ZAHRA SHOMALI

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Homepage/ Linkedin/ Google Scholar/ Orcid/ Scopus/ ResearchGate/ Youtube

Positions:

Assistant Professor (September 2019-present)
Department of Physics, Condensed Matter Group
Tarbiat Modares University, Tehran, Iran

Postdoctoral Researcher (2017-2019)
Working on: "Nano-scale electron/phonon transport" Department of Physics,
Institute for Research in Fundamental Science (IPM), Tehran, Iran

Postdoctoral Researcher (2014-2017)
Working on: "Investigation of non-Fourier heat transfer in new generation of transistors"
Department of Mechanical Engineering
Amirkabir University of Technology, Tehran, Iran
http://rtms.insf.org/ProposalCertificate.php?ID=GVKLS72OEOD78W&Print=

Guest visitor (Sep 2008 - Oct 2008; Feb 2011 – Apr 2011)
Department of Physics, Universität Konstanz, *Konstanz, Germany.*

Education:

PhD, Direct Ph.D. Course of Physics *(June 2014)*
Institute for Advanced Studies in Basic Sciences, Zanjan, Iran
PhD thesis grade: **Excellent**
Thesis title: ***"****Non-Fourier Heat Transfer Modeling in Nanoscale"*
- Being accepted simultaneously in two fields of Electrical Engineering of Tehran University and the Direct Ph.D. Course of Physics at Institute for Advanced Studies in Basic Sciences (IASBS) in National University Entrance Exam, I chose **Direct Ph.D. Course of Physics**.

A Little About Direct Ph.D. Course of Physics*:* This program has started since September 1999, in Institute for Advanced Studies in Basic Sciences (IASBS), for the first time in Iran. The students, which wanted to attend in this program, ought to be in the first thousand of students in the entrance exam of universities, which taking each year by ministry of science in Iran (total number of attendees are about 500,000). This program consists of two major parts, in the first 4-5 years one should pass the courses, which cover BSc, MSc and PhD course. In the next years one work on its PhD thesis. In brief, it starts after high school and finishes by PhD. Up to now it has only 16 graduates in Iran.

Junior School & High School at **Farzanegan** (One of the branches of the Nodet, National Organization for Development of Exceptional Talents), Zanjan, Iran.

Research Interests:

Nanoscale Heat transfer

• Applying of macroscopic methods in thermal transport
• Atomistic method usage in transistors
• Heat transfer in low dimensional systems
• Investigation of transistors with two dimensional channels
• Phonon engineering
• Deep learning algorithms development for micro/nano scale heat transfer
• Thermoelectric materials and TEGs
• Bio heat transfer

Superconductor/ferromagnet hybrid structures

• Long-range triplet supercurrents and Spin supercurrents
• Spin-transfer torque in ferromagnetic systems with nonhomogeneous magnetization
• Triplet ferromagnetic superconductor heterostructures
• Nano transport in low dimensional systems

Computational condensed matter physics

• Quantum circuit theory method Superconductivity: Proximity and Josephson effects

Peer-Reviewing Experience:

- Applied Energy
- Advances in Alzheimer's Disease
- Advances in Nano Research
- Case Studies in Thermal Engineering
- Current Applied Physics
- Energy
- International Journal of Heat and Mass Transfer
- International Communication in Heat and Mass Transfer
- International Journal of Thermal Sciences
- Journal of Physics Communication
- Journal of Physics Condensed Matter
- Nanotechnology
- Nature Communication
- Physica Scripta
- Scientific Reports
- Superconductor Science and Technology
- Superlattices and microstructures

Honors:

- **Outstanding Reviewer Award** for Journal of Physics: Condensed Matter, Awarded April (2022)
- Awarded **IOP Trusted Reviewer status** (2021)
- Received **Kazemi Ashtiani's Award for Young Assistant Professors** (2020)

