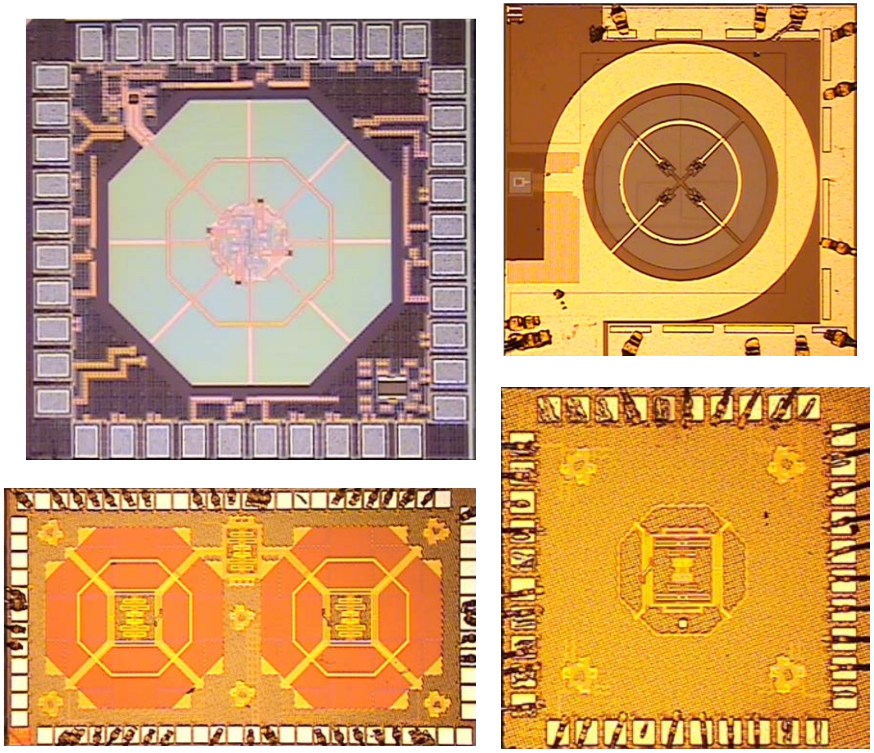

The Integrated Electromagnetics, Circuits, and Systems (IECS) led by Prof. Steven Bowers at the University of Virginia is interested in identifying and using fundamental physical phenomena to bring together multiple domains including circuits, electromagnetics, photonics and bioengineering in order to develop novel systems and architectures broadly related to integrated circuit design. Increased integration and transistor scaling have opened up new possibilities for sophistication and design that are unprecedented in mankind's history. Soon we can imagine a single chip where complex digital computation can exist along with analog radio blocks, electromagnetic radiating structures and even optical interconnects and processing. This will enable the next generation of communication, high-resolution imaging, and spectroscopy that when mass produced can cost just pennies.

Integrated Electromagnetics, Circuits, and Systems Lab

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"Enabling the next generation of imaging and communication hardware through system level innovation of integrated electronic and photonic circuits."

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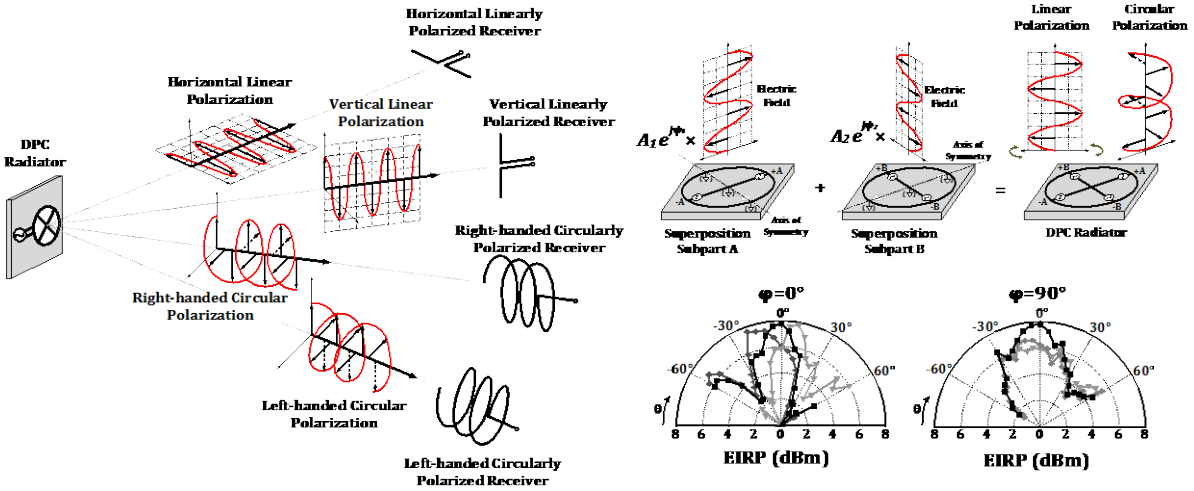
mm-Wave Integrated Radiating Structures

As the maximum frequency of operation of systems on integrated circuits (ICs) increases, the size of antennas associated with those frequencies decreases, to the point where the antennas themselves can be integrated within the IC. This integration opens up new design spaces not feasible with discreet antennas where, in addition to the phase and amplitude, the polarization of the radiated electromagnetic field can be controlled entirely electronically with no mechanical movement. This can enable a system where polarization matching between transmit and receive antennas can be maintained even if the orientation or polarization of the receive antenna changes over time. This was demonstrated in a 2x1 integrated antenna phased array with dynamic polarization control in collaboration with members of the CHIC lab at Caltech.



Integration of Photonic Systems on Silicon Substrates

Photonic integrated circuits (PICs) also present new opportunities for integrated circuit system designers, as systems that previously required large bench top solutions can now be integrated into small packages only a few millimeters on a side. One demonstration of this was creating sub-THz electromagnetic radiation generated by photo-mixing two wavelengths of infrared light to multiple photodiodes on a PIC to drive a multi-port integrated antenna done in collaboration with members of the CHIC lab at Caltech.

RECENT RESEARCH DEVELOPMENTS

- Dynamic polarization control on an integrated electromagnetic radiator was demonstrated at 105.5 GHz
- Photonic integrated circuit implements optically driven multi-port antennas generate electromagnetic radiation from 170-190 GHz.

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