichshev, D. Gardner, Y. Lee, P. A. Lee, N. Gedik, **Nature Physics**, 12, 306 (2016) [link](#)
6. “Ultrafast dynamics in the presence of antiferromagnetic correlations in electron-doped cuprate $La_{2-x}Ce_xCuO_{4\pm\delta}$ ”
I. M. Vishik, F. Mahmood, Zhanybek Alpichshev, J. Higgins, R. L. Greene, N. Gedik, arXiv:1601.06694(2016) (*submitted to **Physical Review B***) [link](#)
5. “The rate of quasiparticle recombination probes the onset of coherence in cuprate superconductors”
Hinton, J. P.; Thewalt, E.; Zhanybek Alpichshev; Mahmood, F.; Koralek, J. D.; Chan, M. K.; Veit, M. J.; Dorow, C. J.; Barii, N.; Kemper, A. F.; Bonn, D. A.; Hardy, W. N.; Liang, Ruixing; Gedik, N.; Greven, M.; Lanzara, A.; Orenstein, J., **Scientific Reports**, 6, 23610 (2016) [link](#)
- *4. “Confinement-Deconfinement Transition as an Indication of Spin-Liquid-Type Behavior in Na_2IrO_3 ”
Zhanybek Alpichshev, Fahad Mahmood, Gang Cao, Nuh Gedik, **Physical Review Letters**, 114, 017203 (2015) [link](#)
- *3. “STM Imaging of Impurity Resonances on Bi_2Se_3 ”
Zhanybek Alpichshev, Rudro R. Biswas, Alexander V. Balatsky, J. G. Analytis, J.-H. Chu, I. R. Fisher, A. Kapitulnik, **Physical Review Letters**, 108, 206402 (2012) [link](#)

- *2. “STM imaging of a bound state along a step on the surface of the topological insulator Bi_2Te_3 ”
Zhanybek Alpichshev, J. G. Analytis, J.-H. Chu, I. R. Fisher, A. Kapitulnik, **Physical Review B**, 84, 041104 (2011) [link](#)
- *1. “STM Imaging of Electronic Waves on the Surface of Bi_2Te_3 : Topologically Protected Surface States and Hexagonal Warping Effects”
Zhanybek Alpichshev, J. G. Analytis, J.-H. Chu, I. R. Fisher, Y. L. Chen, Z. X. Shen, A. Fang, A. Kapitulnik, **Physical Review Letters**, 104, 016401 (2010) [link](#)

AWARDS AND HONORS

- Albion W. Hewlett Stanford Graduate Fellowship, (2008-2010)
- Joseph McCormick Fellowship, (2006)
- “Dynasty Foundation” Fellowship (2005)
- Landau Fellowship, *Landau Institute for Theoretical Physics* (2002)
- “Altyn Belgi” (*Government award for exceptional performance at high school*), *Kazakhstan* (2000)
- Bronze Medal, I APhO, *Jakarta, Indonesia* (2000)
- Bronze Medal, XXIX IPhO, *Padua, Italy* (1999)
- 1st prize, *National High School Physics Olympiad, Kazakhstan* (1998, 1999)

RESEARCH EXPERIENCE

- Gedik Ultrafast Optics Group**, MIT Cambridge, MA
Postdoctoral Scholar Oct. 2012 to present
- Time-resolved study of strongly correlated materials.
 - Discovered spin liquid type behavior in Na_2IrO_3 through observation of confinement-deconfinement transition of excitations
 - Direct observation of a quasiparticle mass enhancement in a frustrated Mott insulator
 - Direct observation of spin dynamics in hybrid lead halide perovskite $(\text{CH}_3\text{NH}_3)\text{PbI}_3$ in external magnetic field
 - Constructed Transient Grating pump-probe setup suitable for work with magnetic field.
 - Observation of magnetic field-tuned binding energy change of a Hubbard exciton in $\alpha\text{-RuCl}_3$
 - Constructed a three-pulse non-degenerate pump-probe setup for understanding non-equilibrium processes in frustrated systems.

- KGB (Kapitulnik) group**, Stanford University Stanford, CA
Graduate Student Researcher Sept. 2005 to Aug. 2012

- Scanning Tunneling Microscopy and Spectroscopy on Topological Insulators.
 - Discovered the absence of back-scattering of surface state quasiparticles in topological insulators.
 - Discovered resonance states near “triangular defects” on the surface of Bi_2Se_3 consistent with relativistic behavior of surface state quasiparticles.

- Proved the existence of topological surface state on the disordered side surface of a topological insulator through scanning tunneling spectroscopy of local density of states near step edge on the surface of Bi_2Te_3 .
- Developed an approximate method for calculating the local surface density of states of a topological insulator near sharp surface edges. Using this model extracted the contribution of Dirac quasiparticles from the total in-gap density of states and resolved the issue of the energy dependence of tunneling density of states in realistic topological insulators.
- Redesigned and rebuilt the home-built lab STM system.
- Designed and built a geophone based noise cancellation system for an STM achieving a factor of 5 reduction in noise amplitude.

