# Manasa Kaniselvan

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## Profile

- Developing *ab initio* simulations to model the physics of nanoelectronic devices at atomistic scales.
- Academic background in solid state physics, nanoelectronics, and computational linear algebra.
- Interested in emerging memory technologies, neuromorphic computing architectures, and physical neural networks

## Education

**ETH Zurich** — Zurich, Switzerland
Candidate for PhD, Information Technology and Electrical Engineering — September 2021–present

**University of Waterloo** — Waterloo, ON, Canada
Master of Applied Science (MASc), Electrical and Computer Engineering — September 2019–May 2021

**University of Waterloo** — Waterloo, ON, Canada
Bachelor of Applied Science (BASc), Nanotechnology Engineering. — September 2014–May 2019

## Experience

**Scientific Assistant (PhD Candidate) - ETH Zürich** — Zürich, Switzerland
Advisor: Dr. Mathieu Luisier, Professor — September $1^{st}$ 2021 - 2026

- Developing atomistic models for resistive switching in Valence Change Memory (VCM) cells, using electronic structure calculations, *ab initio* quantum transport, and Kinetic Monte Carlo. Working with experimental partners at ETH and IBM Zurich to realize new device structures and investigate their operating mechanisms.

**Graduate Intern - Samsung Semiconductor Inc** — San Jose, California, USA
Supervisor: Dr. Byounghak Lee, Principle Engineer — May $15^{th}$ 2023 - August $4^{th}$ 2023

**MASc Student - University of Waterloo** — Waterloo, ON, Canada
Advisor: Dr. Youngki Yoon, Associate Professor — September $1^{st}$ 2019 - September $1^{st}$ 2021

- Used Density Functional Theory and Non-Equilibrium Green's Function-based transport codes to design and simulate devices made from 2D materials. Investigated defect and strain-engineering in FET and TFET structures. Collaborated with an experimental group at Sungkyunkwan University, South Korea, to fabricate and test devices.

**Research Assistant - Waterloo Institute for Nanotechnology (WIN)** — Waterloo, ON, Canada
Supervisor: Dr. Dayan Ban, Professor — January $1^{st}$ 2018 - September $1^{st}$ 2018

- Wrote a model to simulate the operation of Resonant-Phonon Quantum Cascade Lasers, based on self-consistently solved wavefunctions and charge distributions. Implemented Markov-Chain Monte-Carlo optimization methods to search for designs with higher-temperature lasing potential. Assisted in optical characterization of fabricated devices.

**Formulations Engineering Intern - Adaptive Surface Technologies (AST)** — Cambridge, MA, USA
Supervisor: Dr. Tehila Nahum, Principle Formulations Engineer — September $1^{st}$ 2016 - April $30^{th}$ 2017

- AST develops slippery coatings on the principle of infusing a nanoporous surface with a lubricant. Worked in a team of three engineers to formulate food-safe container coatings for a customer in the consumer packaging industry.

**Research Assistant - National Institute of Materials Science (NIMS)** — Tsukuba, Ibaraki, Japan
Supervisor: Dr. Genki Yoshikawa, Associate Professor and Group Leader — January $1^{st}$ 2016 - April $1^{st}$ 2016

- Optimized the coating of drop-casted polymer films on a membrane-type sensor which measures mechanical deflection upon gas absorption to perform 'olfactory' sensing. Designed and 3D printed parts to customize dispensing equipment. Set up COMSOL multiphysics modelling for sensor performance.

**Research Assistant - Canadian Nuclear Laboratories (CNL)** — Chalk River, Ontario, Canada
Supervisor: Dr. Syed Bukhari, Research Associate, Neutron Scattering Branch — May 2015 - August 2015

- Optimized sputtering parameters to minimize the interfacial roughness between stacked metal-alloy thin films

## Teaching & Supervision

### Teaching Assistant Positions

- **Quantum Transport in Nanostructures, ETH Zurich** February 2023 - May 2023
  Taught one third of the tutorials.
- **Quantum Transport in Nanostructures, ETH Zurich** February 2022 - May 2022
  Taught one third of the tutorials.
- **Linear Circuits (NE140), University of Waterloo** January 2021 - April 2021
  Prepared and taught all remote (synchronous) tutorials.
- **Nanoelectronics (NE471), University of Waterloo** September 2020 - December 2020
  Held office hours for student questions, prepared assignments, and marked exams.
- **Electronic Circuits (NE344), University of Waterloo** May 2020 - August 2020
  Prepared and taught all remote (synchronous) tutorials.
- **Linear Circuits (NE140), University of Waterloo** January 2020 - April 2020
  Prepared and taught all tutorials.

