

Careers in Optics and Photonics

The PhD program in Optical Science and Engineering at UNC Charlotte

Jay Mathews

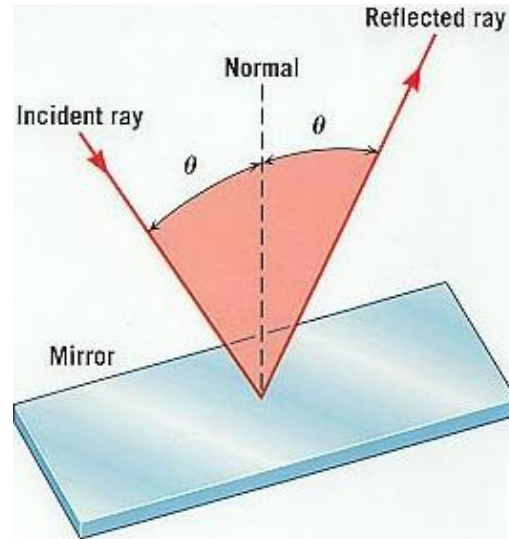
Associate Professor

Department of Physics and Optical Science
University of North Carolina at Charlotte

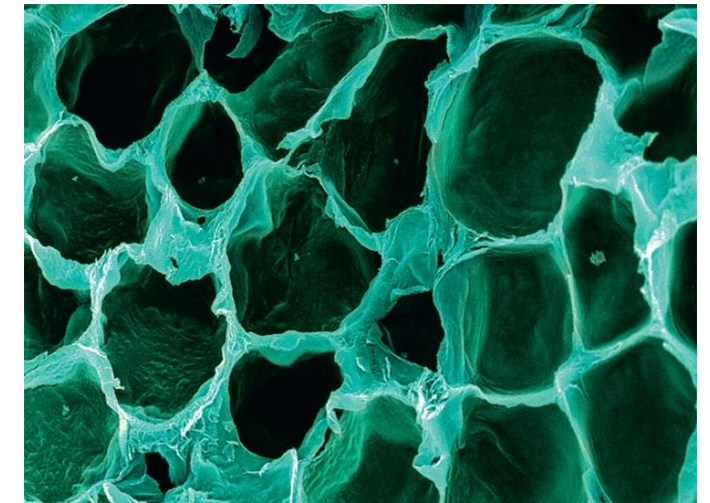
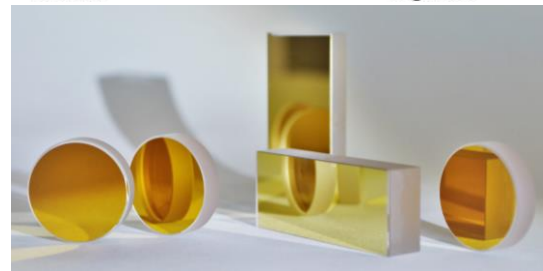
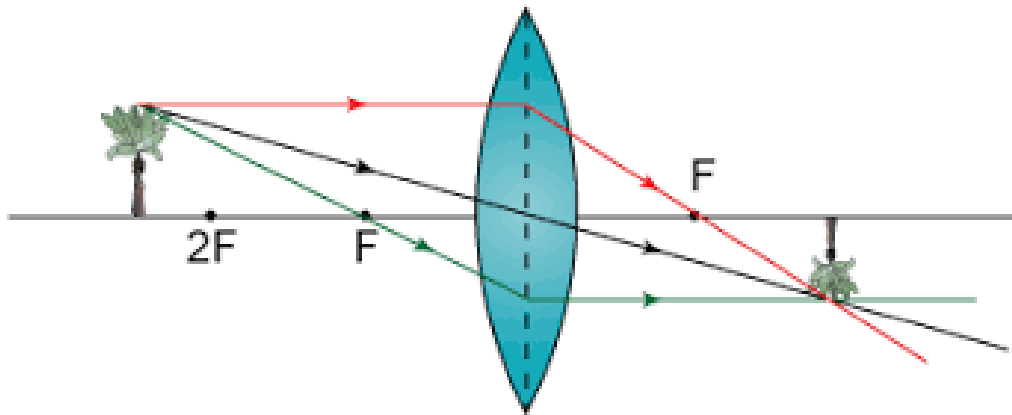
The field of optics

