

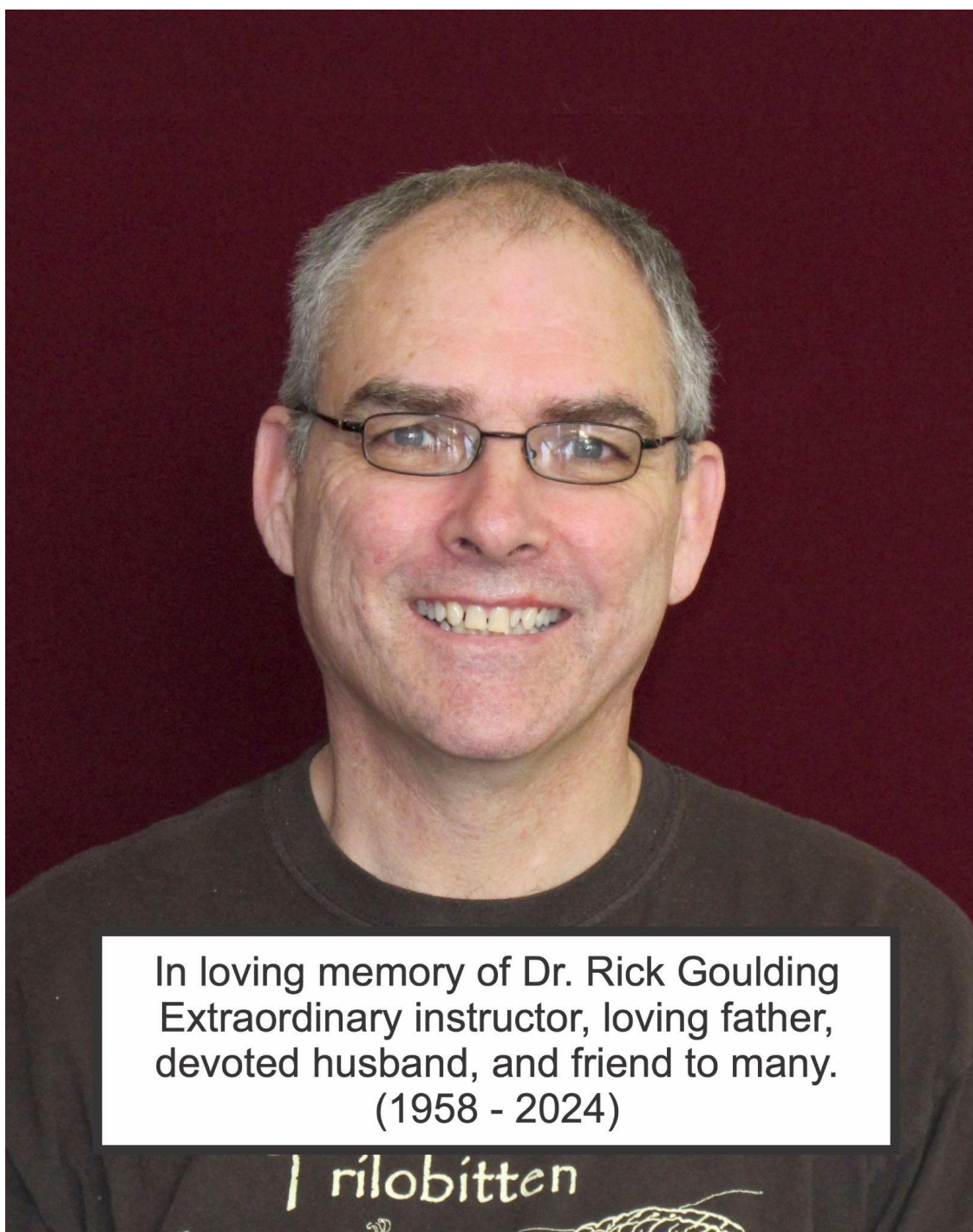
PHYSICS
Awards Ceremony & Research
PIZZA LUNCH
Wednesday, Nov. 13th
1:00-1:45pm
Room C2039

Interested in Physics?

This is an opportunity to meet and mingle with Physics students and faculty, learn about research opportunities *and get some **FREE* PIZZA.***



*Free pizza comes with free information about research opportunities.