### Student Project Supervisions

- **Masters' Thesis of Jente Clarysse, ETH Zurich** April 2023 - October 2023
  Simulating thermally-activated switching phenomena in oxide-based resistive memory.
- **Masters' semester project of Jente Clarysse, ETH Zurich** September 2022 - January 2023
  Developing a Markovian model of non-equilibrium current flow through atomistic structures modelled as resistive networks.
- **Masters' semester project of Zhouyang Yu, ETH Zurich** September 2022 - January 2023
  Preforming quantum transport simulations on Interband Cascade Lasers (ICLs) using an in-house NEGF solver. Co-supervised with Prof. Matheiu Luisier.
- **Bachelor Thesis of Patrik Gjini, ETH Zurich** February 2022 - May 2022
  Implemented a Fast Multipole Method algorithm to accelerate the solution of Poisson's equation in across amorphous structures, written in Python. Co-supervised with Dr. Marko Mladenovic.
- **Masters' semester project of Patrick Bütler, ETH Zurich** February 2022 - May 2022
  Investigating phase transition-induced resistive switching in monolayer $MoTe_2$ towards non-volatile memory applications, using *ab-initio* Molecular Dynamics. Co-supervised with Jonathan Backmann.
- **Research projects of Patrick Kim and Raymond Chong, Deep River Science Academy** May 2015 - Aug 2015
  Minimizing the interfacial roughness of sputtered metal alloy thin films to nano-scale corrosion mechanisms, using X-Ray Reflectometry and X-Ray Diffraction. Counted towards the students' high-school course credit.

## Other Activities

**Team Lead - UW Nano Robotics Group (UWNRG)** Waterloo, ON, Canada
Advisor: Dr. Mustafa Yavuz, Associate Professor January 2015 - July 2019

- UWNRG designs microbotic actuation systems to compete at the annual IEEE ICRA Microbotics Challenges.
- Led the development of a microbot called SAM (Solenoid Actuated Microbot). Managed funding applications for lab expenses, equipment, cleanroom usage, and conference travel costs.
- Competition Record: 3rd place (at ICRA 2015), 1st place (at ICRA 2016), 2nd place (at ICRA 2018).

## Project Funding

- "Flexible Photovoltaics with 2D Material Heterostructures" (NSERC PGSD Doctoral Award) - 63,000 CAD 2021
- "Simulations of semiconductor quantum structures" (NSERC Undergraduate Student Research Award) - 4,000 CAD 2018
- "Modeling of quantum cascade lasers" (NSERC Undergraduate Student Research Award) - 4,000 CAD 2017

## Scholarships & Awards

- Top 10% (out of 715) Poster Commendation at the Psi-K Conference 2022
- Waterloo Faculty of Engineering Awards (x2) 2020
- Sanford Fleming Foundation (SFF) Teaching Assistant Excellence Award 2021
- Waterloo Graduate Research Studentship (with MASc offer) 2019–2021
- Waterloo Dean's Entrance Award (Graduate) 2019
- Presentation Award, Waterloo Nanotechnology Symposium 2019
- Waterloo Undergraduate Research Assistantship Awards (x2) 2017–2018
- Waterloo Undergraduate Research Internship Awards (x2) 2017–2018
- Waterloo International Internship Award 2016
- NIMS (Japan) Internship Program Fellowship 2016
- Waterloo President's (Entrance) Scholarship 2014

## Journal Articles ('*' = equal contribution)

1. **M. Kaniselvan**, M.Luisier, and M. Mladenovic, "Atomistic Modelling of Field-Induced Resistive Switching in Valence Change Memory," *ACS Nano*, April 2023. doi: 10.1021/acsnano.2c12575 ***(*Journal Cover Article)***

2. H. Park*, A. Sen*, **M. Kaniselvan**, A.AlMutairi, A. Bal, L. Lee, Y.Yoon, and S. Kim, "Wafer-scale Nanoporous 2D Active Pixel Image Sensor Matrix with Highly Uniformity, High Sensitivity, and Rapid Switching," *Advanced Materials*, February 2023. doi: 10.1002/adma.202210715 ***(*Journal Cover Article)***

3. **M. Kaniselvan**, M. Luisier, and M. Mladenovic, "An Atomistic Modelling Framework for Valence Change Memory Cells," *Solid State Electronics: LETTERS from the International Conference on Simulation of Semiconductor Processes and Devices 2022*, October 2022 doi: 10.10632F5.0053789

4. **M. Kaniselvan**, M. Sritharan, and Y. Yoon, "Mitigating Tunneling Leakage in Ultrascaled $HfS_2$ pMOS Devices with Uniaxial Strain," *IEEE Electron Device Letters*, June 2022 doi:10.1109/LED.2022.3179228 ***(*Editor's Pick)***