- **Iran nanotechnology initiative council Award** for the outstanding work “Spin-Transfer and Exchange Torques in Ferromagnetic Superconductors” (2015).
- Graduate Student **Poster Award** "15th Annual IASBS Meeting on Condensed Matter Physics", Zanjan (2009)
- Being accepted as a student of Electrical Engineering in Tehran University & Introduced as an **exceptional talent** (September 2003)
- **Ranked 191** out of more than 500,000 participants in entrance exams of universities (2003)
- Top student of Junior & High School (1997- 2003)

Teaching Experiences:

- Assistant professor, Condensed Matter Physics, February 2024- June 2024
- Assistant professor, Introduction to Machine Learning, February 2024- June 2024
- Assistant professor, Numerical modelling and simulation in condensed matter, September 2023- January 2023
- Assistant professor, Computational Physics, February 2020-June 2020.
- Assistant professor, Many-body theory in condensed matter physics, February 2020-June 2023.
- Assistant professor, Advanced Electrodynamic, September 2019- September 2022/ January 2020- January 2023.
- Lecturer Of the course General Physics II, Zanjan University, Autumn 2011- Summer 2012.
- Lecturer of courses Thermodynamics and Statistical Physics I, II, General Physics I, II, and Numerical methods, Islamic Azad University of Zanjan, Autumn 2011-Summer 2012.
- Teaching assistant and Lecturer for Some sessions of Graduate course Advanced Solid State I, II,III IASBS, Spring 2010-Winter 2011.
- Lecturer for Some sessions of Graduate Course Superconductivity, IASBS, Winter 2011.
-Teaching assistant of Graduate Course Advanced Quantum Mechanics IASBS, Autumn 2006-Winter 2009.
- Research Assistant, IASBS, March 2008- March 2010.

Publications:

1- S.A. Sulaiman, and **Z. Shomali**, Non-locality detection in nano-semiconductors based on lagging models. **arXiv preprint** arXiv:2412.10962, 2025.

2- R. Baratifarimani, and **Z. Shomali**, Size effects on non-local heat transfer in one-dimensional and quasi-one-dimensional MOSFET channels, **The Iranian Journal of Physics Research (IJPR),** accepted.

3- A. Bahadori, and **Z. Shomali**, A comparative study of thermoelectric materials of SnSSe and SnS_2 using the Monte-Carlo simulation of phonon Boltzmann equation, **Case Studies in Thermal Engineering, 57, 104377 (2024)**

4- R. Baratifarimani, and **Z. Shomali**, Implementation of nonlocal non-Fourier heat transfer for semiconductor nanostructures. **Case Studies in Thermal Engineering, 54, 104015 (2024).**

5- **Z. Shomali**, An investigation into the reliability of newly proposed $MoSi_2N_4/WSi_2N_4$ field-effect transistors: A Monte Carlo study, **Micro and Nanostructures, 182, 207648 (2023).**

6- M. H. Fotovvat, **Z. Shomali**, A time-fractional dual-phase-lag framework to investigate transistors with TMTC channels (TiS_3, In_4Se_3) and size-dependent properties,
Micro and Nanostructures, 168, 207304 (2022).

7- **Z. Shomali,** Spin-Orbit-Coupling effect on spin transfer torque in Josephson junctions with ferromagnetic superconductor reservoirs, **Superconductor Science and Technology, 35(5), 055012 (2022).**

8- **Z. Shomali**, R. Kov'acs, P. V'an, J. Ghazanfarian, I. V. Kudinov, Recent Progresses and Future Directions of Lagging Heat Models in Thermodynamics and Bioheat Transfer, **Continuum Mechanics and Thermodynamics, 34, 637–679 (2022**).

