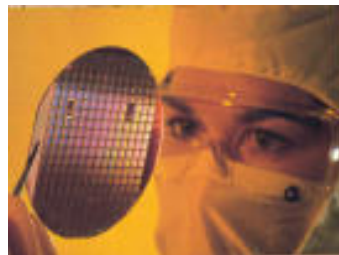
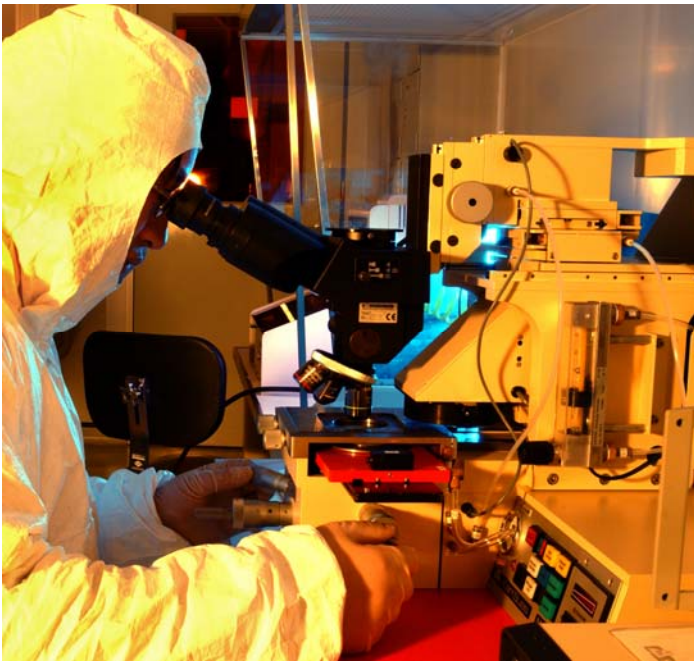


Careers in Engineering Physics



This document is a brief survey of the career possibilities available with a degree in Engineering Physics. The Engineering Physics undergraduate program at McMaster has been organized into 4 streams:

- Nano- and Micro-Device Engineering
- Photonics
- Nuclear Engineering and Energy Systems
- Interdisciplinary

In the interdisciplinary stream, students follow a course of study that covers aspects of the other three streams. Some of the possible careers made possible by an Engineering Physics degree are described below for each of the streams.

1. Nano- and Micro-Device Engineering

Electronics

Nano- and micro-device engineering is dominant in the electronics industry which seeks to miniaturize electronic components and integrated circuits to make computers, cell phones, and other electronic equipment smaller (more portable), faster, and less expensive. This has enabled computer processor speeds to increase from a few kiloHertz decades ago to several GigaHertz today, and to shrink cell phones from the size of bricks to practical hand-held devices. These are just two examples of how nano- and micro-device engineering has revolutionized the world and will continue to do so. Engineering Physicists are involved in the design and fabrication of next generation devices in this exciting and fast-paced field.

Organizations involved in nano- and micro-device engineering are collaborating to move the technology forward. These companies are organized into the Semiconductor Industry Association, SIA (http://www.sia-online.org/mem_list.cfm). The Semiconductor Research Corporation (SRC), a branch of the SIA, lists the member companies doing electronics engineering (<http://src.org/member/about/membercompanies.asp>).

A sampling of large companies doing nano- and micro-device engineering includes:

Intel

http://www.intel.com/jobs/index.htm?iid=HMPAGE+Footer_jobs

Hewlett-Packard

<http://h10055.www1.hp.com/jobsathp/>

IBM

<http://www-03.ibm.com/employment/>

Texas Instruments

http://www.ti.com/recruit/index.htm?DCMP=TIHomeTracking&HQS=Other+OT+home_embody

Hitachi

<http://www.hqrd.hitachi.co.jp/global/index.cfm>

Motorola

<http://www.motorolacareers.com/index.cfm>

Samsung

<http://www.samsung.com/AboutSAMSUNG/ELECTRONICSGLOBAL/Careers/ApplyOnline/index.htm>

