

PHYS 600 / 1 credit option

Faculty supervisor: R. J. Wilkes, wilkes@uw.edu *

Independent study short-courses for PMSP students who want to add 1 or 2 credits

* **Starting Autumn Quarter 2021: faculty supervisor will be Prof. Ann Goussiou, goussiou@uw.edu**

Study a topic of your own choice, or use suggestions from the list below. Your topic must be narrow enough for you to give a reasonable report in 5 pages.

Write a brief term paper (5 pages max for 1 credit, 10 pp for 2 credits) summarizing what you have learned.

You can get help and access to report preparation software at the [Odegaard Learning Commons](#). You can also get help with term paper writing at the [Odegaard Writing & Research Center](#). Both are in the Odegaard Undergraduate Library.

Alternatively, you can create a website with an equivalent amount of content - see <https://itconnect.uw.edu/connect/web-publishing/shared-hosting/web-development-environments/vergil-u-washington-edu/> for resources and guidance.

At the beginning of the term, submit a proposal outlining

1. A list of resources you will use - At least 2 of your information sources must be NOT be websites (eg, journal articles or books).
2. Goals for your study - what you want to accomplish.
3. Specify milestone dates for submitting an outline of your paper, a rough draft of your paper, and the final version.
4. Form of your deliverable - term paper or website with equivalent content.

Submit your term paper or website URL no later than the last day of classes (NOT the last day of exam week).

Some suggested topics:

All the following have abundant information sources available in the UW libraries and/or on the web.

You are not limited to these topics! They are just intended to suggest the type of report desired; feel free to pursue your own interests. Requirement: your topic must have some significant connection to physics.

- One of Albert Einstein's major contributions - choose from the following:
 - Special relativity ('absolutes' don't make sense)
 - Brownian motion (atoms are really there)

- Photoelectric effect (quanta are real too)
- General relativity (the shape of space)
- Paradoxes of quantum theory (does God play dice?)

Your paper can be about the science itself, or about the context of Einstein's work (connections to other peoples' work.

Examples of the latter could be to explore influence of Mileva Maric or Michele Besso on Einstein, or describe the work of Mach, Poincare or Lorentz that impacted his ideas.

- Modern (20th C. and later) models of the Universe: compare the steady-state universe (which Einstein thought he had to accommodate when building General Relativity), the expanding universe (which caused Einstein to think his cosmological constant was his 'greatest blunder'), and the current Dark Energy concept (which in effect restored the cosmological constant).
- Pseudo-science: alas, many topics! for example
 - Fraudulent "medical physics" devices
 - "Refutations" of basic scientific principles (usually relativity or quantum theory)
 - perpetual motion / cost-free energy: burn water instead of oil, etc.
- Take a recent significant science-based news item and look into the details that don't get mentioned in the 10 second sound bite on TV news or the 1-paragraph maximum allowed for such dull topics in most newspapers. Was the overall impression given viewers/readers accurate or misleading, and in what ways?
- Science in public policy, politics, and law
 - Global warming: summarize the scientific basis for this hypothesis
 - Consider a public policy question where an interest group uses a scientific issue to press their special agenda. Investigate the details, and analyze the accuracy of arguments and facts presented (and their careful editing). How can an earnest and unbiased citizen get at The Truth? (does The Truth exist?)
 - Realities of electrical power generation: current status and alternative futures. Many topics here. What fraction of US power is produced by fossil fuel, nuclear, hydro, and solar/wind power plants? What amounts of atmospheric pollutants and nuclear waste are produced? How is the cost of this waste currently covered? How does US compare to similar economically-developed nations (France, Japan, Germany) and large developing nations - China, India, Brazil? How many oil or coal fired power plants are needed to supply current US demand? What would total pollutant emissions be if all power plants were fossil fueled? Same questions for nuclear power: how many plants needed to supply all power? what amount of waste per year would have to be dealt with?
 - How safe are alternative fuels and energy sources? Investigate safety issues regarding proposed methods for supplying our energy needs from non-fossil sources such as wind, waves, tides, solar power.
 - France and Japan depend upon nuclear power and are much less dependent on foreign sources of petroleum than the USA. Why does nuclear power work for them? How do they deal with the safety issues (both public safety and nuclear proliferation security) and waste management issues that have tied up the US nuclear industry for 25 years? Related topics: investigate the CANDU nuclear reactor (Canadian reactor design, using deuterium - of which Canada happens to have the world's biggest supply), which is claimed to be very safe and benign.
 - How practical are proposed mass-market energy sources right now? Is solar power practical at any scale, as of today, or soon? What about wind power (eg in California)? Tidal power (eg in Britain)? 'Practical' here means 'reasonably competitive in cost relative to fossil fuels, and ready to replace fossil-fuel generators on a large scale '.