In loving memory of Dr. Rick Goulding
Extraordinary instructor, loving father,
devoted husband, and friend to many.
(1958 - 2024)

| rilobitten

Research in Physics and Physical Oceanography

<https://www.mun.ca/physics/research-and-teaching/research/>

Condensed Matter

Biomaterials and Soft Matter

Magnetic and quantum materials

Nanoscience and molecular physics

Photonics, Spectroscopy and Microscopy

Physical Oceanography

Coastal oceanography, numerical modeling, ocean acoustics, geophysical fluid dynamics and turbulence, machine learning of ocean physics, ocean mixing, fisheries oceanography, laboratory fluid dynamics, ocean instrumentation and operational oceanography.

Astrophysics

Stellar atmospheres, Cepheid variable stars, Exoplanets

Research in Physics and Physical Oceanography

Faculty actively seeking honours research students for Physics 490A/B

- **M. Evstigneev - 1 - Solar cell modeling
2 - Anomalous diffusion**
- **E. Demirov - Impact of sea-ice variations on the marine environment of the Labrador Sea.**
- **J. Fitzgerald - A simple model of the turbulence closure problem**
- **K. Poduska - Physics for climate change mitigation**
- **L. Zedel - Ocean noise in Labrador Sea**
- **A. Yethiraj - Intensity fluctuation microscopy of soft materials**
- **S. Curnoe - Entanglement and concurrence in quantum systems**
- **Q. Chen - Photonic materials, devices & applications**
- **S. Wallin - Protein folding in crowded environments**

Faculty actively seeking summer students

- **K. Poduska - Designing materials that capture CO₂**
- **S. Curnoe - as above; developing algorithms for quantum computing**
- **A. Yethiraj**

Research in Physics and Physical Oceanography

Faculty open to supervising honours students

- **M. Evstigneev (possibly more projects are available)**
- **S. Wallin**

Faculty open to/seeking summer students (may depend on NSERC USRA, SURA and other grant results)

- **J. LeBlanc**
- **J. Fitzgerald**

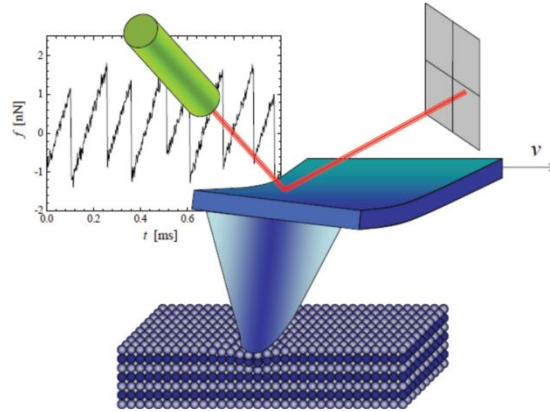
Group research info slides and some project descriptions follow.

Please contact anyone listed about doing an honours project or summer research work.

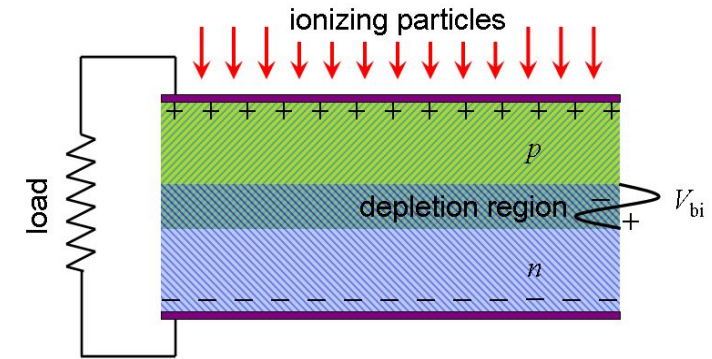
Non-equilibrium processes in solids

Mykhaylo (Misha) Evstigneev

<http://www.physics.mun.ca/~misha/> mevstigneev@mun.ca

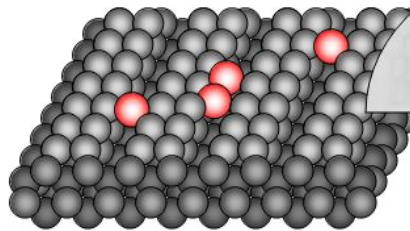


Nanoscale friction

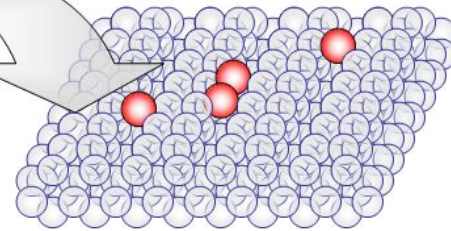


Voltaics

- Molecular dynamics:



- Stochastic dynamics:



How ?

