

Kexin Li

Research Interests

Nanoelectronic devices; GaN devices and circuits; Device-circuit co-design and optimization; Analog and digital IC design; Cryogenic device modeling for quantum computing.

Education

- 2019–2022 **Ph.D, ECE, University of Illinois Urbana-Champaign**, Champaign, IL, USA
Advisor: Prof. Shaloo Rakheja. Research area: Nanotechnology, Semiconductor Device Physics.
Thesis title: Modeling and simulation of III-nitride devices for next generation communications and quantum computing
Committee: Prof. Shaloo Rakheja, Prof. Can Bayram, Prof. Elyse Rosenbaum, Prof. Xiuling Li (UT Austin)
- 2015–2019 **Ph.D candidate, M.Eng., Computer Engineering, New York University**, New York, USA
Quantum Nanoelectronics Lab, Advisor: Prof. Shaloo Rakheja.
- 2013–2014 **MSc., Analog and Digital IC Design, Imperial College London**, London, UK (Merit Degree)
Advisor: Dr. David Thomas. Thesis: Automatic pipeline creation for numerical computing in FPGAs.
- 2008–2012 **B.Eng., Electronic, Science and Technology, Southeast University**, Nanjing, China
Thesis: Detection and analysis the structure of Alanine and Polypeptide using RFID.

Research Experience

- 2022 Fall - **Postdoctoral Fellow, CoSMIC Lab, Columbia University**, New York City, NY
Advisor: Prof. Harish Krishnaswamy
- Summer 2020 **Research Intern, Mitsubishi Electric Research Laboratories (MERL)**, Cambridge, MA
- Summer 2019 Applied Physics Group, Host: Dr. Koon Hoo Teo
- 2016–2019 **Research Assistant, Quantum Nanoelectronics Lab, New York University**
Project: Compact modeling of III-V semiconductor devices for high-frequency and high-power applications,
Advisor: Dr. Shaloo Rakheja
- Fall 2015 **Research Assistant, NYU Nano Lab, New York University**
Project: VLSI custom layout design for ADC, Mentor: Dr. Bayan Nasri

Awards and Honors

- 2022 EECS Rising Stars at UT Austin
- 2015 ECE Academic Achievement Award. New York University
- 2014 Graduate with Merit. Imperial College London
- 2013 Graduate with Distinction. University of Bristol
- 2011 Third place, "National Mathematical Modeling Competition. Southeast University
- 2011 Champion, the "Smart Car Competition." Southeast University
- 2010 GuoWei Electronic Scholarship. Southeast University

Patents

- U.1 Lars F. Voss, Adam M. Conway, Karen M. Dowling, David Hall, Shaloo Rakheja, **Kexin Li**. **Pulse Compression Photoconductive Semiconductor Switches.** *US Patent, App No. 17502681, 2021.*
(In collaboration with Lawrence Livermore National Laboratory)