In addition to these suggestions, here are some ideas on topics related to elective courses offered in our program:

- Optics

Here are some recent articles in *Scientific American* that could help you select a topic. (You can access SciAm back

issues online via the UW Libraries website)

- What Will NASA's Biggest-Ever Space Telescope Study First? December 7, 2017 - Lee Billings
 - New Telescope "Gives Back the Sky" to City-Dwellers, October 10, 2017 - Lee Billings
 - Building a Better Mirror for Telescopes, September 22, 2017 - Christopher Intagliata
 - Interfering Patterns, August 10, 2017 - Science Buddies and Sabine de Brabandere
 - Making Impossible Objects with Mirrors, May 1, 2017 - Susana Martinez-Conde and Stephen L. Macknik
 - The Invisibility Cloak Illusion, February 6, 2017 - Susana Martinez-Conde
 - Physicists Twist Light, Send 'Hello World' Message Between Islands, November 23, 2016 - Jesse Emspak and LiveScience
 - People May Sense Single Photons, July 19, 2016 - Davide Castelvecchi and Nature magazine
 - Self-Focusing Eyeglasses Are in Development in Israel, June 1, 2016 - Jordana Cepelewicz
 - Nanophotography camera, April 12, 2016
 - Mirror on the Cosmos: NASA's Next Big Telescope Takes Shape, January 30, 2016 - Lee Billings
- Acoustics

Here is a list of some recent articles in the New York Times and Scientific American magazine that could help you select a term paper topic. Of course, you will need to use information sources beyond one article for your paper.

You can access NYT and SciAm back issues online via the UW Libraries website, see <http://www.lib.washington.edu/help/connect>

1. Acoustics-related articles in New York Times

A 'Sonic Attack' on Diplomats in Cuba? These Scientists Doubt It

The symptoms reported by U.S. embassy staff in Havana probably were not caused by a mysterious sonic weapon, experts said.

<https://www.nytimes.com/2017/10/05/science/cuba-sonic-weapon.html>

See also <https://www.nytimes.com/2019/01/04/science/sonic-attack-cuba-cricket.html>

The Sound of Silence

How many crazy gizmos are needed to achieve your optimum sleep environment?

<https://www.nytimes.com/2018/12/27/style/white-noise-machines.html>

Visitors From the Ocean's Twilight Zone

Researchers recently hauled up specimens from a layer of the world's seas that contains an abundance of aquatic life.

<https://www.nytimes.com/2018/11/21/science/twilight-zone-ocean.html>

Listen to the Sounds of Narwhals That Have Been Elusive to Science

As melting ice opens east Greenland to petroleum prospectors and cruises, scientists are rushing to study the noises made by a remote population of toothed whales.

<https://www.nytimes.com/2018/06/13/science/narwhals-greenland-sounds.html>

Russia Buys Crowd-Control Vehicles That Emit Sonic Waves and Light

Russia's National Guard, which polices anti-government protests, has purchased two vehicles fitted with a laser and a sonic sound system to disorient people, raising fears among the opposition they could be used to disperse peaceful protesters.