From atomistic to stochastic models of nanoscale phenomena

Misha Evstigneev – Solar cell modeling

mevstigneev@mun.ca



When sunlight enters a solar cell, it produces charge carriers that can either contribute to the output power or become lost due to a process known as recombination. What is the maximal electrical power we can realistically hope to obtain from a solar cell? The answer to this question depends on the intrinsic recombination mechanisms that cannot be controlled by technological means.

An important intrinsic mechanism is radiative recombination, in which the photogenerated charge carriers disappear with the emission of light quanta that eventually exit the cell. Fortunately, those light quanta can also be reabsorbed by the material and again produce charge carriers in a process known as photon recycling.

This project will be focused on the investigation of photon recycling in solar cells made of various materials and having different surface textures. The results obtained within this research will be relevant not only in solar cell technology, but also in the design of light-emitting diodes.

Misha Evstigneev – Anomalous diffusion

mevstigneev@mun.ca



The textbook diffusion law says that the mean-square displacement of a Brownian particle increases linearly in time. Although a linear increase has been extensively studied theoretically and often observed experimentally, it is not generic.

Depending on the physical system, the mean-square displacement may increase in proportion to time raised to some power, which can be either greater than 1 (superdiffusion) or smaller than 1 (subdiffusion). Deviations from the standard diffusion law are termed anomalous diffusion.

In this project, various models exhibiting anomalous diffusion behaviour will be investigated using computer simulations and analytically. Of main interest will be the parameters that characterize free diffusion of the Brownian particle, its response to an external force and variations of temperature, as well as some counterintuitive types of behaviour, such as ratchet effect and negative mobility.

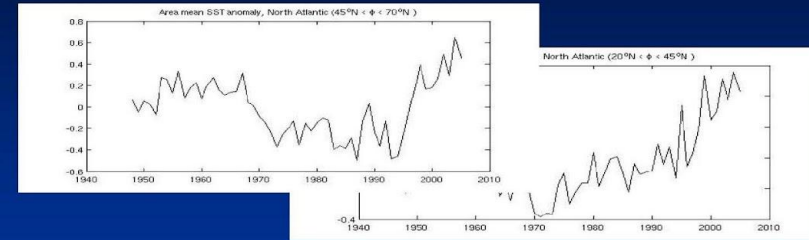
Ocean climate and climate change

Entcho Demirov

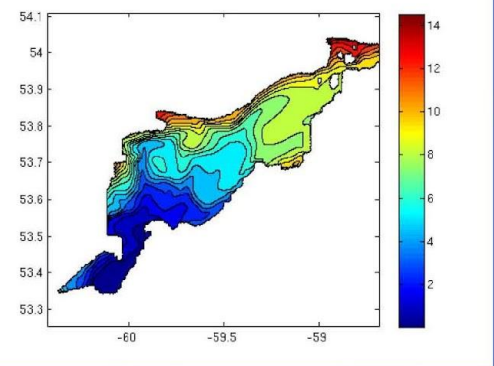
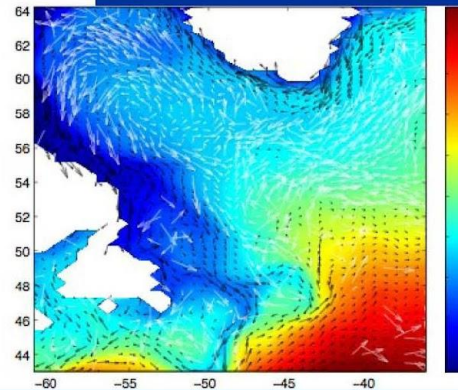
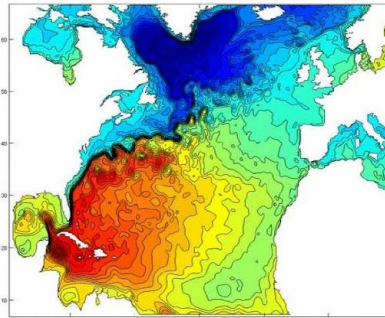
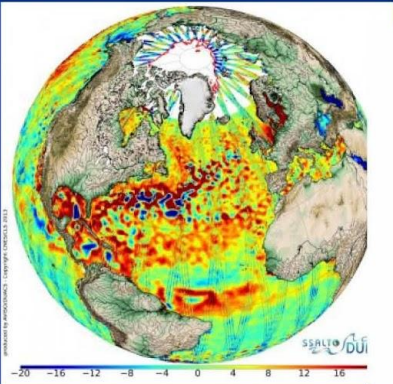
entcho@mun.ca

