Notre Dame Semiconductors/Microelectronics Faculty 17 January 2024

1. Semiconductor materials, devices, and integrated circuits, heterogeneous integration logic, memory, microwave, millimeter-wave devices and circuits

Gary H. Bernstein (Prof. Electrical Engineering) gbernste@nd.edu, website: https://garyhbernstein.nd.edu/: nano and microfabrication, electron beam lithography, nanoantennas for infrared sensors, MEMS, nanomagnetics

Ningyuan Cao (Asst. Prof., Electrical Engineering) ncao@nd.edu, website: http://www.ncao-nd.com/ analog/mixed-signal circuit, digital architecture, and IoT system design for privacy-preserving machine learning; custom computational-security-hardware design for DL-resillience data security; communica-tion optimization for privacy-encrypted data; custom IC design automation with data-driven methods.

Patrick Fay (Prof, Electrical Engineering) pfay@nd.edu, website: https://engineering.nd.edu/faculty/patrick-fay/: design, fabrication, and characterization of microwave, millimeter-wave, and power electronic devices and circuits; RF/microwave/mm-wave circuits and systems; heterogeneous integration; micromachining techniques for the fabrication of microwave components and packaging; Director ND Nanofabrication Facility

Chris Hinkle: (Prof, Electrical Engineering) chinkle@nd.edu, website: https://hinklelab.nd.edu/: growth, characterization, and device physics of semiconductor materials for novel devices and applications, including back-end-of-line monolithic 3D materials and device integration, 2D materials, interconnects, and semiconductor defects for quantum communication. Our MBE/ALD/MOCVD cluster tool, with in-situ XPS and diffraction, enables unique studies critical to advancing these technologies

Siddharth Joshi (Asst Prof, Computer Science & Engineering) sjoshi2@nd.edu, website: https://siddharth-joshi.com/: Massively parallel circuits for mixed-signal computing and sensing under energy and power constraints. Front-end, data converter, and baseband circuits for low-power, high-performance wireless transceivers. Novel machine learning accelerators with in- and near- memory structures. Algorithm-hardware codesign for autonomous and intelligent systems

Kai Ni (Asst Prof, Electrical Engineering) kni@nd.edu, website: https://engineering.nd.edu/faculty/kai-ni/ Integration of novel functional materials into the new nanoelectronic devices and exploring exciting applications in various domains. Utilization of novel materials, such as ferroelectric, oxide thin-film, and phase transition materials, etc. to design new devices that could greatly accelerate the deployment of Artificial Intelligence, transform the memory hierarchy, revolutionize computing paradigms, and safeguard human's space explorations.

Alan Seabaugh (Prof, Electrical Engineering) seabaugh.1@nd.edu, websites: https://seabaugh.nd.edu/, https://nano.nd.edu/: Analog memory for AI, resistive-read ferroelectric random access memory (FRAM), back-end-of-line (BEOL) transistors and memory, tunnel FETs, heterogeneous integration in

BEOL, integrated circuit fabrication, workforce development. Director, Notre Dame Nanoscience & Technology

Gregory Snider (Prof, Electrical Engineering) snider.7@nd.edu, website: https://ee.nd.edu/faculty/gregory-snider/: Circuits and devices for ultra-low energy dissipation in computation. Nanoelectronic devices for conventional and quantum computing; nanofabrication and micromachining techniques. Chair, Department of Electrical Engineering

2. Wireless 5G/6G, mmwave - THz devices, circuits, antennas, W to G band

Jon Chisum (Assoc Prof, Electrical Engineering) jchisum@nd.edu, website: https://microwavelab.nd.edu/: circuits and antenna systems for millimeter-wave (MMW) wireless communications and sensing; utilize new materials (e.g., phase-change, dielectrics) and novel devices to realize improved performance over the state of the art, or provide completely new functionality; MMW and THz lens antennas; Low-energy radios for MMW Massive-MIMO

Patrick Fay (Prof, Electrical Engineering)

Lei Liu (Assoc Prof, Electrical Engineering) lliu3@nd.edu, website: https://www3.nd.edu/~lliu3/: millimeter- and submillimeter-wave device and circuit design, modeling, and testing, quasi-optical techniques, terahertz detectors for imaging and spectroscopy, novel microwave materials and devices, superconducting electronics, and microfabrication and processing