Classical optics

- Reflection
- Refraction
- Lenses
- Imaging
- Diffraction



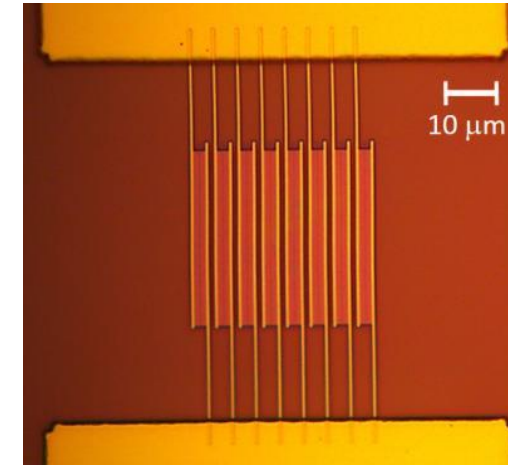
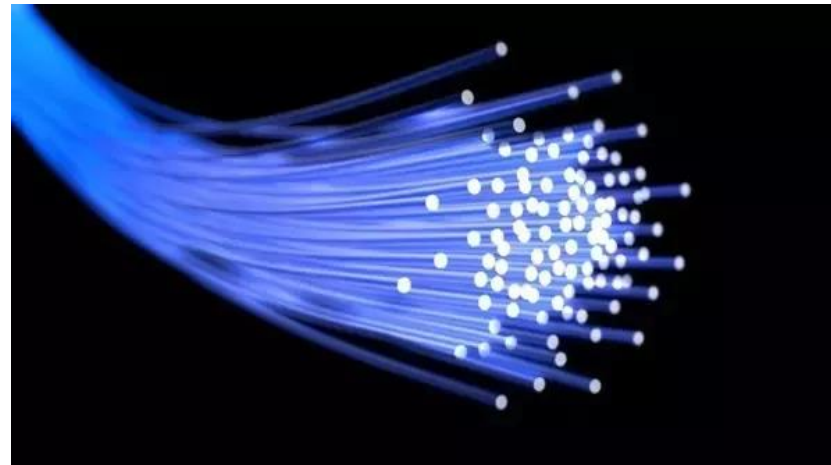
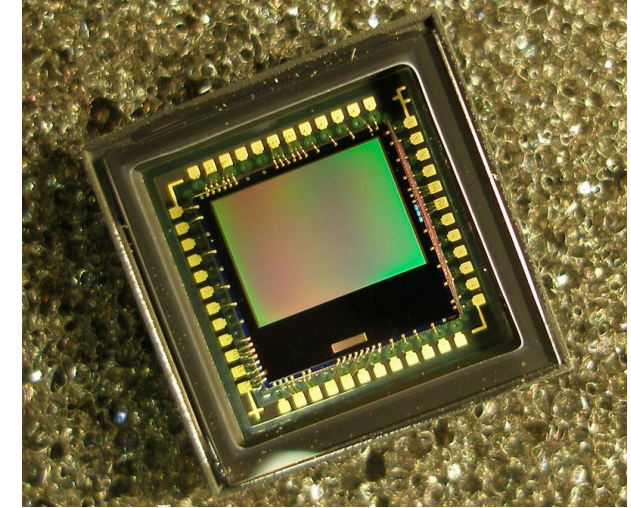
Optics is mostly about passive devices: bending light with lenses, reflecting from surfaces to make images, and using interference and diffraction



Photonic devices

Photonics is about active devices that can be controlled to generate, transmit, manipulate, and detect light

- **Light generation**
Lasers and LEDs
- **Transmission**
Optical fibers and waveguides
- **Modulation**
Electro-optic modulators
- **Detection**
Photodetectors
- **Amplification**
Resonators and cavities

