

Lightwave electronics

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Modulating the flow of electrons in semiconductors is central to modern information processing. The 1956 Nobel Prize in Physics was awarded to three researchers who performed experiments that laid the groundwork for the first semiconductor transistors. Much of today's technology is built upon these foundations. Unfortunately, the raw processing speed of conventional electronics is no longer increasing.

The 2023 Nobel Prize in Physics was awarded to three researchers who made pioneering contributions to the experimental tools required to steer and observe electronic processes in atoms on attosecond timescales (1 attosecond = 10^{-18} seconds). Harnessing such rapid processes in compact, solid-state devices would accelerate classical information processing from GHz rates to the order of 100 terahertz (1 terahertz = 10^{12} Hz). Conventional wires have severe limitations at these frequencies, so attosecond electronic processes must be controlled with high-frequency electromagnetic waves, *i.e.*, light.

Lightwave electronics focuses on using precise laser light to manipulate both classical and quantum attributes of electrons on very short timescales. As a research assistant in the Sederberg Photonics Lab, you will receive advanced training in femtosecond laser operation, optics, and measurement techniques. You will learn to implement and use an experimental technique, depicted in the figure below, that Dr. Sederberg developed while working in Ferenc Krausz's (one of the 2023 Nobel Prize in Physics recipients) research group. This apparatus will be used to implement lightwave electronics in both established and emerging material platforms.

Required skills/background:

- Laser safety training will be required before you are able to work in the lab.
- Any coursework in electromagnetics, optics, or quantum mechanics will give you a deeper understanding of the project.
- Use of Matlab or Python to interface instruments to a PC and automate measurements.
- Data analysis and plotting.
- CAD and PCB design.

Excellent candidates enrolled in an honours program will be offered the possibility to directly transfer the experience they have gained to an undergraduate thesis project.

