# İlke ERCAN

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**Research Interests:** Emerging and unconventional computing paradigms; Fundamental energy efficiency limitations in computing; Nanoelectronics; Nanophotonics; Quantum-computing; Physical-information theory; Thermodynamics of computation.

**Teaching Interests:** Introduction to Electrical Engineering, Physics of Semiconductor Devices, Circuit Theory, Electronics, Physical-Information Theory, Probability and Random Processes, Thermodynamics.

### Education

University of Massachusetts, Amherst MA, USA	
Ph.D., Electrical & Computer Engineering (ECE) Advisor: Professor Neal G. Anderson	Fall 2008 - Spring 2014
Area of Study: Heat Dissipation Bounds for Nanocomputing: Met	thodology and Applications
M.S., Electrical & Computer Engineering (ECE)	Fall 2006 - Summer 2008
Advisor: Professor Neal G. Anderson Area of Study: Electron Transport Properties and Information B by Microcanonical Approach	ounds of Nanoscale Conductors
Middle East Technical University, Ankara, Turkey	
B.S., Physics, Solid State Physics	Fall 2002 - Summer 2006
Minor, Logic and Philosophy of Science	Spring 2004 - Summer 2006
Academic Positions	
TU Delft Department of Microelectronics	
Associate Professor Principal Educator	Spring 2023 - present
Fincipal Educator	Spring 2021 - Spring 2023
University College Roosevelt Engineering Department Associate Professor	Fall 2019 - Spring 2021
Boğaziçi University Department of Electrical and Electronics Engineering Assistant Professor	Fall 2015 - Spring 2020
Massachusetts Institute of Technology Electronic Materials Research Group (EN Visiting Resercher	MAT) Summer 2018
Sabancı University Foundations Development Program Part-Time Instructor	Spring 2018
TU Darmstadt Institute for Semiconductor Technology and Nanoelectronics and Postdoctoral Research Fellow	l Institute for Philosophy Spring and Summer 2015
Smith College Picker Engineering Program Visiting Faculty	Spring and Fall 2014
Research and Teaching Grants	
TU Delft Education Fellowship (PI)	2023 - 2024
MIT International Science and Technology Initiatives Seed Fund (co-PI)	2018 - 2020
TUBITAK 3501 Career Development Grant (PI) Boğazici University Start-up Research Grant (PI)	2017 - 2019 2016 - 2010
TÜBİTAK 2219 Postdoctoral Research Grant (PI)	2010 - 2013 2014 - 2015

# **Research Awards**

IEEE $12^{th}$ International Conference on Nanotechnology First Place Best Oral Conference Paper IEEE $11^{th}$ International Conference on Nanotechnology Best Paper Award	2012 2011
Teaching Awards	
TU Delft Department of Microelectronics Teacher of the Year	2022
Boğaziçi University Faculty of Engineering Excellence in Teaching Award	2018
UMass Amherst ECE Outstanding Teaching Assistant Award	2012
Teaching Certificates	
TU Delft University Teaching Qualification (UTQ) Exemption	2021
Utrecht University Basic University Teaching Qualification (BTQ)	2020

# Publications

#### Preprint

S. Faletic, P. Bitzenbauer, M. Bondani, M. Chiofalo, S. Goorney, K. Krijtenburg-Lewerissa, O. Mishina, R. Muller, G. Pospiech, *İ. Ercan*, M. Malgieri, A. Merzel, M. Michelini, P. Onorato, H. Pol, L. Santi, Z. C. Seskir, J. Sherson, K. Stadermann, A. Stefanel, E. Surer, K. Toth, J. Y. Malo, O. Zabello, "Contributions from Pilot Projects in Quantum Technology Education as Support Action to Quantum Flagship," March 13, 2023. arxiv: 2303.07055