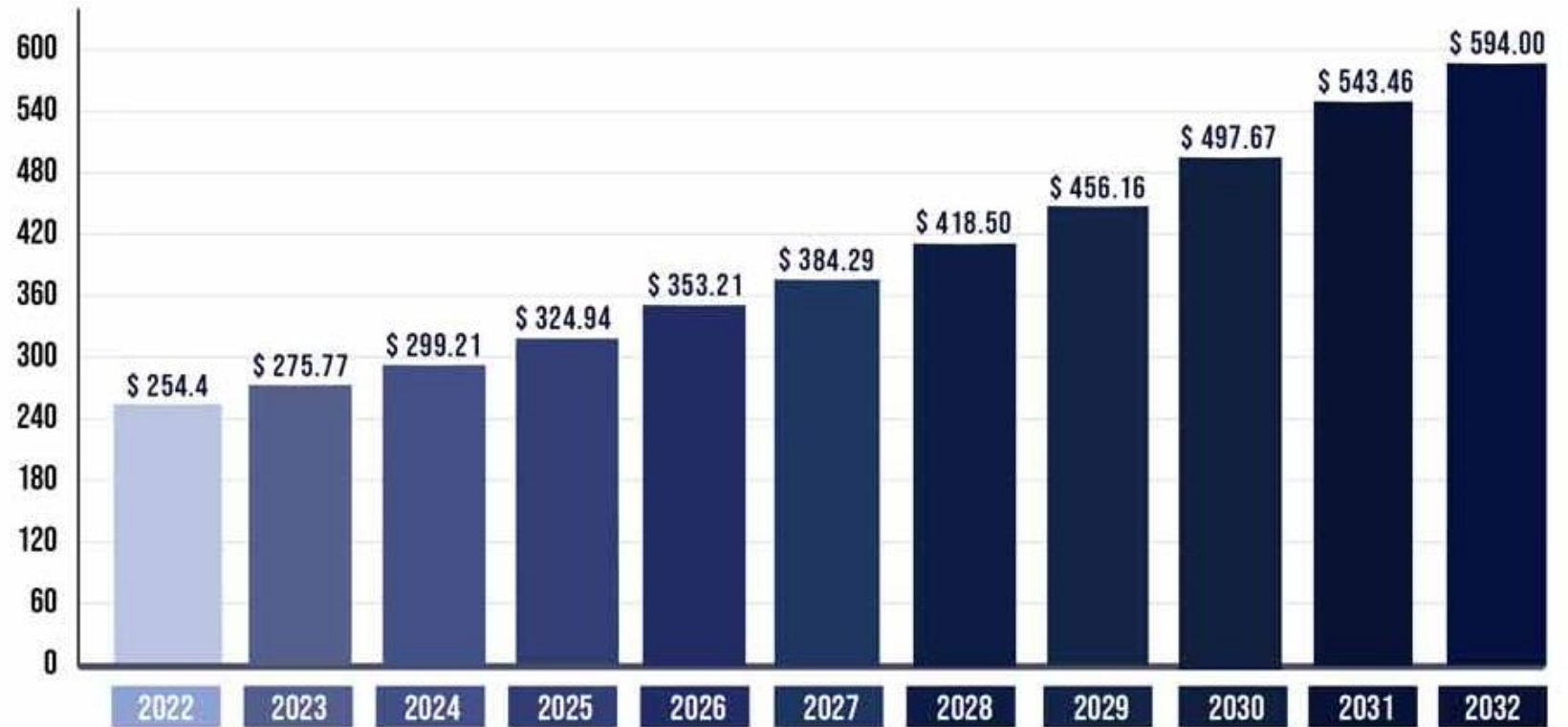


The optics industry

- Nearly \$300bn industry in 2024
- Projected to be nearly \$600bn
- One of the fastest growing areas of electronics industry
- LiDAR, Lighting Solutions, Optical Communication, Intelligence, Surveillance & Reconnaissance, Medical Equipment, Cameras, Metrology Devices, 3D Scanners