Lucent Technologies

<http://www.lucent.com/work/work.html>

Agilent

<http://www.jobs.agilent.com/?cmpid=4722>

In addition to these companies, there are many local Canadian companies that continually hire Engineering Physics students, including:

Gennum (Burlington, ON)

<http://www.gennum.com/hr/index.html>

Research in Motion (Waterloo, ON)

<http://www.rim.net/careers/index.shtml>

Semiconductor Insights (Ottawa, ON)

http://www.semiconductor.com/about_si/careers/index.asp

Dalsa Semiconductor (Bromont, QC)

<http://www.dalsasemi.com/foundry/mems.asp>

Nanometrix (Montreal, QC)

<http://www.nanometrix.com/>

CMC Microsystems is a Canadian non-profit corporation that provides electronic resources, access to state-of-the-art manufacturing technologies, and support services. Their website includes a list of career opportunities at Canadian electronic companies and other websites of interest (<http://www.cmc.ca/careers/index.htm>)

A Canadian nanotechnology job centre is available at <http://cnba.tinytechjobs.com/>

The Canadian NanoBusiness Alliance (<http://www.nanobusiness.ca/partners.php>) also lists a number of member organizations interested in the development and marketing of nano-applications.

Micro-electro-mechanical Systems

Micro-electro-mechanical systems, otherwise known as MEMS, are tiny moving machines usually made from the element silicon. You may not have heard of MEMS, but they are used extensively as sensors in the automobile industry. For example, the sensor that deploys an automobile airbag is made from MEMS. But there are many other applications of MEMS:

- MEMS can include tiny vibrating structures that may be used to generate and detect the electromagnetic waves used in cell phones. These vibrating structures can also be used to produce radio frequency identification tags used to track packages (FedEx) or parts in a manufacturing line.
- Engineering Physicists are developing MEMS devices as sensitive detectors used in medicine and biology (e.g., to detect viruses).
- MEMS devices can be used to create tiny fluid pumps to mix small volumes of chemicals. This could be used in the pharmaceutical industry in drug testing, or by a physician to test for diseases.
- MEMS might be used to align tiny components in a manufacturing line.
- MEMS are used to move tiny mirrors used in a new display device called digital micro-mirror devices (DMD). It might completely replace current display technologies such as LCDs, plasma TVs, and CRTs.
- MEMS are used in optical communications to produce tiny moving mirrors that control where light goes.

Canadian companies making or using MEMS include:

Micalyne (Edmonton, AB)

<http://www.micalyne.com/>

Dalsa Semiconductor (Bromont, QC)

<http://www.dalsasemi.com/foundry/mems.asp>

Intelligent MEMS Design (Ottawa, ON)

<http://www.imemsdesign.com/>

NanoMEMS (Edmonton, AB)

<http://www.nanomems.org/>

Norcada (Edmonton, AB)

<http://www.norcada.com/index.php>

MEMSCAP

<http://www.memscap.com/>

Mechatronics

Mechatronics refers to the control and feedback mechanisms used in manufacturing processes. For example, in the manufacture of a substance, you might want to measure the pressure in a reaction chamber and use that pressure to open or close a valve to keep the pressure constant. Mechatronics involves instrumentation, data acquisition and processing, actuators, motors and motion controllers, electronics, etc – basically, anything that can be used to measure and control a process. Companies hiring product or process engineers will be interested in Engineering Physicist with some knowledge in mechatronics. If you've read this far, you'll realize that Engineering Physicists design and fabricate components and systems used in mechatronics such as MEMS and electronic devices. In Engineering Physics at McMaster, you will be involved in a number of hands-on mechatronics projects such as our 4A06 Project (<http://engphys.mcmaster.ca/undergraduate/outlines/4a06/4a06.htm>) that will prepare you for this important field. Mechatronics is also important in the field of robotics. See, for example,

MDA (Brampton, ON)

<http://www.mdrobotics.ca/>

Instrumentation

A number of companies are involved in the use of nanotechnology or microelectronics for the production of instrumentation used in industry or research. Some examples include:

Aurora NanoDevices (Nanaimo, BC)

<http://www.aurorand.com/>

Applied Nanofluorescence

http://www.appliednanofluorescence.com/Product_info.html

Others

Caneus (Montreal, QC)

<http://www.caneus.org/about.html>

CANEUS is a non-profit organization catering primarily to the needs of the aerospace community by fostering the coordinated, international development of MNT (Micro-Nano- Technologies) for aerospace applications.