Publications

Journal Publications

- J.7 Ashwin Tunga, **Kexin Li**, Nicholas C. Miller, Matt Grupen, John D. Albrecht, Shaloo Rakheja. **A comparison of a commercial hydrodynamics TCAD solver and Fermi kinetics transport convergence for GaN HEMTs.** *Journal of Applied Physics (JAP 2022)*. *arXiv preprint arXiv:2208.03576*
(In collaboration with Air Force Research Laboratory)
- J.6 Saptarshi Mukherjee, Karen M Dowling, Yicong Dong, **Kexin Li**, Adam Conway, Shaloo Rakheja, Lars Voss. **A Prony-based curve-fitting method for characterization of RF pulses from optoelectronic devices.** *IEEE Signal Processing Letters (SPL 2021)*. DOI: 10.1109/LSP.2021.3135795
(In collaboration with Lawrence Livermore National Laboratory)
- J.5 Koon Hoo Teo, Yuhao Zhang, Nadim Chowdhury, Shaloo Rakheja, Rui Ma, Qingyun Xie, Eiji Yagyu, Koji Yamanaka, **Kexin Li**, Tomás Palacios. **Emerging GaN technologies for power, RF, digital, and quantum computing applications: Recent advances and prospects.** *Journal of Applied Physics (JAP 2021)*. DOI:10.1063/5.0061555
(In collaboration with Mitsubishi Electric Research Laboratories)
- J.4 Shaloo Rakheja, **Kexin Li**, Karen M. Dowling, Adam M. Conway, Lars F. Voss. **Design and simulation of near-terahertz GaN photoconductive switches—operation in the negative differential mobility regime and pulse compression.** *IEEE Journal of the Electron Devices Society (J-EDS 2021)*. DOI:10.1109/JEDS.2021.3077761
- J.3 **Kexin Li**, Shaloo Rakheja. **Modeling and simulation of quasi-ballistic III-Nitride transistors.** *International Journal of High Speed Electronics and Systems, Special Issue on Wide Bandgap Semiconductor Electronics and Devices (2019)*. DOI:10.1142/S0129156419400111
- J.2 **Kexin Li**, Shaloo Rakheja. **A unified charge-current analytic model for ultra-scaled III-Nitride high electron mobility transistors.** *Journal of Applied Physics (JAP 2019)*. DOI:10.1063/1.5064385
- J.1 **Kexin Li**, Shaloo Rakheja. **An analytic current-voltage model for quasi-ballistic III-nitride high electron mobility transistors.** *Journal of Applied Physics (JAP 2018)*. DOI:10.1063/1.5025339
(Sponsored by Boeing)

Conference Proceedings

- C.8 **Kexin Li**, Takashi Matsuda, Eiji Yagyu, Koon Hoo Teo, Shaloo Rakheja. **Trapping Phenomena in GaN HEMTs with Fe- and C-doped Buffer.** *80th Device Research Conference, Columbus, OH. (DRC 2022)*. DOI: 10.1109/DRC55272.2022.9855817
- C.7 **Kexin Li**, Shaloo Rakheja. **Physical modeling of Quasi-ballistic GaN HEMTs operating at cryogenic temperatures.** *The Compound Semiconductor Week, Ann Arbor, MI. (CSW 2022)*. DOI: 10.1109/CSW55288.2022.9930446
- C.6 **Kexin Li**, Eiji Yagyu, Hisashi Saito, Koon Hoo Teo, Shaloo Rakheja. **Compact modeling of gate leakage phenomenon in GaN HEMTs.** *IEEE International Conference on Simulation of Semiconductor Processes and Devices (SISPAD 2020)*. DOI:10.23919/SISPAD49475.2020.9241666
- C.5 **Kexin Li**, Shaloo Rakheja. **A unified charge-current compact model of gallium nitride transistors for RF and digital applications.** *IEEE Electron Devices Technology and Manufacturing, Singapore. (EDTM 2019)*. DOI:10.1109/EDTM.2019.8731282
- C.4 **Kexin Li**, Shaloo Rakheja. **A unified current-voltage and charge-voltage model of quasi-ballistic III-nitride HEMTs for RF applications.** *IEEE 76th Device Research Conference, Santa Barbara, CA. (DRC 2018)*. DOI: 10.1109/DRC.2018.8442193
- C.3 **Kexin Li**, Shaloo Rakheja. **Analytic modeling of nonlinear current conduction in access regions of III-Nitride HEMTs.** *Materials Research Society Fall Meeting, Boston, MA. (MRS 2018)*. DOI: 10.1557/adv.2017.632
- C.2 **Kexin Li**, Shaloo Rakheja. **Optimal III-nitride HEMTs – from materials and device design to compact model of the 2DEG charge density.** *OPTO, the optoelectronics, photonic materials and devices conference, San Francisco, CA. (SPIE 2017)*. *International Society for Optics and Photonics* DOI: 10.1117/12.2251582

- C.1 Shaloo Rakheja, **Kexin Li**. **Graphene-based plasma wave interconnects for on-chip communication in the terahertz band**. IEEE Fifth Berkeley Symposium on Energy Efficient Electronic Systems & Steep Transistors Workshop, (2017). DOI: 10.1109/E3S.2017.8246185

Technical Report

- MERL TR2019-160 **Kexin Li**, Koon Hoo Teo. **Gate leakage mechanisms and modeling in GaN based high electron mobility transistors – literature survey**. *Tech. Rep., Mitsubishi Electric Research Laboratories*, 2019.