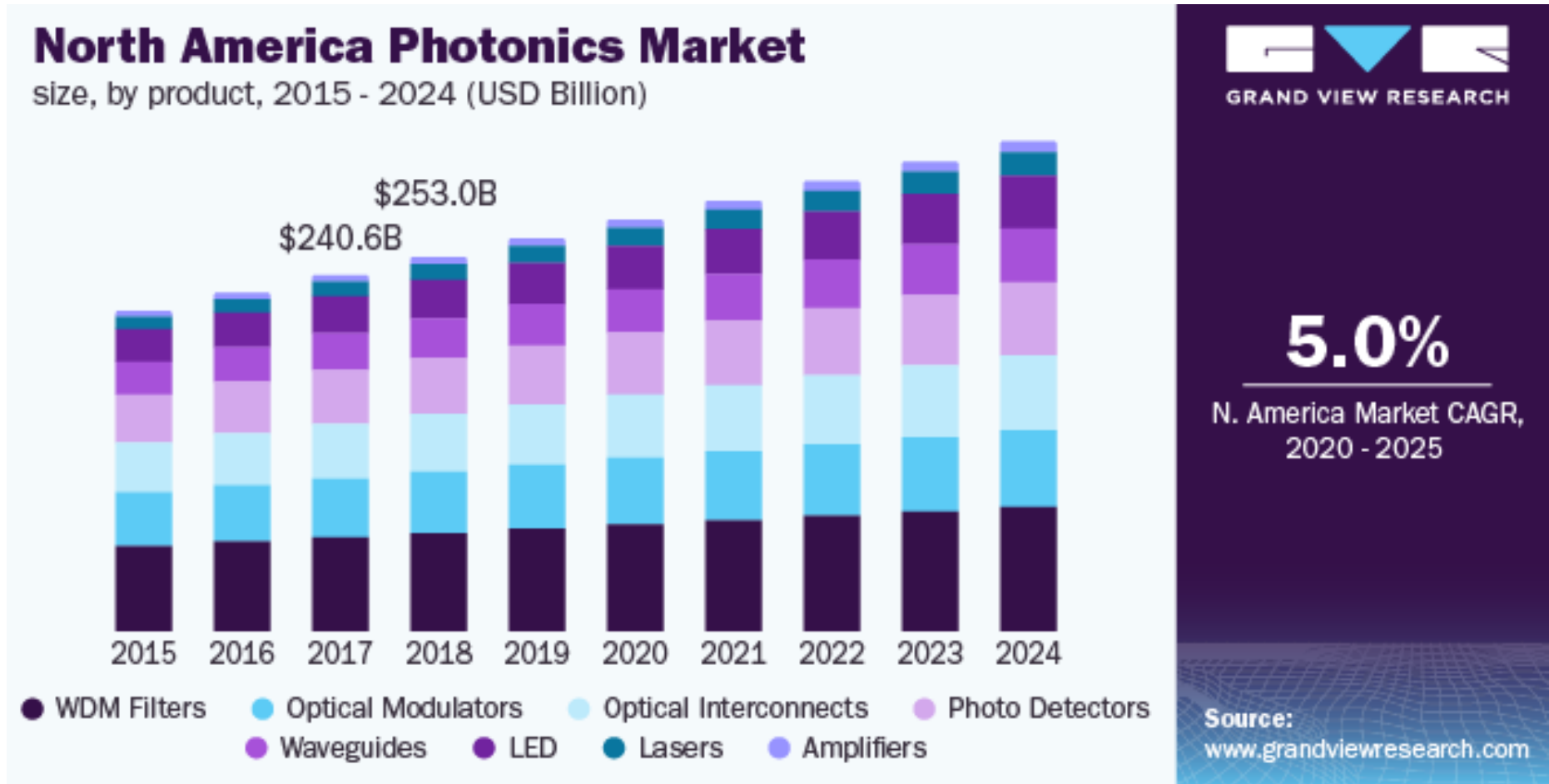
ADVANCED OPTICS MARKET SIZE 2022 TO 2032 (USD BILLION)



Source: www.precedenceresearch.com

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Salaries in the optics industry