#### Selected Peer-Reviewed Journal Articles

- Z. C. Seskir, P. Migdal, C. A. Weidner, A. Anupam, N. Case, N. Davis, C. Decaroli, *İ. Ercan*, C. Foti, P. Gora, K. Jankiewicz, B. R. La Cour, J. Y. Malo, A. Naeemi, L. Nita, N. Parvin, F. Scafirimuto, J. Friis Sherson, E. Surer, J. R. Wootton, L. Yeh, O. Zabello and M. Chiofalo. "Quantum Games and Interactive Tools for Quantum Technologies Outreach and Education: A Review and Experiences from the Field," *Optical Engineering*, 61(8), 081809, 2022. doi.org/10.1117/1.OE.61.8.081809
- İ. Ercan, Z. D. Sütgöl, and F. O. Özhan, "Physical Limitations on Fundamental Efficiency of SET-Based Brownian Circuits," *Entropy*, vol. 23 no 4, 406, 2021. doi.org/10.3390/e23040406
- S. Barışık and İ. Ercan, "Thermodynamic Cost of Edge Detection in Artificial Neural Network (ANN)-Based Processors," *International Journal of Parallel, Emergent and Distributed Systems*, Published online: 29 Oct 2020. doi: 10.1080/17445760.2020.1836639
- F. Dinç, İ. Ercan and A. M. Brańczyk, "Exact Markovian and non-Markovian time dynamics in waveguide QED: collective interactions bound states in continuum, superradiance and subradiance," *Quantum*, vol. 3, p. 213, 9 December, 2019. doi: 10.22331/q-2019-12-09-213
- 5. **İ. Ercan** and E. Suyabatmaz "Fundamental Energy Limits of SET-Based Brownian NAND and Half-Adder Circuits," *European Physical Journal B*, vol. 91 p. 113, 2018. doi: 10.1140/epjb/e2018-80619-6
- F. Dinç and İ. Ercan "Single Photon Two-Level Atom Interactions in 1-D Dielectric Waveguide: Quantum Mechanical Formalism and Applications" Optical and Quantum Electronics (OQEL), 50: 390, Published Online October 15, 2018. doi: 10.1007/s11082-018-1658-y
- 7. F. Dinç and İ. Ercan "Quantum Mechanical Treatment of Two-Level Atoms Coupled to Continuum with an Ultraviolet Cutoff," *Journal of Physics A: Mathematical and Theoretical*, vol. 51, no 35, p. 355, 2018. doi: 10.1088/1751-8121/aad165
- İ. Ercan and N. Anderson, "Heat Dissipation in Nanocomputing: Lower Bounds from Physical Information Theory," *IEEE Transactions on Nanotechnology*, vol. 12, no. 6, pp. 1047 - 1060, 2013. doi: 10.1109/tnano.2013.2276938
- N. Anderson, İ. Ercan and N. Ganesh, "Toward Nanoprocessor Thermodynamics," *IEEE Transactions on Nanotechnology*, vol. 12, no. 6, pp. 902 909, 2013. doi: 10.1109/tnano.2013.2260352
- I. Ercan and N. Anderson, "Tight-biding Implementation of the Microcanonical Approach to Transport in Nanoscale Conductors: Generalization and Analysis," *Journal of Applied Physics*, vol. 107 no. 12, pp. 124318-13, 2010. doi: 10.1063/1.3388055

- I. Ercan and N. Anderson, "Current and Information in the Microcanonical Picture of Nanoscale Transport," *Journal of Computational Electronics*, vol. 7, no 3., pp. 466 470, 2008. doi: 10.1007/s10825-008-0234-2
- I. Ercan and S. Katurcioğlu, "The Electronic Structure of Capped and Uncapped CdS Nanoparticles," Journal of Nanoscience and Nanotechnology 8, pp. 645 - 649, 2008. doi: 10.1166/jnn.2008.A219

#### **Book Chapters**

- A. Vartanyan, T. Arman, İ. Ercan, and A. D. Pinçe, "Boğaziçi Üniversitesi'nde Cinsel Tacizi Önleme Çalışmaları Sürecinde Şemsa Özar'la Yol Arkadaşlığımız (Working with Şemsa Özar in Sexual Harassment Prevention Committee at Bogazici University)," *Feminizm, Ekoloji, Toplumsal Direniş (Feminism, Ecology, Collective Resistance), Eds. H. Çağlayan and K. A. Türker*, İstanbul, 2022. ISBN: 978-605-260-367-3.
- I. Ercan and N. Anderson, "Modular Dissipation Analysis for QCA," Field-Coupled Nanocomputing, N.G. Anderson and S. Bhanja. Eds. Lecture Notes in Computer Science, vol. 8280, pp. 357-375, Heidelberg, 2014. doi: 10.1007/978-3-662-43722-3\_15