9- H. Soheibi**, Z. Shomali**, And J. Ghazanfarian, "Combined active-passive heat transfer control using slotted fins and oscillation in turbulent flow: the cases of single cylinder and tube banks", **International Journal of Heat and Mass Transfer, 182, 121972 (2022).**

10- **Z. Shomali** and R. Asgari, Spin transfer torque and Exchange coupling in Josephson junction with Ferromagnetic superconductor reservoirs, **Journal of physics. Condensed matter, 33, 035806 (2020).**

11- J. Ghazanfarian, **Z. Shomali,** Shiyun Xiong, 21st CENTURY NANOSCIENCE - A HANDBOOK, In press (**Taylor & Francis Publishing Group) (2019).**

12- **Z. Shomali** and R. Asgari, "Effects of low-dimensional material channels on energy consumption of Nano-devices", **International Communication in Heat and Mass Transfer, 94, 77-84 (2018).**

13- **Z. Shomali**, B. Pedar, J. Ghazanfarian, A. Abbassi, "Monte-Carlo Parallel Simulation of Phonon Transport for 3D Nano-Devices", **International Journal of Thermal Sciences, 114, 139-154 (2017).**

14- **Z. Shomali**, A. Abbassi, J. Ghazanfarian, "Development of Non-Fourier Thermal Attitude for Three- Dimensional and Graphene-Based MOS Devices", **Applied Thermal Engineering, 104, 616-627 (2016).**

15- J. Ghazanfarian, **Z. Shomali**, A. Abbassi, "Macro- to nanoscale heat and mass transfer: the lagging behavior, **International Journal of Thermophysics**, **36 (7), 1416-1467 (2015).**

16- **Z. Shomali**, J. Ghazanfarian, A. Abbassi, "Investigation of bulk/film temperature-dependent properties for highly non-linear DPL model in a nanoscale device: the case with high-k metal gate MOSFET", **Superlattices and Microstructures, 83, 699 (2015)**.

17- **Z. Shomali** and A. Abbassi, "Investigation of highly non-linear dual-phase-lag model in nanoscale solid argon with temperature-dependent properties", **International Journal of Thermal Sciences, 83, 56-67 (2014).**

18- J. Linder, A. Brataas, **Z. Shomali**, M. Zareyan, “Spin-Transfer and Exchange Torques in Ferromagnetic Superconductors”, **Physical Review Letters, 109, 237206 (2012).** [Selected and awarded as the outstanding work by Iran Nanotechnology Initiative council]

19- J. Ghazanfarian and **Z. Shomali**, “Investigation of dual-phase-lag heat conduction model in a nanoscale metal-oxide-semiconductor field-effect transistor”, I**nternational Journal of Heat and Mass Transfer, 55, 6231 (2012)**.

20- **Z. Shomali**, M. Zareyan and W. Belzig, “Spin supercurrent in Josephson contacts with noncollinear ferromagnets”, **New Journal of Physics, 13, 083033 (2011)**. [Among the most downloaded articles of all IOP journals, October 2011][selected for Virtual Journal of Nanoscale Science & Technology]

21- **Z. Shomali**, M. Zareyan and W. Belzig, "Width of the 0 -\pi phase transition in diffusive magnetic Josephson junctions ", **Physical Review B, 78, 214518 (2008).** [selected for Virtual Journal of Nanoscale Science & Technology and Virtual Journal of Applications of Superconductivity]

Talks:

1- **Z. Shomali**, Nonlocal effects in nanoscale heat transport, November 21, in “Nonoscale Heat Transport workshop”, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran (2024).

2- **Z. Shomali**, Effect of non-local theory on precise investigation of heat transport in semiconductor nanostructures using non-Fourier macroscopic models, in “Uniting Today’s Nanotechnology for Advancing Tomorrow’s Semiconductor Physics conference”, 13 November - 15 November, Germany (2024).

3- **Z. Shomali**, Phonon analysis of complex Mo/W-Si_2N_4 materials, the solutions for MOSFET thermal management, in “9th International Symposium on Advances in Computational Heat Transfer”, CHT-24, 26-30 May, Istanbul, Turkey (2024).

4- J. Ghazanfarian, **Z. Shomali**, Heat Transfer Augmentation Through the Sliding-Wall Concept, in “9th International Symposium on Advances in Computational Heat Transfer”, CHT-24, 26-30 May, Istanbul, Turkey (2024).

5- **Z. Shomali**, Thermal investigation of newly proposed field effect transistors using non-equilibrium Monte Carlo simulation of phonon Boltzmann equation, in “Nonequilibrium Physics – Current Trends and Future Perspectives, 793. WE-Heraeus-Seminar”, 28 August - 01 September, at the Physikzentrum Bad Honnef, Germany (2023).