Bert Hochwald (Prof, Electrical Engineering) bhochwald@nd.edu, website: https://wireless.nd.edu/: high-frequency radio circuits, sixth-generation cellular technologies, and methods to reduce human exposure to electromagnetic radiation from cell phones; oversees the RadioHound spectrum sensing platform; co-director ND Wireless Institute

Nick Laneman (Prof, Electrical Engineering) jnl@nd.edu, website: https://jnlaneman.github.io/: communications system engineering—blending information theory, signal processing for communications, as well as prototyping and experimental validation—with emphasis on wireless systems; Co-director ND Wireless Institute; Director, SpectrumX

SpectrumX, a National Science Foundation Spectrum Innovation Center https://www.spectrumx.org/ SpectrumX, initiated by a 5-year, $25M center grant from the U.S. National Science Foundation, is the world's largest academic hub where all radio spectrum stakeholders can innovate, collaborate, and contribute to maximizing social welfare of this precious resource. SpectrumX, is led by the University of Notre Dame and brings together a team of 41 founding researchers and staff from 27 universities, including 14 minority serving institutions (MSIs), a key federal research facility, and corporate partner. SpectrumX's vision is to become a trusted resource within the spectrum ecosystem offering objective, long-term and innovative policy and technical contributions through collaborative, inclusive and integrative education and research activities.

3. Biomedical devices, bioelectronics, medical diagnostics

Tom O'Sullivan (Assoc Prof, Electrical Engineering) tosullivan@nd.edu, website: https://osullivangroup.nd.edu/: novel devices and techniques to perform noninvasive and minimally invasive quantitative measurements of tissue composition, architecture and metabolic function

Scott Howard (Assoc Prof, Electrical Engineering) showard@nd.edu, website: https://howardphotonics.nd.edu/: biomedical photonics, including optoelectronic device development used as sources in systems, technique development, contrast agent development, and new platform development; methods to reconstruct crowd locations in complex RF environments

4. Photonics - optical materials and devices, lasers

Anthony Hoffman (Assoc Prof, Electrical Engineering) ajhoffman@nd.edu, website: https://photon.nd.edu/: optical materials and devices that emit, detect, and control optical fields, including metamaterials, intersubband devices, localized and propagating surface polaritons, mid-infrared intersubband lasers, deep-ultraviolet interband lasers,q uantum repeaters, quantum sensing, long-wavelength optoelectronics, super-resolution imaging, quantum education/training

Doug Hall (Assoc Prof, Electrical Engineering) dhall@nd.edu, website: https://engineering.nd.edu/faculty/douglas-hall/: understanding and developing new applications of native oxides for optoelectronic, electronic, and integrated optics devices, including wafer bonding for heterogeneous integration. Silicon Photonics. Photonic Integrated Circuits. Semiconductor diode laser fabrication and characterization.

5. Secure Edge / IoT Computing and AI

Sharon Hu (Prof, Computer Science & Engineering) shu@nd.edu, website: https://sites.nd.edu/xsharon-hu/: Circuit and architecture design with emerging technologies, energy and reliability aware system design, in-memory computing for data intensive and privacy-preserving applications, resource management for real-time embedded systems, hardware-software co-design, and computational medicine

Michael Niemier (Prof, Computer Science & Engineering) mniemier@nd.edu, website: https://niemierlab.nd.edu/: computation beyond the CMOS field effect transistor, including the design and evaluation of computer architectures for emerging technologies, the integration of heterogeneous technologies to improve computational performance, and non-Boolean computing systems. He also has a strong interest in education, including integrating issues related to nanoscale design into a "conventional" computer science curriculum

Siddharth Joshi

Ningyuan Cao

Kai Ni

Michael Lemmon (Prof, Electrical Engineering) lemmon@nd.edu, website: https://www3.nd.edu/~lemmon/: neural network computation, specifically with regard to issues of fairness and implicit bias in federated learning platforms; large-scale sensor-actuator networks; networked control systems

6. Semiconductor and Microelectronics Workforce Development

Matthew Morrison (Assoc Teaching Prof, Computer Science & Engineering) mmorri22@nd.edu, website: http://sites.nd.edu/mmorrison/2018/12/28/morrison/: Low-power hardware security, digital and analog VLSI design, smart and connected health in athletic and space environments, experiential learning, and STEM outreach and education. Co-organizer of the Design Automation Conference Summer School.