CG² Nanocoatings (Ottawa, ON)

<http://www.cg2nanocoatings.com/>

Developer of nanotechnology based coatings with applications in numerous industries, including aerospace and defence, materials, optics, electronics, energy generation and medicine.

ChiralTF Devices Inc. (Edmonton, Alberta)

<http://www.chiraltf.com/about.htm>

ChiralTF is developing MEMS and advanced coating products based on its proprietary glancing angle deposition technology.

Epocal (Ottawa, ON) <http://www.epocal.com/biosensors.htm>
Developing flexible biosensor systems on a chip.

Fibics Inc. (Ottawa, ON) <http://www.fibics.com/index.html>
Develops focussed ion beam instrumentation.

Integran (Toronto, ON) <http://www.integran.com/index.htm>
Integran Technologies Inc. is the world's leading supplier of nanostructured material technologies.

Nanox (Quebec) <http://nanoxnps.com/nanoxenglish/home.htm>
Nanox currently is focused on auto catalysts that exhibit superior catalytic activity at lower temperatures using significantly reduced levels of precious metals.

Quantium (Edmonton, AB) <http://www.quantiam.com/whoweare.cfm>
In addition to new product development, Quantium provides consulting, technical and research services at the leading edge of advanced materials, nanomaterials, catalysis, coatings and surfaces.

Quantiscript Nanotechnologies (Sherbrooke, QC)
<http://www.quantiscript.com/contact.html>
Developer of e-beam lithography resists and processes.

Raymor (Montreal, QC) <http://www.raymor.com/>
Producer of advanced materials and nanomaterials.

Tekion (Burnaby, BC) <http://www.tekion.com/company/index.htm>
Developing fuel cells on a chip.

AMR (Toronto, ON) <http://www.amr-ltd.com/home/index.html>
Develops materials for diverse applications.

2. Photonics

Photonics involves the generation, detection, and manipulation of light for applications in consumer products, telecommunications, medicine and biology, and manufacturing. For example, laser machining and welding are used in manufacturing vehicles and other commodities. Computer LCDs, TVs, DVDs, CDs, cell phone displays, and laser printers use laser light sources. Photonics became big in the late 1990's due to huge growth in the optical communications industry where information is encoded in light pulses propagating along optical fibres. Solar cells for energy production and energy efficiency through LED lighting are a growing part of photonics. Light-based therapies

are being employed in cancer research and treatment, and laser surgery and eye treatments. Engineering Physicists design and decide how to manufacture these small devices. Like electronic components, photonic devices are being made smaller and smaller. Many companies involved in electronics are also involved in photonics (see the earlier websites for nano- and micro-device companies). It is also likely that photonics will replace microelectronics in many applications.

Light is non-invasive, which means that it can make a measurement without disturbing the object. The use of light to make measurements is known as light metrology. For example, bouncing a laser beam off an object might tell the size, color, and surface texture of the object. Light can monitor the composition of liquids, detect vibrations in solids, and measure the composition of gases. As a result, light metrology is being implemented more frequently for process and quality control in many manufacturing lines. Even if you don't work for a company making metrology equipment, it is likely that you will use light metrology at some point in your engineering career.