Median salary by job level, selected countries

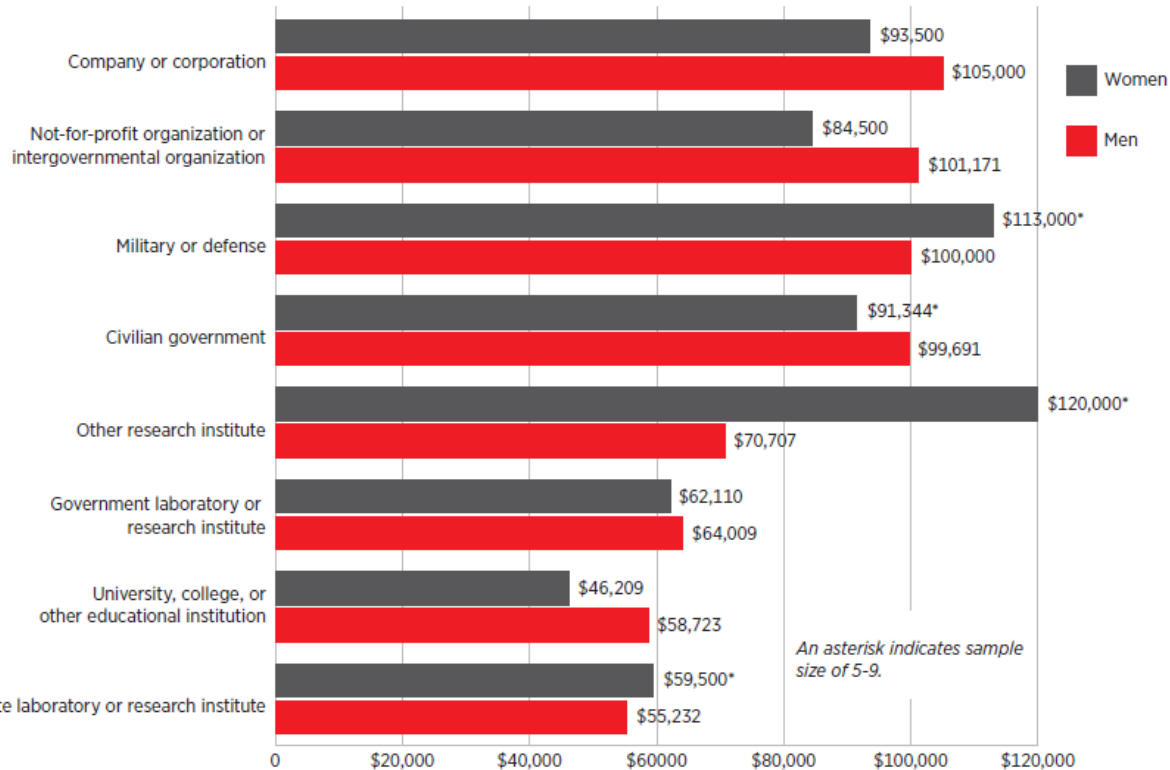
- Starting salary for PhD in Optics is typically over \$100k per year in the US
- PhDs with optics backgrounds are highly sought after in industry
- There are not enough skilled workers to fill all the jobs!

	Staff	Lead or senior level	Supervisor or manager	Assistant professor	Associate professor	Full professor
United States	\$107,000	\$150,000	\$148,788	\$105,000	\$120,000	\$150,000
Netherlands	\$84,696*	\$116,881				
Germany	\$75,195*	\$83,550*	\$112,792*			
South Korea	\$71,032	\$95,989	\$115,187			
Canada	\$66,916	\$92,895	\$100,374			\$110,214*
France	\$53,867*	\$64,934	\$67,757		\$45,171*	
Japan	\$51,664	\$74,913	\$90,412	\$48,220*	\$67,163*	\$94,717
United Kingdom	\$48,752	\$71,636	\$60,940*		\$69,066*	\$134,068*
Italy	\$45,171	\$70,580	\$56,464	\$40,654	\$62,110	\$75,662*
Spain	\$39,525	\$62,110*		\$37,266*	\$56,464	\$92,601*
Peoples Republic of China	\$32,211	\$72,278*	\$70,707*	\$39,282*	\$31,425	\$39,282
Russia	\$11,308	\$17,960	\$19,956*		\$11,973*	\$18,625*
India	\$9,393	\$32,205*	\$14,761*	\$13,419	\$32,205*	\$33,547