Alan Seabaugh

Greg Snider

7. Quantum Materials

Badih Assaf (Asst Prof, Physics and Astronomy) bassaf@nd.edu, website: https://badihassaf.wordpress.com/: Synthesis and characterization of topological and quantum materials having reduced dimensions

Yamil Colón (Asst Prof, Chemical and Biomolecular Engineering) ycolon@nd.edu, website: https://www.computationalnano.org/: leveraging data science, statistical mechanics, molecular modeling, and machine learning tools to design and discover new materials

Morten Eskildsen (Prof, Physics and Astronomy) eskildsen@nd.edu, website: https://www3.nd.edu/~vortex/: experimental studies of mesoscale magnetic structures, namely skyrmions in chiral magnets or vortices in superconductors

László Forró (Prof, Physics and Astronomy) lforro@nd.edu, website: https://quantummatter.nd.edu/: quantum electronic materials, functional nanostructures, and biomaterials

Christopher Hinkle

Anthony Hoffman

Yi-Ting Hsu (Asst Prof, Physics and Astronomy) yhsu2@nd.edu, website: https://sites.google.com/view/hsugroup/home, theoretical studies of emergent phenomena in quantum many-body systems driven by intertwined symmetries, topology, and interactions

Boldizsár Jankó (Prof, Physics and Astronomy) bjanko@nd.edu, website: http://sites.nd.edu/condensed-matter-theory/, confined vortex network of type-II superconductor, optical cooling of semiconductors, superfluorescence from perovskite nanocrystal superlattices

Dafei Jin (Assoc Prof, Physics and Astronomy) dfjin@nd.edu, website: https://sites.nd.edu/dfjin/, single-electron qubits, superconducting qubits; few-phonon optomechanics; quantum and topological photonics and electronics

Craig Lent (Prof, Electrical Engineering) lent@nd.edu, website: https://www3.nd.edu/~lent/, Quantum Dot Cellular Automata (QCA), enabling binary computing scaled down to the single molecule size scale. Quantifying the spread of entanglement in quantum information in qubit arrays

Xinyu Liu (Assoc Research Prof, Physics and Astronomy) xliu2@nd.edu, website: https://physics.nd.edu/people/xinyu-liu/, structural, electrical, and optical properties of semiconductor alloys and their heterostructures; band structure, optical, electrical and magnetic properties of diluted magnetic semiconductors, including bulk and low-dimensional structures; growth by molecular beam epitaxy and physics of low-dimensional semiconductor structures; physics of ferromagnetic semiconductors; electrical transport in magnetic semiconductors; electronic spin phenomena in semiconductor nanostructures; semiconductor/superconductor hybrid structures

Xiaolong Liu (Asst Prof, Physics and Astronomy) xliu33@nd.edu, website: https://sites.nd.edu/xliu/, creation, manipulation, visualization, and understanding of novel quantum states of matter such as unconventional superconductivity

Yiyu Shi (Prof, Computer Science and Engineering) yshi4@nd.edu, website: https://www3.nd.edu/~scl/, Quantum machine learning; quantum optimal control; hardware/software co-design for quantum computers

Greg Snider

The Stavropoulos Center for Complex Quantum Matter, https://quantummatter.nd.edu/
The center is engaged in materials discovery (synthesis and imaging), electronic transport and magnetism, atomic-resolution microscopy, out-of-equilibrium transport in condensed matter, and theoretical understanding of time-dependent phenomena and quantum information. This center was established in 2019 with 8 faculty positions.