#### **Conference Proceedings**

- S. van Rijs, İ. Ercan, A. Vladimirescu, and F. Sebastiano, "Single-Electron-Transistor Compact Model for Spin-Qubit Readout," Proceedings of SMACD'23: International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design, 3-5 July 2023.
- M. Chiofalo, A. Anupam, M. Bondani, İ. Ercan, S. Goorney, M. Michelini, L. Santi, Z. Seskir, J. F. Sherson, A. Stefanel J. Y. Malo, E. Surer, C. A. Weidner, and O. Zabello, "Cultural Storytellings in Quantum Science and Technology Education," *GIREP Conference 2022: Effective Learning in Physics from Contemporary Physics to Remote Settings*, July, 2022.
- O. Yakar, Y. Nie, K Wada, A. Agarwal and İ. Ercan, "Energy Efficiency Analyses of Microring-Resonator-Based BDD Logic Circuits," *Proceedings of the IEEE International Conference on Rebooting Computing*, 28 November, 2019. doi: 10.1109/ICRC.2019.8914708
- 4. İ. Ercan, Ö. Susam, M. Altun, and M. H. Cılasun, "Synthesis and Fundamental Energy Analysis of Fault-Tolerant CMOS Circuits," *IEEExplore Proceedings of SMACD'17: International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design,* 12-15 June 2017. doi: 10.1109/smacd.2017.7981586
- I. Ercan, "Fundamental Energy Dissipation Limits in Logic Circuits," ICT Energy Letters, vol. 12, pp. 3-4, August 2016. (Invited Paper)
- N. Anderson, İ. Ercan and N. Ganesh, "Toward Nanoprocessor Thermodynamics," Proceedings of the 12<sup>th</sup> IEEE Conference on Nanotechnology (IEEE NANO, 2012), 2012. doi: 10.1109/nano.2012.6322186 (First Place Best Oral Conference Paper)
- 7. İ. Ercan and N. Anderson, "Heat Dissipation in Nanocomputing: Theory and QCA Application," Proceedings of the 11<sup>th</sup> IEEE Conference on Nanotechnology (IEEE NANO, 2011), pp.1289-1294, 2011. doi: 10.1109/nano.2011.6144346 (Best Paper Award)
- İ. Ercan, M. Rahman and N. Anderson, "Determining Fundamental Heat Dissipation Bounds for Transistor-Based Nanocomputing Paradigms," NANOARCH'11: IEEE/ACM Symposium on Nanoscale Architectures, Proceedings of the 2011 IEEE/ACM International Symposium on Nanoscale Architectures, pp. 169 - 174, 2011. doi: 10.1109/nanoarch.2011.5941500
- 9. İ. Ercan and N. Anderson, "Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model," NANO'08: Proc. of the 8<sup>th</sup> IEEE Conference on Nanotechnology (IEEE NANO, 2008), pp. 331 - 334. doi: 10.1109/nano.2008.104
- I. Ercan and N. Anderson, "Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model," Proceedings of the 17<sup>th</sup> Annual Connecticut Symposium on Microelectronics and Optoelectronics, pp. 39 - 40, April, 2008.

# **Oral Presentations**

- 1. **İ. Ercan** and B. Kılınç, "Entropy, Information, and Their Relation to Energy: Implications in Science and Engineering" *Philosophy of Science Around the Mediterranean POND 3: Unity/ Disunity of Science*, Lisbon, Portugal, September 21, 2018.
- İ. Ercan, "Energetic Cost of Information Processing at the Quantum Precipice: A Physical-Information-Theoretic Approach," KOBIT-2, Quantum Optics and Information Meeting, İstanbul, Turkey, 1-2 February, 2018. (Invited Talk)
- 3. **İ. Ercan**, "Energy Efficiency Limit in Brownian Circuits," *Micro Energy*, Gubbio, Italy, 3- 7 July, 2017. (Invited Talk)
- 4. İ. Ercan, Ö. Susam, M. Altun, and M. H. Cılasun, "Synthesis and Fundamental Energy Analysis of Fault-Tolerant CMOS Circuits," SMACD'17: International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design, Giardini Naxos, Italy, 12-15 June 2017.
- 5. **İ. Ercan**, "Fundamental Energy Dissipation Limits in Logic Circuits," *ICT Energy Science Conference*, Aalborg, Denmark, 16-19 August, 2016. (Invited Talk)
- 6. **İ. Ercan**, "Making of Measurement on Limits: Examples from Nanoelectronics," *The Making of Measurement Conference*, University of Cambridge, July 24, 2015.
- 7. **İ. Ercan**, N. Ganesh, and N. Anderson, "Modular Dissipation Analysis for QCA," *FCN 13: The Workshop* on Field Coupled Nanocomputing, Tampa, FL, February 7, 2013.
- I. Ercan, "A Case Study of Actor-Network Theory: The Structure of Scientific Research on Nanoscale Semiconductor Devices," ST Global Consortium Science and Technology in Society Conference, Washington, DC, March 31, 2012.
- I. Ercan and N. Anderson, "Heat Dissipation in Nanocomputing: Theory and QCA Application," *IEEE NANO'11:* 11<sup>th</sup> *IEEE Conference on Nanotechnology*, Portland OR, August 18, 2011. (Best Paper Award)
- İ. Ercan, M. Rahman and N. Anderson, "Determining Fundamental Heat Dissipation Bounds for Transistor-Based Nanocomputing Paradigms," NANOARCH '11: IEEE/ACM Symposium on Nanoscale Architectures, San Diego, CA, June 2011.
- 11. **İ. Ercan** and N. Anderson, "Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model," *IEEE* 8<sup>th</sup> International Conference on Nanotechnology, Arlington, TX, August 19, 2008.
- I. Ercan and N. Anderson, "Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model," 17<sup>th</sup> Annual Connecticut Symposium on Microelectronics and Optoelectronics, Storrs, CT, April 9, 2008.