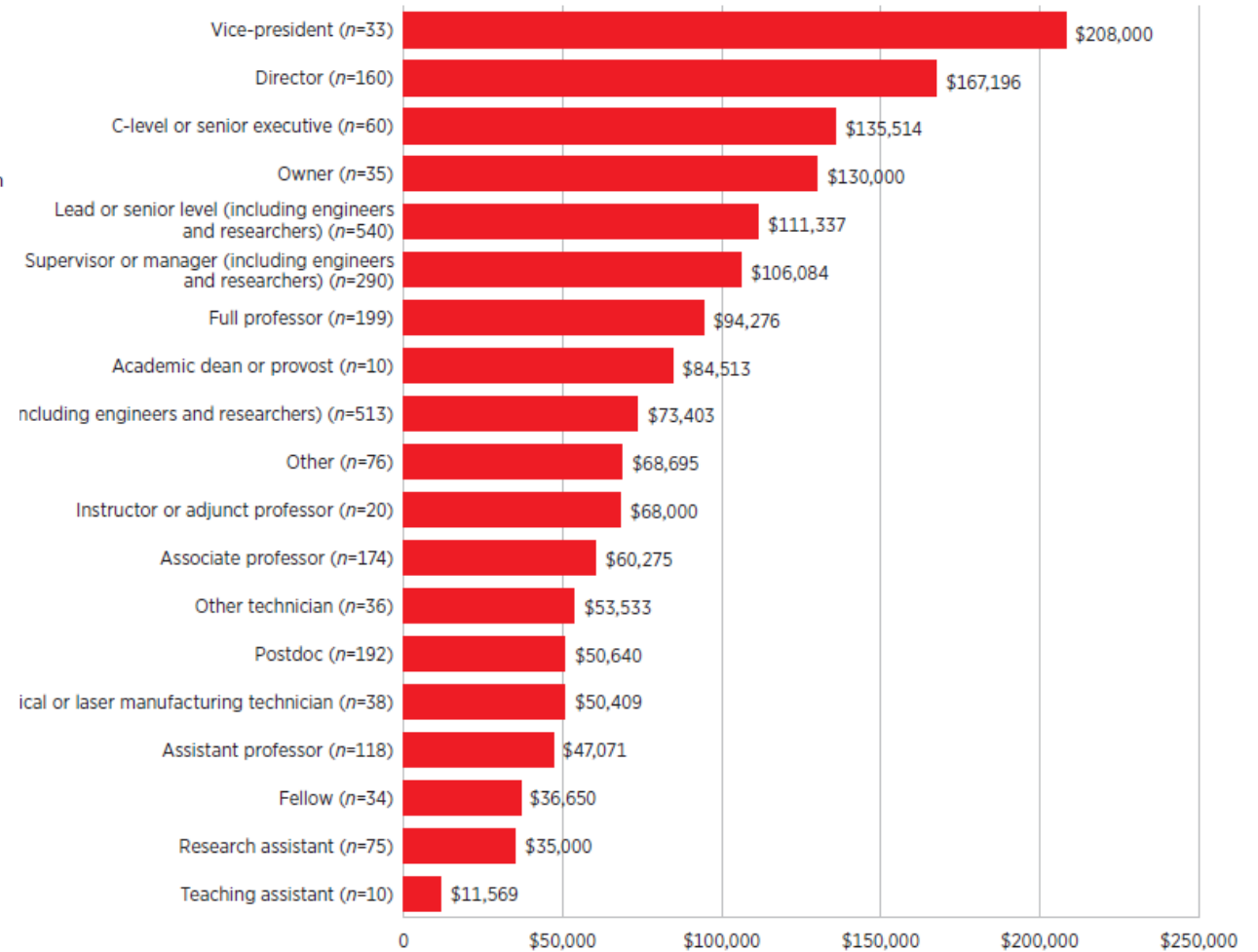
Blank cells result from sample size below 5 respondents. An asterisk indicates sample size of 5-9.

