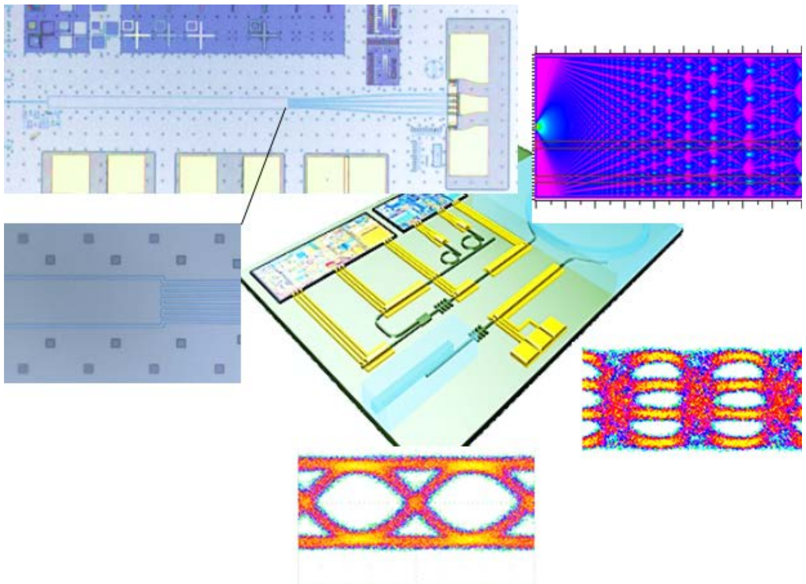
Beling Research Group



Our group focuses on integrated photonic technologies for optical communications, sensing, and the emerging field of microwave photonics.
Recent work includes the development of high-speed high-power photodiodes for photonic microwave generation, radar transmit and receive applications, and optical communications. Other projects are focused on simulation, design, fabrication, and characterization of Indium phosphide-based photonic integrated circuits on a silicon photonic-electronic platform.

Andreas Beling

Assistant Professor
andreas@.virginia.edu
www.ece.virginia.edu/faculty/beling.html

Dept. of Electrical & Computer Engineering
University of Virginia
Charlottesville, VA
434.243.2147

"Develop enabling optoelectronic devices for broadband communications and photonic systems."

University of Virginia Engineering

High-Speed Optoelectronic Devices

Driven by the ever-increasing demand for higher capacity in optical communication systems optoelectronic components continue to play a crucial role in evolving fiber optic systems as they are required to operate at higher and higher speed and at an increasingly higher spectral efficiency. High-speed applications in microwave photonics, including RF optical links, oscillators, and radar, call for integrated high-performance devices with higher bandwidth, better power handling capability, and higher linearity to improve signal-to-noise ratio and spur-free dynamic range. To meet future requirements of these applications photonic integrated circuits (PICs) combining optical, optoelectronic and eventually electronic functionalities on a single chip will become more and more important. Our research is focused on the development of optoelectronic devices and technologies that enable new applications and advances in a wide range of photonic systems. Our work includes the development of state-of-the-art high-speed high-efficiency waveguide photodetectors, integrated optical coherent receivers, high-power photodiodes and arrays, and large dynamic range detectors.

InP-Based Photonic Integrated Circuits on Silicon Photonic-Electronic Platforms

Heterogeneous integration of III-V material on silicon is a promising approach to realize high-performance optoelectronic devices on a silicon photonics platform. Owing to their material properties, Indium phosphide-based photodiodes (PDs) allow for complex bandgap engineering and have the potential to achieve low dark current, high saturation current and wideband absorption over C- and L-bands. We have demonstrated discrete InP-based modified uni-traveling carrier PDs that have achieved record-high saturation current and high linearity. In collaboration with UC Santa Barbara and Aurrion Inc., we have been using wafer-bonding technology to integrate this type of photodiode on Silicon-on-insulator waveguides. The goal of this work is to enable high-performance photonic integrated circuits on a versatile Silicon photonic-electronic platform.

Microwave Photonics

Microwave photonics, an emerging field that unites the domains of radio frequency (RF) engineering and photonics, has the potential to become a disruptive technology as integrated photonic-electronic technologies offer operational capabilities not possible with all-electronic systems. Progress in the field will advance radar, obstacle avoidance, portable sensing and imaging, communications, electronic warfare systems, antenna remoting, and phased array beam forming. Our group studies a variety of microwave photonic systems including RF optical links, photonic pulsed RF generation, and photonically driven integrated antennas.

RECENT RESEARCH DEVELOPMENTS

- We demonstrated high-speed waveguide-coupled photodiodes that achieved the highest output power levels to date.
- Developed integrated distributed traveling wave photodetector for sub-Terahertz applications up to 300 GHz.
- Fundamental research on non-linear mechanisms in photodiodes that led to photodiodes with the highest linearity and output power to date.

RECENT GRANTS

- Direct On-Chip Digital Optical Synthesizer (DODOS) – Defense Advanced Research Projects Agency (DARPA).
- Resonant Cavity Photodetectors using thin GaInAs/GaAsSb Quantum Wells – National Science Foundation (NSF).
- Highly Linear Uni-traveling Carrier Photodiodes for Pulsed Photonic Applications) – Rockwell Collins.

SEAS Research Information
Pamela M. Norris,
Executive Associate Dean for Research
University of Virginia
Box 400232
Charlottesville, VA 22903
pamela@virginia.edu
434.243.7683

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