5. **M. Kaniselvan** and Y. Yoon, "Strain-tuning $PtSe_2$ for high ON-current lateral tunnel field-effect transistors," *Applied Physics Letters*, vol. 119, no. 7, p. 073102, Aug. 2021. doi:10.1063%2F5.0053789

6. G. Han, **M. Kaniselvan**, and Y. Yoon, "Photoresponse of $MoSe_2$ Transistors: A Fully Numerical Quantum Transport Simulation Study," *ACS Applied Electronic Materials*, vol. 2, no. 11, pp. 3765–3772, Nov. 2020. doi:10.1021/acsaelm.0c00795

7. M. Naqi*, **M. Kaniselvan***, S. Choo*, G. Han, S. Kang, J. Kim, Y. Yoon, and S. Kim, "Ultrasensitive Multilayer $MoS_2$-Based Photodetector with Permanently Grounded Gate Effect," *Advanced Electronic Materials*, vol. 6, no. 4, p. 1901256, Feb. 2020. doi: 10.1002/aelm.201901256.

## Conferences

**Refereed Contributions:**

1. Marko Mladenovic, **Manasa Kaniselvan**, Christoph Weilenmann, Alexandros Emboras, and Mathieu Luisier *Termination-Dependence of Resistive Switching in $SrTiO_3$-based Valence Change Memory.* International Workshop on Computational Nanotechnology (IWCN), Barcelona, Spain, June 2023. Accepted for a talk.

2. **Manasa Kaniselvan**, Mathieu Luisier and Marko Mladenovic *An Atomistic Modelling Framework for Valence Change Memory Cells.* International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), Granada, Spain, August 2022. Talk.

3. **Manasa Kaniselvan**, Marko Mladenovic, Patrik Gjini, and Mathieu Luisier *Modelling transport in valence change memory cells.* Psi-k Conference, Lausanne, Switzerland, August 2022. Poster.

**Non-Refereed Contributions:**

4. **Manasa Kaniselvan**, Marko Mladenovic, Patrik Gjini, and Mathieu Luisier *Modelling transport in valence change memory cells.* CECAM Workshop on "Quantum transport methods and algorithms: from particles to waves approaches", ETH Zürich, Switzerland, July 2022. Poster.

5. Marko Mladenovic, **Manasa Kaniselvan**, and Mathieu Luisier *Ab-Initio-Parametrized Kinetic Monte Carlo Model for Vacancy Diffusion in Amorphous Oxides in Valence Change Memory.* First Principles Modelling of Defects in Solids Workshop, ETH Zürich, June 2022. Poster.

6. **Manasa Kaniselvan**. *Engineering the Performance of 2D Transition Metal Dichalcogenide Nanotransistors through Quantum Transport Simulations.* Nanotechnology Seminar delivered at the University of Waterloo, June 2021. Talk.

7. Boyu Wen, Chao Xu, Siyi Wang, Sm Shazzad Rassel, **Manasa Kaniselvan**, Chris Deimert, Zbigniew Wasilewski and Dayan Ban *Novel 4-well THz QCL with hybrid injection/extraction channels.* ITQW2019: Infrared Terahertz Quantum Workshop.

8. Mary Chen*, **Manasa Kaniselvan***, Corin Seeleman*, Danielle Smith*. *A Real-Time Non-Invasive Sensor for Monitoring Laser-Induced Temperature in Medical Applications.* Waterloo Engineering Design Symposium 2019. Waterloo, ON, Canada. Oral presentation & poster.

9. **UW Nano Robotics Group**. *Solenoid Actuated Microbot (SAM).* 2018 IEEE IEEE International Conference on Robotics and Automation (ICRA). Brisbane, Australia. Competition & poster.

10. **UW Nano Robotics Group**. *ElectroMagnetic Micro Actuation (EMMA): Version 2.* 2016 IEEE International Conference on Robotics and Automation (ICRA). Stockholm, Sweden

11. **UW Nano Robotics Group**. *ElectroMagnetic Micro Actuation (EMMA)* 2015 IEEE International Conference on Robotics and Automation (ICRA). Seattle, Washington, USA

## Skills

- **Languages:** Expert in Python and MATLAB for scientific computing, proficient with C++ and Julia, comfortable using OpenMP and MPI
- **Spoken Languages:** English at a very high level of native fluency, for both creative and technical writing, German at a basic working level (B1), can understand written and spoken French
- **Open-source Materials and Device Modelling codes:** CP2K, Quantum Espresso, LAMMPS, Quantum ATK
- **Scientific Visualization:** Blender (2x publication graphics, 1x journal cover), VMD (2x publication graphics)