Salary by industry and job level

Median salary by gender and employer type



Median salary by job level



PhD Optical Science and Engineering

- Study the field of optics and photonics through specialized courses
- Hands-on experience through laboratory courses
- Perform research in optics and photonics
- Professional development
- Become an independent researcher in a supportive environment
- Get a high-paying job directly after graduation

Courses in the program

Core courses (21 credits):

- OPTI 8101 – Mathematical Methods of Optical Science and Engineering (3)
- OPTI 8102 – Principles of Geometrical Optics (3)
- OPTI 8102L – Geometrical Optics Lab (1)
- OPTI 8103 – Light Sources and Detectors (3)
- OPTI 8104 – Electromagnetic Waves (3)
- OPTI 8105 – Optical Properties of Materials (3)
- OPTI 8106 – Principles of Physical Optics (3)
- OPTI 8106L – Physical Optics Lab (2)

Additional courses (2 credits):

- OPTI 8610 – Seminar (1)
- OPTI 8611 – Graduate Colloquium (1)

Electives (9 credits):

- OPTI 8203 – Metamaterials (3)
- OPTI 8205 – Advanced Optical Materials (3)
- OPTI 8212 – Integrated Photonics (3)
- OPTI 8221 – Optical Communications (3)
- OPTI 8244 – High Speed Photonics and Optical Instrumentation(1)
- OPTI 8302 – Nanoscale Phenomena (3)
- OPTI 8371 – Solid State Materials (3)
- OPTI 8384 – Advanced Surface Metrology (3)

Dissertation Research Course (24 credit hours):

- OPTI 8991 – Dissertation Research (1 to 3)

Funding

- Teaching assistantships (\$32k per year)
- First year students typically teach lab courses and workshops, as well as perform grading and tutoring
- Research assistantships
- Faculty fund students through grants or contracts with federal, state, or non-profit institutions
- Some internal funding programs available
- Fellowships
- UNCC has multiple fellowships for grad students
- National Science Foundation, NASA, National Defense Science and Engineering

Areas of research at UNC Charlotte

- Photonic materials for infrared lasers and detectors
- Fiber optics and optical communication
- Metamaterials for high power laser optics
- Advanced optics manufacturing
- Optical spectroscopy of materials
- Microelectronic/photonic fabrication
- Femtosecond lasers and ultrafast optics
- Sensing and imaging
- Medical applications of high-power fiber lasers
- Optical and near-IR spectroscopy of planetary nebulae
- Quantum optics
- Novel structures and materials for light trapping
- Polarization-based microscopy
- Infrared antennas and transmission lines
- Metrology for optics manufacturing

Application and admission requirements

- A Statement of Purpose essay detailing the applicant's motivation and career goals.
- A minimum of three letters of reference.
- UNC Charlotte online application for graduate admission.
- Official GRE scores (can be waived if you are not able to take it).
- Official TOEFL or IELTS score from international applicants whose native language is not English, unless the previous college degree was from a country where English is the official language.
- Unofficial transcripts from all colleges and universities attended should be uploaded to the application. (Applicants offered admission will be required to submit official transcripts.)
- \$75 application processing fee (can be waived if you have financial need)

Priority application deadline: March 1st (funding decisions will be made shortly after)

Useful links

- Admissions information

<https://physics.charlotte.edu/academics/optical-science-engineering/admissions/>

- PhD program degree requirements

<https://physics.charlotte.edu/academics/optical-science-engineering/admissions/phd-program/>

- Graduate school online application

<https://gradadmissions.charlotte.edu/>

Contact information

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- **Prof. Tino Hofmann**, Associate Professor, Optical Science and Engineering Graduate Program Director
Email: tino.hofmann@charlotte.edu

Please contact us if you have any questions or would like to talk about our PhD program! We are happy to set up a Zoom meeting to talk with you.