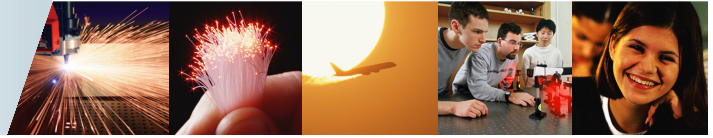


# Photonics

## An *Enabling* Technology



### What Is Photonics?

Photonics is the technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. Photonics involves cutting-edge uses of lasers, optics, fiber-optics, and electro-optical devices in numerous and diverse fields of technology—manufacturing, health care, telecommunication, environmental monitoring, homeland security, aerospace, and many others.

### Why Is Photonics Important?

Lasers and other light beams are the “preferred carriers” of energy and information for many applications. For example:

- Lasers are used for welding, drilling, and cutting of metals, fabrics, human tissue, and other materials.
- Coherent light beams (lasers) have a high bandwidth and can carry far more information than radio frequency and microwave signals.
- Fiber optics allow light to be “piped” through cables.
- Spectral analyses of gases and solid substances provide positive identification and quantifiable concentrations.

The applications of photonics as an “enabling” technology are extremely broad. From an educational standpoint, this means that the infusion of one or two photonics courses into two-year postsecondary programs in related

technologies can qualify graduates for a far wider variety of jobs and increase the global competitiveness of the American workforce.

### Projected Demand for Workers in Photonics-Enabled Technologies

Rapid growth in the number and complexity of photonics and photonics-enabled technologies has caused the demand for technicians to exceed supply. The number of college degrees in engineering is decreasing, causing fierce competition for the relatively small pool of qualified optics technicians and engineers. A recent survey of employers showed that the number of U.S. technical jobs in photonics and photonics-enabled technologies is expected to

grow more than 1800 per year on average through 2009, an annual increase of more than 6 percent. Clearly, the current supply of qualified graduates of two-year

postsecondary programs falls far short of industry demand.

The current supply of qualified graduates of two-year postsecondary programs in optics, photonics, and related technologies falls far short of industry demand.

### Photonics-Enabled Fields

- **Aerospace technology**—Uses LiDAR (laser RADAR systems) and laser altimeters, imaging systems for test and analysis of aircraft, holographic heads-up displays, and optical pattern recognition systems for navigation
- **Agriculture**—Uses satellite remote sensing to detect large-scale crop effects, scanning

technology and infrared imaging to monitor food production and quality, and sensor systems for planting and irrigation

- **Biomedicine**—Uses lasers for surgery, therapies such as photodynamic therapy, and in situ keratomileusis (LASIK) procedures; uses testing and analysis devices such as noninvasive glucose monitors
- **Construction**—Includes scanning site topography, laser bar-code readers to inventory materials, laser distance measuring and alignment, and three-dimensional analysis to track the progress of construction
- **Engineering, microtechnology, and nanotechnology**—Uses lasers in the manufacture of electrical devices, motors, engines, semiconductor chips, circuits, and computers; via photolithography, photonics is central to mems production.
- **Environmental technology**—Uses ultraviolet Doppler optical absorption spectroscopy (UV-DOAS) to monitor air quality; uses fast Fourier transform analysis to monitor particulate matter in effluents released from stacks
- **Geographic information systems and global positioning**—Uses optics and photonics in imaging and image processing to refine atmospheric and space-based images
- **Information technology**—Uses optics for data storage, ultrafast data switching, and (especially) transmission of data across fiber-optic networks
- **Chemical technology**—Relies on molecular optical spectroscopy for analysis and on ultrashort laser pulses to induce fluorescence; chemical vapor deposition and plasma etching support photonics thin film applications

- **Transportation**—Uses optics for monitoring exhaust emissions to ensure the integrity of shipping containers arriving from foreign ports, and navigation with ring laser gyroscopes
- **Homeland Security**—DNA scanning, laser forensics, retinal scanning, identification of dangerous substances, optical surveillance
- **Manufacturing**—Laser welding, drilling, and cutting; precision measurements

### **OP-TEC: Building the Educational Pipeline**

OP-TEC, the National Center for Optics and Photonics Education—funded through the National Science Foundation’s Advanced Technological Education (ATE) program—is pooling the expertise and resources of schools (especially two-year postsecondary), businesses, and professional associations in supporting the implementation of photonics programs and/or elective courses (including teacher professional development) in high schools and colleges toward the aim of creating a secondary-to-postsecondary “pipeline” of highly qualified and strongly motivated students. By empowering community colleges to meet the urgent need for technicians in optics and photonics, OP-TEC will play a significant role in maintaining our country’s economic competitiveness and military preparedness, and ensuring that highly rewarding jobs will be retained for American citizens.

#### **For more information**

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