#### Selected Invited Public Lectures

- 1. **İ. Ercan**, "Belonging through Agency: Student Involvement and Community Building in University Education," *TU Delft Education Day*, November 10, 2022.
- 2. **İ. Ercan**, "Fiziksel Enformasyon Teorisi: Kavramlar ve Yanlış Anlamalar (Physical Information Theory: Concepts and Misunderstanding)," 5<sup>th</sup> Systems and Control Engineering Graduate Student Camp, The Chamber of Electrical Engineers (EMO), Nesin Math Village Şirince, Spring 2017.
- 3. **İ. Ercan**, "Integrative Approach to Education in Turkey," Boğaziçi University IEEE Student Branch Science, Technology, Engineering, Arts, and Math (STEAM) Workshop, October 1, 2016.
- 4. **İ. Ercan**, "Teknolojilerin Sınırlarınıve Gelişmelerini Etkileyen Faktörler (Factors Affecting the Limits and Evolution of Technologies," *Sabancı University, Science Canteen*, May 21, 2014.

### **Courses Taught**

#### TU Delft

EE1G1: Introduction to Electrical Engineeirng (responsible instructor); EE1C11: Linear Circuits A (responsible co-instructor); EE1C21: Linear Circuits B (responsible co-instructor); EE1P11: Classical and Quantum Mechanics (co-instructor); EE1P21: Electricity and Magnetism (co-instructor); EE1L11: IP1/EPO-1 and EE1L21: EPO-2 (tutor)

University College Roosevelt

SCIMATH 101: Calculus for Scientists; ENGPROJ102: Sensing Systems for Sustainability; ENGELEC101: Basic Electronics and Circuits

Sabancı University

NS 102: Science of Nature (Brain Module)

Boğaziçi University

EE 101: Orientation to Electrical Engineering; EE 202: Electrical Circuits II; EE 313: Probability for Electrical Engineers; EE 335: Electronics Laboratory; EE 58M: Intro to the Physical-Information-Theory

Smith College

EGR 220: Circuit Theory; EGR 390: Advanced Topics in Engineering: Semiconductor Technologies

University of Massachusetts, Amherst

Engin 112: Introduction to Electrical and Computer Engineering; ECE 211: Circuit Analysis I; ECE 212: Circuit Analysis III ECE 314: Introduction to Probability and Random Processes; ECE 344: Semiconductor Devices and Materials; EE 572: Optoelectronics, PHYS 132: Introductory Physics Laboratory

### **Professional Service Contribution**

Technical Programme Committee Member: Design, Automation and Test in Europe Conference (DATE'23) Applications of Emerging Technologies track

Ad-Hoc Reviewer: Scientific Reports, Journal of Applied Physics, IEEE Transactions on Nanotechnology, IEEE Transactions on Very Large Scale Integration Systems, Journal of Supercomputing, Journal of Computational Electronics

Co-Editor and Ad-Hoc Reviewer: Springer Lecture Notes on Computer Science State-of- the-Art-Survey Series Special Volume on Field-Coupled Nanocomputing

### **Outreach Activities**

TU Delft, EEMCS IEEE Women in Engineering Affinity Group, Chair	Fall 2021 - present
University College Roosevelt Eleanor Green Office, Faculty Advisor	Fall 2019 - Spring 2021
Sabancı University Gender Studies Center (SUGender), STEM Education Academic Consultant	Summer 2017 - Fall 2018
Boğaziçi University IEEE Women in Engrineering Affinity Group, Faculty Advisor Sexual Harassment Prevention Committee, Member	Fall 2015 - 2019 Fall 2015 - 2019
Smith College Wearable Electronics Workshop, Facilitator Museum of Art Family Day, Science Education Consultant	Fall 2012 Fall 2006
University of Massachusetts Amherst, Science, Technology and Society Initiative Internatinal Dimensions of Ethics Education in Science and Engineering, Foc	us Group Member <b>Fall 2008</b>
Professional Affiliations	
Institute of Electrical and Electronics Engineers (IEEE)	2006 - present
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The Society of Women Engineers (SWE)	2011 - 2014
International Association of Computing And Philosophy (IACAP)	2010 - 2014
American Association of University Women (AAUW)	2011 - 2014

# Languages

Turkish (native), English (fluent written and spoken, ITAV: C2), Dutch (intermediate).