Canada has taken a leading role in photonics. Canadian's invented the charge coupled device (CCD) used in digital imaging, the fibre Bragg grating used in sensors and communications, the first commercial 10 Gbit/s optical communications system enabling high speed internet, and the world's first open-heart surgery using lasers. Today, there are a broad range of photonics-related jobs available in Ontario, Canada, and the world. Some companies include:

Consumer Products:

PerkinElmer Optoelectronics (Vaudreuil, QC)
www.optoelectronics.perkinelmer.com

Picarro (Ottawa, ON)
<http://www.picarro.com/>

MPB Technologies Inc. (Montreal, QC)
<http://www.mpb-technologies.ca/>

Luxell Technologies Inc. (Mississauga, ON)
<http://www.luxell.com/>

Elcan Optical Technologies (Midland, ON)
<http://www.elcan.com/>

Oz Optics (Ottawa, ON)
<http://www.ozoptics.com/>

EXFO (Various locations throughout Ontario and Quebec)
<http://www.exfo.com/en/burleigh.asp>

Newcon Optik (Toronto, ON)

<http://www.newcon-optik.com/index.html>

ATS (Cambridge, ON)

http://www.atsautomation.com/profile/worldwide/pro_advman.asp

Biophotonics:

The Juravinski Cancer Centre in Hamilton (<http://www.hrcc.on.ca/webpage.cfm>) hires McMaster Engineering Physicists to develop light-based detection and treatment of cancer. Other examples are:

QLT (Vancouver, BC)

<http://www.qlt-pdt.com/Qtinc/main/mainhome.cfm>

Ottawa Eye Institute (Ottawa, ON)

<http://www.eyeinstitute.net/main.html>

Axela Biosensors Inc. (Toronto, ON)

<http://www.axelabiosensors.com/tech/index.html>

Metrology:

Lightway Systems (St. Catherines, ON)

<http://www.lightwaysystems.com/faqs/>

Other companies include:

Nanometrics

<http://www.nanometrics.com/>

Zygo

<http://www.zygo.com/>

There are a number of associations that list Canadian companies involved in photonics. For example,

Ontario Center of Excellence <http://www.oce-ontario.org/>

Canadian Photonics Consortium <http://www.photonics.ca/community.html>

Ontario Photonics Technology Industry Cluster <http://www.optic.on.ca/members.htm>

These sites will include lists of member companies that are involved in photonics.

Ontario photonics companies (provided by the Ontario Centres of Excellence)

Company	Start-up	SME	Large	Company	Start-up	SME	Large	Company	Start-up	SME	Large
Alcatel-Lucent (Newbridge)			✓	Genesis Genomics		✓		Optelian *		✓	
ALFT Inc	✓			Gennum Optical Division		✓		OPTIKON Corporation		✓	
A-maps Environmental Inc		✓		George Kelk		✓		Optiwave *		✓	
Annidis	✓			Go Lighting Technologies		✓		Optotek		✓	
Apollo Photonics		✓		Group IV Semiconductor *	✓			Osram Sylvania *			✓
Arise *	✓			H.K.Eyecan		✓		OTI			✓
Attodyne	✓			iFire Technology Ltd. *	✓			Oz Optics *		✓	
Avtech Systems		✓		Imax			✓	P & P Optica *		✓	
Axela	✓			Instrument Systems		✓		Passat Ltd		✓	
B-Con Engineering		✓		Iridian *		✓		Peleton Photonic Systems *	✓		
Biomedical Photometrics Inc *		✓		IVG Fiber		✓		Pharos		✓	
BMV Optical Tech		✓		JDSU *			✓	Photon League		✓	
Bookham *			✓	K.J.Micromachining		✓		Pixelink		✓	
Breconridge			✓	Laser Facturing		✓		Plaintree		✓	
Brightwell		✓		Light Machinery *		✓		Power Lasers Ltd		✓	
BTI Photonics *	✓			Lightguide Systems Inc		✓		Process Photonics		✓	
C2C Link	✓			Lighting Science Canada *		✓		Resonance Ltd		✓	
Canon Canada			✓	Lightway Systems		✓		Sciencetech Inc. *		✓	
Christie Digital *			✓	LTG LaserTech		✓		Sciex-MDS			✓
Cisco			✓	Lumenera (Roper Industries)			✓	Shapegrabber		✓	
Claire Lasers Inc.*	✓			Lumetrix		✓		Solica Corp		✓	
Comtest		✓		Luminos		✓		Spectalis	✓		
Cyrium Technologies *	✓			Luxcom		✓		SpectraDigital Corporation		✓	
D&T Photonics	✓			Luxell		✓		Spectral Applied Research		✓	
Dalsa Corp. *			✓	Luzchem Research		✓		Spectra-Nova		✓	
Diffraction Limited		✓		Matcortech (NA Display)	✓			SSP Solar		✓	
Dipix Technologies Inc. *		✓		Melcort	✓			Theralaze *		✓	
Dofasco			✓	Menova		✓		T-ray Science	✓		
Eco Vu Analytics *	✓			Meriton		✓		Trojan *			✓
Elcan *			✓	Mightex		✓		Tropic Networks (Alcatel) *		✓	
Enablence *	✓			Newport			✓	Tyco			✓
eSight	✓			Nexma		✓		Unisearch Associates		✓	
Exfo			✓	Norel	✓			Virtek Vision *		✓	
Fersht Inc		✓		Nortel (Metro Optical) *			✓	Walsh Medical *		✓	
Fiber Connections		✓		Northern Digital		✓		Wegu *		✓	
Fiber Tech Optica *		✓		Novadaq *	✓			Wescam *			✓
Fio Corp		✓		Novx Systems		✓		Xerox			✓
Flextronics			✓	One Chip Photonics *	✓			XJ Design		✓	
FoxTek *		✓		Optech Inc *		✓		XYZ RGB		✓	