TEACHING
EXPERIENCE

Department of Physics, Stanford University Stanford, CA

Teaching Assistant for PHYSICS 108 “Advanced Physics Laboratory: Project”
Winter Quarter, 2011-2012

- Supervised the design, construction and execution of a low-temperature lab student project (“Observation of λ -transition in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ”)

Department of Physics, Stanford University Stanford, CA

Teaching Assistant for PHYSICS 108 “Advanced Physics Laboratory: Project”
Winter Quarter, 2005-2006

- Supervised the design, construction and execution of a low-temperature lab student project (“Observation of AC Josephson Effect”)

Department of Physics, Stanford University Stanford, CA

Teaching Assistant for PHYSICS 41 “Mechanics” Winter Quarter, 2005-2006

- Led weekly discussion section
- Tutored students during weekly “Reference Frame” help room sessions
- Graded midterm exams, final exam, and weekly problem sets

“Fiztekh-Kolledzh”, Moscow, Russia

Physics Instructor for “Mechanics” 2005

- Weekly after-school classes for high-school students

INVITED TALKS

- “Non-equilibrium dynamics of a frustrated Mott insulator” University of Arkansas, Fayetteville, AR (March 2016)
- “Non-equilibrium dynamics of a frustrated Mott insulator” Harvard University, Cambridge, MA (February 2016)
- “Non-equilibrium dynamics of a frustrated Mott insulator” University of Chicago, Chicago, IL (February 2016)

- “Non-equilibrium dynamics of a frustrated Mott insulator” University of Minnesota, Minneapolis, MN (February 2016)
 - “Non-equilibrium dynamics of a frustrated Mott insulator” UC Davis, Davis, CA (January 2016)
 - “Confinement-deconfinement transition in the magnetically frustrated Mott insulator Na_2IrO_3 ,” *APCTP - Quantum Materials Symposium*, Korea (February 2015)
 - “Frustrated magnetism and confinement-deconfinement transition in the magnetically frustrated Mott insulator Na_2IrO_3 ,” *Harvard Condensed Matter Theory Kid’s Seminars*, Harvard University, Cambridge, MA (February 2015)
 - “Confinement and deconfinement of topological excitations Na_2IrO_3 ,” *Gordon Research Seminars*, Mount Holyoke College; South Hadley, MA (June 2014)
 - “Evidence of a spin liquid behavior and confinement-deconfinement transition in a frustrated Mott insulator Na_2IrO_3 ,” *Center for Energy Research*, Nazarbayev University; Astana, Kazakhstan (May 2014)
 - “STM and STS studies of electronic states near macroscopic defects in topological insulators” *APS March Meeting*, Dallas, Texas (March 2011)
- CONTRIBUTED TALKS AND POSTERS
- “Confinement and deconfinement of topological excitations in Na_2IrO_3 ,” *APS March Meeting*, Denver, CO (March 2014)
 - “STM imaging of impurity resonances on Bi_2Se_3 ,” *APS March Meeting*, Boston, MA (February 2012)
 - “STM and STS studies of electronic states near macroscopic defects in topological insulators,” *Workshop and School on Topological Aspects of Condensed Matter Physics*, ICTP; Trieste, Italy (June-July 2011)
 - “STM Imaging of Electronic Waves on the Surface of Bi_2Te_3 : Topologically Protected Surface States and Hexagonal Warping Effects,” *Gordon Research Conference on Correlated Electron Systems*, Mount Holyoke College; South Hadley, MA (June 2010)
 - “STM imaging of electronic waves on the surface of Bi_2Te_3 : Na_2IrO_3 ,” *APS March Meeting*, Portland, OR (March 2010)
 - “Using a Geophone for Vibration Cancellation in a STMs,” (with A. Fang) *APS March Meeting*, New Orleans, LA (March 2008)
- PRESS COVERAGE
- The work on Topologically Protected Surface States and Hexagonal Warping Effects Bi_2Te_3 was selected as a cover story for *Physical Review Letters* and was reviewed in *Nature Physics News and Views* section ([link](#))
- PROFESSIONAL ACTIVITIES
- Refereed papers for **Physical Review Letters**, **Nature Communications** and **Journal of Applied Physics**.
- LABORATORY SKILLS
- Operation and maintenance of ultrafast laser systems
 - Operation and maintenance of a Scanning Tunneling Microscope
 - Computer control of instruments and data acquisition using LabView
 - Low-temperature and ultra-high vacuum equipment design and techniques

- Analog electronic equipment design and building
- Basic machining (drill press, milling, lathe, etc.)

REFERENCES

Aharon Kapitulnik

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Stanford University
aharonk@stanford.edu

Nuh Gedik

Biedenharn Career Development Associate Professor of Physics
Massachusetts Institute of Technology
gedik@mit.edu

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Steven Kivelson

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