6- **Z. Shomali**, “Monte Carlo simulation of the new generation transistors with low-dimensional material channel”, in “Conference on Nanophononics, Bridging Statistical Physics, Molecular Modeling and Experiments”, 24-28 June, Trieste, Italy (2019).

7- **Z. Shomali**, Spin Transfer Torque in Different Josephson Junctions, in "20th Annual IASBS Meeting on Condensed Matter Physics & School on Soft Matter and Biological Physics", May 28-30, IASBS, Zanjan, Iran (2014).

Conference Proceedings:

1- **Z. Shomali**, Uniting Today's Nanotechnology for Advancing Tomorrow's Semiconductor Physics, 13 November - 15 November, Germany (2024).

2- **Z. Shomali**, Phonon analysis of complex Mo/W-Si2N4 materials, the solutions for MOSFET thermal management, 9th International Symposium on Advances in Computational Heat Transfer, CHT-24, 26-30 May, Istanbul, Turkey (2024).

3- J. Ghazanfarian, **Z. Shomali**, 9th International Symposium on Advances in Computational Heat Transfer, CHT-24, 26-30 May, Istanbul, Turkey (2024).

4- A. Bahadori, **Z. Shomali**, Investigation of the SnSSe Janus monolayer as the solution for efficient thermoelectric materials, Bulletin of the American Physical Society, APS March Meeting, March 3-8 (2024).

4- R. Baratifarimani, **Z. Shomali**, Nonlocal heat transport in Silicon MOSFETs, Bulletin of the American Physical Society, APS March Meeting, March 3-8 (2024).

5- R. Baratifarimani, **Z. Shomali**, Investigation Of Size-Dependent Thermal Properties Effect On Nonlocal Heat Transport In 1-D Materials Of Si And TiS_3, 15th International Conference on Thermal Engineering Theory and Applications, 29 May- 1 June, Tashkent, Uzbekistan (2024)

6- **Z. Shomali**, Thermal investigation of newly proposed field effect transistors using non-equilibrium Monte Carlo simulation of phonon Boltzmann equation, Nonequilibrium Physics – Current Trends and Future Perspectives, 793. WE-Heraeus-Seminar, 28 August-01 September, Germany (2023).

7- **Z. Shomali**, Z. adhami, The 34th International Symposium on Superconductivity (ISS2021) Web-based Symposium November 30–December 2, Japan, (2021).

8- **Z. Shomali,** H. Soheibi, J. Ghazanfarian, "Investigation of Fin Ripping on Convective Heat Transfer over a Cylinder in Cross Flow", 21st IACM Computational Fluids Conference, 17-21 October, Hangzhou, China, (2021).

9- **Z. Shomali**, R. Asgari, "Spin Transfer Torque in Ferromagnetic Josephson Junctions Including chiral P-wave Ferromagnetic Superconductor Reservoirs", 736. Wilhelm and Else Heraeus Seminar, Magnetism at the Nanoscale: Imaging- Fabrication – Physics, Germany, January 6-8, (2021).

10- **Z. Shomali**, R. Asgari, "Monte Carlo simulation of the new generation transistors with low-dimensional material channel", Conference on Nanophononics, Bridging Statistical Physics, Molecular Modeling and Experiments (Contributed Talk), Trieste, Italy, 24-28 June 2019.

11- **Z. Shomali**, R. Asgari, “Effects of low-dimensional material channels on energy consumption of Nano- devices”, The Physics Society of Iran Annual Meeting, Tehran University, 27 December (2018).

12- **Z. Shomali,** B. Pedar**,** J. Ghazanfarian, A. Abbassi, “Monte-Carlo Parallel Simulation of Phonon Transport for 3D Nano-Devices”, Autumn Meeting of the Physics Society of Iran, 10 November, Tehran University, (2017).