Oral Conference Presentation/ Poster presentation

- P13 **Modeling and simulation of III-Nitride devices and circuits: for next generation communications and quantum computing**. *EECS Rising Stars*, Austin, TX
- P12 **Trapping Phenomena in GaN HEMTs with Fe- and C-doped buffer**. *IEEE 80th Device Research Conference (DRC)*, Columbus, OH
- P11 **Physical modeling of Quasi-ballistic GaN HEMTs operating at cryogenic temperature**. *The Compound Semiconductor Week (CSW)*, Ann Arbor, MI
- P10 **Compact modeling of gate leakage phenomenon in GaN HEMTs**. *International Conference on Simulation of Semiconductor Processes and Devices (SISPAD)*, Virtual conference
- P9 **A unified static-dynamic analytic model for ultra-scaled III-nitride high electron mobility transistor**. *Design Automation Conference (DAC)*, Las Vegas, NV
- P8 **A unified static-dynamic analytic model for ultra-scaled III-nitride high electron mobility transistor**. *ECEDHA*, Tuscon, AZ
- P7 **A unified charge-current compact model of GaN transistor for RF and digital application**. *Electron Devices Technology and Manufacturing (EDTM)*, Singapore
- P6 **Design and modeling of III-Nitride HEMTs for extremely linear RF operation**. *Materials Research Society (MRS)*, Boston, MA
- P5 **A unified current-voltage and charge-voltage model of quasi-ballistic III-nitride HEMTs for RF applications**. *76th Device Research Conference (DRC)*, Santa Barbara, CA
- P4 **An analytic current-voltage model for quasi-ballistic III-nitride high electron mobility transistors**. *Annual Scientist Symposium*, NYC, NY
- P3 **Analytic modeling of nonlinear current conduction in access regions of III-Nitride HEMTs**. *Materials Research Society (MRS)*, Boston, MA
- P2 **Optimal III-nitride HEMTs – from materials and device design to compact model of the 2DEG charge density**. *International Society for Optics and Photonics*, San Francisco, CA
- P1 **Challenges and opportunities in modeling gallium nitride high electron mobility transistors—from numerical simulations to compact transistor model**. *International Workshop on Nitride Semiconductors*, Orlando, FL

Teaching Experience

- Fall 2021 **Teaching Assistant**, *Introduction to Electric and Electronic Circuits*, UIUC
- Fall 2018 **Teaching Assistant**, *Introduction to VLSI (Graduate)*, New York University
- Spring 2018 **Teaching Assistant**, *Nanoelectronic Devices (Graduate)*, New York University
- Spring 2016 **Teaching Assistant**, *Introduction to VLSI (Undergraduate)*, New York University

Research Mentoring

- Summer 2022 **Bohao Wu (PhD - UIUC)**, Project: Reliability of GaN HEMTs: TCAD simulation and compact modeling
- Fall 2021 **Ashwin Tunga (PhD - UIUC)**, Project: TCAD simulation of GaN based HEMTs
- Spring 2020 **Yicong Dong (MSc - UIUC)**, Project: Photoconductive semiconductor switches
First Employer: Ph.D. program at University of Illinois Urbana-Champaign

Summer 2019 **Linyi Huang (MSc - NYU)**, *Project: GaAs based photoconductive semiconductor switches*
First Employer: Ph.D. program at Rutgers university

Academic Service

- 2022 Journal of Semiconductors (Invited Reviewer)
- 2021 IEEE Transactions on Electron Devices (Invited Reviewer)
- 2021 Device Research Conference (External Reviewer)
- 2019 ACM/IEEE Design Automation Conference (External Reviewer)

Skills

Programming

C/C++, Python, Bash scripts, Matlab, Verilog-A, Verilog, VHDL, SystemC.

Tools

Cadence (Genus, Virtuoso, Spectre), ModelSim, Synopsys Sentaurus TCAD, Keysight ADS.