8. Quantum Computing and Networks

Anthony Hoffman

Peter Kogge (Prof, Computer Science and Engineering) kogge@nd.edu, website: https://engineering.nd.edu/faculty/peter-kogge/, massively parallel processing architectures, advanced technology and architectures, non van Neumann models of programming and execution, parallel algorithms and applications and their impact on computer architecture; benchmarking unconventional systems. Retired IBM Fellow. Notre Dame Site lead for NSF IUCRC - Center for Quantum Technologies

Jarek Nabrzyski (Director, Center for Research Computing) naber@nd.edu, website: https://crc.nd.edu/, distributed ledger technologies and quantum computing

Petr Stepanov (Asst Prof, Physics and Astronomy) pstepano@nd.edu, website: https://sites.nd.edu/stepanovlab/lab-members/, emergent phenomena in van der Waals heterostructures Polaritons and light-matter interaction in strongly correlated systems Unconventional superconductivity

Mariya Vyushkova (Quantum Computing Research Scientist, Center for Research Computing) Mariya.Vyushkova.1@nd.edu, website: https://crc.nd.edu/about/people/mariya-vyushkova/, quantum algorithms, quantum programming, and chemistry applications of quantum computing

Notre Dame Facilities

Notre Dame Nanofabrication Facility (NDNF) www3.nd.edu/~ndnf/index.html
The Notre Dame Nanofabrication Facility (NDNF) is a 9,000-square-foot teaching and research cleanroom that houses a wide array of tools for material and device processing. The NDNF provides a comprehensive suite of state-of-the-art equipment for designing and manufacturing integrated circuits and devices with geometries of a few nanometers. NDNF researchers explore a wide range of materials and processes, including silicon-related electronic devices, compound semiconductors, zinc selenide nanowires, carbon nanotubes, graphene, and organic polymer-based materials. In addition, the NDNF facilitates the study of microfluidic technologies and for microelectromechanical device fabrication.

Advanced Manufacturing - Notre Dame Engineering Innovation Hub
https://engineering.nd.edu/departments-programs/engineering-innovation-hub-at-notre-dame/
The Notre Dame Engineering Innovation Hub (EIH) is a 10,000-square-foot facility in the heart of Notre Dame's campus that offers a state-of-the-art experiential learning and advanced manufacturing environment with first-rate resources for collaboration, fabrication, automation, robotics, and modeling. The EIH combines dedicated collaboration space with leading-edge technology and expertise, including advanced manufacturing; additive manufacturing (3D printing); metrology and computing resources; and fabrication and machining technology. The EIH serves as a regional resource to develop innovative product solutions for established companies and new start-ups.

University of Notre Dame IDEA Center https://ideacenter.nd.edu/
The IDEA Center is the fundamental resource for commercialization and entrepreneurial activities at ND. It provides the space, services, and expertise for idea development, commercialization, business formation, prototyping, entrepreneurial education and student entrepreneurial efforts. A central focus for the IDEA Center is to advance the commercial potential of University research.. The IDEA Center has launched over 100 startups that have collectively raised over $20M in investment.

Notre Dame Integrated Imaging Facility https://imaging.nd.edu/
The Notre Dame Integrated Imaging Facility (NDIIF) provides an integrated suite of sophisticated microscopes and imaging stations that enable expert users to address the most complex modern research problems. The NDIIF's Electron Microscopy Core integrates a unique bundle of state-of-the-art FEI instrumentation, including a Magellan 400 field emission scanning electron microscope, Helios G4 Ux DualBeam, Spectra 300 scanning transmission electron microscope, JEOL 2011 transmission electron microscope, Leica Automatic Plunger Freezer EM GP2, and a Leica EM UC7 Ultramicrotome.

Notre Dame Nanoscience & Technology (NDnano) https://nano.nd.edu/ This center represents 80+ multidisciplinary faculty across the Colleges of Engineering and Science and promotes collaborative research to address unsolved scientific and technical questions. Notre Dame faculty, researchers, and students collaborate to broaden understanding and organize multidisciplinary research and proposal teams.

The Stavropoulos Center for Complex Quantum Matter, https://quantummatter.nd.edu/
The center is engaged in materials discovery (synthesis and imaging), electronic transport and magnetism, atomic-resolution microscopy, out-of-equilibrium transport in condensed matter, and theoretical understanding of time-dependent phenomena and quantum information. This center was established in 2019 with 8 faculty positions.