13- **Z. Shomali**, R. Asgari, “Monte-Carlo Study of the Low-Dimensional Systems”, Recent Progress in the Physics of Thermal Transport, ICTP – Eurasian Centre for Advanced Research, Izmir, Turkey, July 17-21, (2017).

14- **Z. Shomali,** J. Ghazanfarian, A. Abbassi, “Monte-Carlo study of the three-dimensional silicon MOSFETs”, The 7^{th} International Symposium on Advances in Computational Heat Transfer, CHT-17, in Napoli, Italy, 28 May - 02 June (2017).

15- **Z. Shomali**, J. Ghazanfarian, A. Abbassi, “Development of Non-Fourier Thermal Attitude for Three- Dimensional and Graphene-Based MOS Devices”, 10 November, Tehran University, (2016).

16- **Z. Shomali**, J. Ghazanfarian, A. Abbassi, “Non-Fourier investigation of the Tri-Gate MOSFET with a graphene heat spreader”, 6th International Advances in Applied Physics and Materials Science Congress & Exhibition (APMAS2016), Turkey, Istanbul.

17- J. Ghazanfarian, **Z. Shomali**, A. Abbassi, “Non-Fourier behaviors in different three-dimensional MOSFET transistors”, 6th International Advances in Applied Physics and Materials Science Congress & Exhibition (APMAS2016), Turkey, Istanbul.

18- **Z. Shomali**, J. Ghazanfarian, A. Abbassi, “Investigation of solid argon film with temperature-dependent properties under the framework of highly non-linear Dual-Phase-Lag Model in a nanoscale geometry”, Proceedings of National Conference on Mechanical Engineering of Iran (NCMEI2014), February 27, Shiraz, Iran, (2014).

19- **Z. Shomali**, M. Zareyan and W. Belzig, "Spin Transport in Diffusive Ferromagnetic Josephson Junctions with Noncollinear Magnetization ", 75th Annual Meeting of the DPG and DPG Spring Meeting, March 13-18, Dresden, Germany, P 516, (2011).

20- **Z. Shomali**, M. Zareyan and W. Belzig, "Spin Supercurrent in Ferromagnetic Josephson Contacts with Noncollinear Magnetization " ,469. Wilhelm and Else Heraeus Seminar, Quantum Dynamics in Nanoscale Heterostructures, Physikzentrum Bad Honnef, Germany, December 7- 10, (2010).

21- **Z. Shomali**, M. Zareyan and W. Belzig, ‘Investigation of the 0-\pi phase transition in ferromagnetic Josephson nanostructures’ in proceeding of the 3rd Conference on nanostructures (NS2010), March 10-12, Kish Island, I.R. Iran, (2010).

22- **Z. Shomali**, M. Zareyan and W. Belzig, "0 -\pi phase transition in diffusive magnetic Josephson junctions ", In proceeding of 420th WEH Seminar "Unconventional Proximity Effects in Novel Materials", October 12-15, Physikzentrum Bad Honnef, Germany, (2008).

23- Z. Shomali, M. Zareyan and W. Belzig, "The quantum transport in ferromagnetic and normal Josephson nanocontacts with complex structures", In proceeding of the 15th Annual IASBS Meeting on Condensed Matter Physics, Zanjan, Iran.

Attended Workshops and Schools:

- Career Development Workshop for Women in Physics, ICTP, Italy, 17 - 19 November 2021
- The Hitchhiker's Guide to Condensed Matter and Statistical Physics: Topological Phenomena in Condensed Matter, ICTP, Italy, 06 May - 03 Jun 2021
- 2D Materials for Spin-Orbitronics, ICTP, Italy, 03 - 05 May 2021
- Workshop on Recent Progress in the Physics of Thermal Transport, ICTP – Eurasian Centre for Advanced Research, Izmir, Turkey, July 17-21, (2017).
- Workshop on High Performance Computing (HPC08), IPM, Tehran, February 16-21- 2008.
- The 11th IASBS Physics Spring School on new topics in Statistical Physics, Zanjan, May 7-10 2006. (This school is held for talented physics students of Iran who are attending last year of their BSc studies)
- The 10th IASBS Physics Winter School on new topics in Condensed Matter Physics, Zanjan, January 30- February 2 2005.
- The 9th IASBS Physics Winter School on new topics in High Energy Physics, Zanjan, December 21-25 2003.