<https://www.nytimes.com/reuters/2018/11/22/world/europe/22reuters-russia-politics-protests.html>

To Create a Quieter City, They're Recording the Sounds of New York

The goal of the project, Sounds of New York City, or Sonyc, is to create an aural map that a group of researchers hopes will help city agencies monitor and enforce noise pollution, and will empower citizens to assist in the process.

<https://www.nytimes.com/2016/11/07/nyregion/to-create-a-quieter-city-theyre-recording-the-sounds-of-new-york.html>

NOTE: visit the sonyc website, <https://wp.nyu.edu/sonyc/> for files of recordings collected by the project since the article was written.

Surround Sound? You Ain't Heard Nothing Yet

At Empac, musicians and technicians are learning to work with sophisticated advances in spatial audio technologies. <https://www.nytimes.com/2017/07/14/arts/music/surround-sound-you-aint-heard-nothing-yet.html>

Seeking America's Quietest Spots: The Quest for Silence in a Loud World

Dennis Follensbee has climbed through New Hampshire's White Mountains trying to find somewhere — anywhere — that is quiet. He is not alone in his quest. <https://www.nytimes.com/2018/09/23/us/silence-escapes-noise-pollution-travel.html>

What Do Ducks Hear? And Why Do We Care?

To develop acoustic warning devices that might save sea ducks from getting caught in fishing nets scientists are studying their underwater hearing. <https://www.nytimes.com/2018/08/28/science/ducks-hearing-fishing.html>

What Happens When You Microwave a Boiled Egg

Tasked with determining whether an exploding egg could damage a man's hearing, acoustics experts learned more about the temperatures inside a microwaved yolk. <https://www.nytimes.com/2017/12/06/science/egg-microwave.html>

Why Do Our Recorded Voices Sound Weird to Us?

Many people are unpleasantly surprised when they hear recordings of themselves: Do we really sound like that? <https://www.nytimes.com/2017/01/13/science/recorded-voices.html>

2. Acoustics-related articles in *Scientific American* magazine

<https://www.scientificamerican.com/article/shaping-sound/>

<https://www.scientificamerican.com/article/physics-of-guitar/>

<https://blogs.scientificamerican.com/cocktail-party-physics/anatomy-of-a-stradivarius/>

<https://blogs.scientificamerican.com/cocktail-party-physics/a-shot-in-the-dark-the-acoustics-of-gunfire/>

<https://blogs.scientificamerican.com/but-seriously/chladni-figures-amazing-resonance-experiment/>

<https://www.scientificamerican.com/article/time-reversed-acoustics/>

<https://www.scientificamerican.com/article/the-physics-of-brasses/>

- Radiation and radiation detectors

These are very general headings, you should pick a more specific topic within one of them for your paper.

- Computer tomography image reconstruction
- Cyclotrons and/or synchrotrons
- Dosimetry devices
- PET techniques
- Contemporary designs for nuclear reactors
- Gamma ray astrophysics detectors
- Ultra-high energy cosmic ray detectors
- Methods for producing medical radionuclides
- Contemporary models for nuclei
- Magnetic spectrometers

- Low energy gamma rays and their absorption
 - Neutron shielding issues
 - Cherenkov detectors
 - background radiation levels - low BG labs, spacecraft, etc
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- Physics of renewable energy sources

Again, these are very general, you should pick a more specific topic within one of these areas for your paper.

Tidal power systems in operation (ie, beyond R&D or prototype phase)

Wave power systems in operation

Wind power systems in operation

Unusual solar power systems

Practical biomass energy sources (ie, not requiring subsidies to break even)

New technologies (R&D or proto phase) for photovoltaics

New and proposed (R&D phase) battery technologies

New ideas for fission reactors

Fusion power approaches most likely to yield results

Reality and hype in green energy technology

Public policy initiatives supporting green technology

Public relations problems for renewable energy sources

Public relations problems for nuclear energy vs actual hazards (NOT "actual" according to power companies, or government agencies tied to them, but according to reliable academic studies)

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