3. Nuclear Engineering and Energy Systems

McMaster University is the only Engineering Physics Department in Canada with a working nuclear reactor where undergraduate students perform experiments. The Department of Engineering Physics is actively involved in the nuclear field. Our nuclear engineering and energy systems stream covers all aspects of the nuclear field as well as renewable energy technologies such as wind, solar, biomass, etc.

The nuclear engineering field is extremely active in Ontario. Nuclear-related jobs are consolidated under the Organization of CANDU Industries which includes 122 members: <http://www.oci-aic.org/OurMembership/>

Here are some examples of job opportunities:

Atomic Energy of Canada Limited (AECL)

<http://www.aecl.ca/>

ALARA Research, Inc

Established in 1994. A small consulting firm specializing in Nuclear Safety Analysis with a presence in New Brunswick and Ontario.

Babcock & Wilcox Canada (Cambridge, Ontario)

Manufacturers of nuclear steam generators, etc.

<http://www.babcock.com/bwc/>

Bruce Power

The new owners of the Bruce nuclear site.

<http://www.brucepower.com/>

Canatom NPM Inc.

The largest private sector engineering company in Canada engaged in engineering, procurement, project management and construction for the nuclear industry.

<http://www.canatomnpm.ca/>

Canadian Nuclear Society (CNS)

<http://www.cns-snc.ca/>

Canadian Nuclear Safety Commission (CNSC)

Formerly the Atomic Energy Control Board, Ottawa.

<http://www.nuclearsafety.gc.ca/>

Hydro Quebec

Liste des emplois présentement offerts.

<http://www.hydroquebec.com/>

IAEA

International Atomic Energy Agency Postings.
<http://www.iaea.org/>

MDS Nordion

A company focussed on the medical and industrial uses of radiation.
<http://www.mds.nordion.com/>

MNR

The McMaster Nuclear Reactor typically hires one or two summer students and occasionally needs new full time staff.
<http://www.science.mcmaster.ca/mnr/>

NB Power

New Brunswick Power
<http://www.nbpower.com/en/>

NEA

Nuclear Energy Agency Postings
<http://www.nea.fr/html/general/>

Nuclear Safety Solutions

Formerly the safety technical division of OPG.
<http://www.nuclearsafetysolutions.com/>

Oak Ridge National Laboratory

A U.S. Department of Energy Laboratory managed by Lockheed Martin Energy Research.
<http://www.ornl.gov/>