Grant/ Project

- **Project Title:** Investigation of conductive heat transfer models in nano/bio models, **International grant**, Samara State University, Russia,
- **Project Title:** The effect of nonlocal heat transfer on thermal management of transistors considering the temperature dependent thermal properties/ **Iran national Science Foundation (INSF)/ Grant No. 4027465/ 2024**

Graduated students:

- Zhina Adhmai, Master thesis "The effect of emergent of the pseudospin-1 fermions on the NS-structures"
- Mohammad Ebrahim Moazzen, Master thesis "thermal investigation of MOSFET transistor using deep learning algorithms"
- Roya Barati Farimani, Master thesis "The effect of nonlocal heat transfer on thermal management of transistors"
- Sharif Abdulrahman Sulaiman (International), Master thesis "Investigation of non-local heat transfer with time delay in two-dimensional nanomaterials"

Current Phd students:

- Ameneh Bahadori
- Zhina Adhmai

- Niloufar Kamalkhani
- Roya Barati
-MohammadReza Hassanlou
- Safwa Haitham (International)
- Roghayeh Aghaei

Current MSc students:

- Maryam Mirzaei

Experimental experiences:

- Electronic lab (from elementary up to working with micro controller).
- Optics lab (familiar with all instruments in an Optics lab)
- Condensed Matter lab

Selected courses taught:

-Introduction to Machine Learning
- Numerical Modelling and Simulation in Condensed Matter
- Many-body Theory in Condensed Matter Physics
- Advanced Electrodynamic
- Condensed Matter Physics
- General Physics I, II
- Numerical methods
- Superconductivity
- Thermodynamic and Statistical Mechanics I, II
- Advanced Quantum Mechanics I, II, III (Teaching Assistant of the course taught by Prof. Yusef Sobuti)

Computer skills:

- Programming Languages: Fortran, Python, C, C++, a little assembly.
- Mathematical Softwares: Matlab, Maple, Mathematica, Pro fit.
- Technical Softwares: OpenFoam, COMSOL.
- Graphical Software: Photoshop, Tecplot, Pro fit, Corel Draw.
- Other Softwares: Microsoft office, Latex, Pages, Keynote, TeXworks, iMovie, Xcode, familiar with clustering and MPI programming.
- Libraries: LAPACK, BLAS, SCALAPACK.

Selected courses attended:

- Physics of Superconductors, Prof. Y. Sukrinov
- Electrodynamics, Prof. Sobuti
- Group Theory, Dr. M. F. Miri
- Many Body Particles, Prof. M. R. Khajehpour

Languages:

- English (Fluent)
- Turkish, Azari (Fluent)
- Française (Intermédiaires)
- Deutsch (Mittelstufe)

Organizing Experiences:

- Organizer of the Weekly Seminars of Department of Physics at **IPM**, also helping in organizing International Workshops and Schools in Institute for Research in Fundamental Sciences (2016-2019)
- The member of the organizing team of the conference, "14th Annual IASBS Meeting on Condensed Matter Physics, Zanjan" (2008).

International Collaborators:

- Prof. Pierre-Olivier Chapuis (Centre for Energy and Thermal Sciences of Lyon, France)
- Dr. Sami Merabia (Université Lyon, France)
- Prof. Wolfgang Belzig (Konstanz University, Germany), (also Host for my visit during Feb 2011 - Apr 2011 and Sep 2008 - Oct 2008)
- Prof. Peter V'an (Wigner Research Centre for Physics, Budapest, Hungary)
- Dr. Robert Kov'acs (Wigner Research Centre for Physics, Budapest, Hungary)
- Dr. Shiyun Xiong **(**Max Planck Institute for Polymer Research**)**
- Prof. Arne Brataas (NTNU, Norway)
- Prof. Jacob Linder (NTNU, Norway)