OPG

Ontario Power Generation (formerly Ontario Hydro)
<http://www.opg.com/default3.asp>

Health Physics Related Employment Website

US based Health Physics site.
<http://www.physics.isu.edu/radinf/hpjob.htm>

Wardrop Engineering

A Large Consulting Engineering Firm.
<http://www.wardrop.com/>

1 Nuclear Place

A comprehensive guide to nuclear news and information on the internet, jobs, bookstore, classifieds and more.
<http://www.1nuclearplace.com/>

NuclearMarket.com

A valuable resource for professionals in the Nuclear Industry featuring news, a buyer's guide, procurement opportunities, jobs, conference details and much more. The site is hosted by NuclearMarket.com, a private business based in London. Site information is posted by individual member companies. Students can register their profile at the Career Center and will be informed by email each time a relevant job notice is posted by one of the members.

<http://www.nuclearmarket.com/>

Prolet Inc.

Specializes in providing engineering and technical personnel. They bring together the expertise of specialists in personnel placement and active engineering and technical professionals.

<http://www.prolet.com/index.htm>

A special website, dedicated to nuclear engineering, is also provided by our department:

<http://nuceng.mcmaster.ca>

In this website, you will find many career postings for the nuclear industry, and links to nuclear associations. Each year, the Engineering Physics Department hosts a nuclear career night to link our nuclear students with industries hiring nuclear engineers.

Our department also provides training in other energy technologies (e.g., solar, wind, biomass, etc). Jobs in these other energy technologies may be found at the following websites:

Canadian solar energy companies are listed at

<http://www.solarbuzz.com/CompanyListings/Canada.htm>

Canadian Solar Industries Association

<http://www.cansia.ca/>

Solar Energy Society of Canada

<http://www.solarenergysociety.ca/2003/index.asp>

Canadian Association for Renewable Energies

<http://www.renewables.ca/main/main.php>

Canadian Renewable Fuels Association

<http://www.greenfuels.org/>

Cyrium Technologies Inc. (Ottawa, ON) <http://www.cyriumtechnologies.com/index.html>

CYRIUM Technologies is developing high-efficiency solar cells, using proprietary breakthrough technology, for the space and terrestrial markets.

4. Interdisciplinary Stream

You've probably realized that there can be a lot of overlap among the three streams in Engineering Physics (photonics, nano- and micro-devices, and nuclear engineering and energy systems). For example, Engineering Physicists are designing and making solar cells using nano-sized particles. Does this activity fall into photonics (solar cells are an application of light), nano- and micro-devices (the solar cells are using nano-scale components), or Nuclear Engineering and Energy Systems (solar cells are a renewable energy source)? The answer is all three. This type of overlap among the streams is common. If you are not sure which stream to choose, or if you are interested in all aspects of Engineering Physics, then the interdisciplinary stream is for you. But don't panic - you don't have to choose your stream until Level 3. Level 2 is common to all Engineering Physics students and exposes you to all aspects of Engineering Physics so you can make an informed decision.

Summary

We hope that this small document gives you an idea of the careers that are available in Engineering Physics, and an idea of what is involved in each of the four streams. Engineering Physics involves the application of the smallest objects in nature (electrons, photons, neutrons) to solve the engineering problems of today and tomorrow. Engineering Physics covers a lot of ground – electronics, micro-electro-mechanical systems (MEMS), mechatronics, photonics, energy systems, nuclear engineering, etc. A 2005 survey of Ontario engineering companies found that the number one skill that employers are seeking in engineering graduates is “well-roundedness”. Engineering Physics prepares you for this reality.

In addition to the jobs in each of the streams already discussed, there are many financial institutions that hire engineers and scientists to manage services related to various technical fields. For example:

Sygertech	http://www.sygertech.com/
Coastal Holdings Inc.	http://www.coastalholdings.com/
Westaim	http://www.westaim.com/Default.aspx

The McMaster Engineering Physics program also provides excellent training for those interested in pursuing graduate studies. A career is waiting for you!