<http://www.physics.mun.ca/~entcho/>

Climate change in the North Atlantic and its impact on the coastal ocean environment of Newfoundland and Labrador.



Approach: analysis of ocean observations and climate modeling

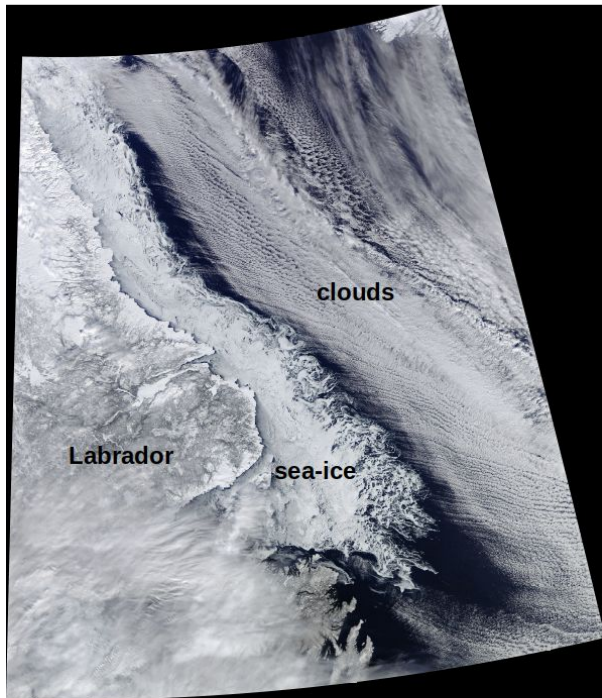


Student's research includes studies and simulations of climate change in the Labrador Sea and Lake Melville, Labrador.



Entcho Demirov: Impact of sea-ice variations on the marine environment of the Labrador Sea.

entcho@mun.ca



Sea-ice in the Labrador Sea

Sea ice is one of the elements of the Earth's environment most affected by climate warming. Changes in sea ice have a profound effect on water characteristics and ocean currents. They also affect life in the coastal area, from animals looking for shelter and food to local communities using the ice for transportation, fishing, and hunting. This study aims to quantify the recent long-term (decadal) changes in sea ice and how they impacted the marine environment of the Labrador Sea.

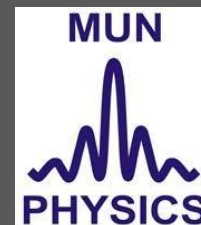
The project will use satellite observations and model simulations to identify changes in sea-ice characteristics over the past several decades and understand their impact on the air-sea interaction at the ocean surface, ocean properties, and ocean currents.

Geophysical Turbulence: Physics & Machine Learning

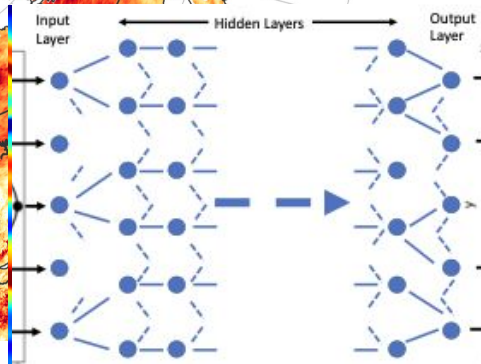
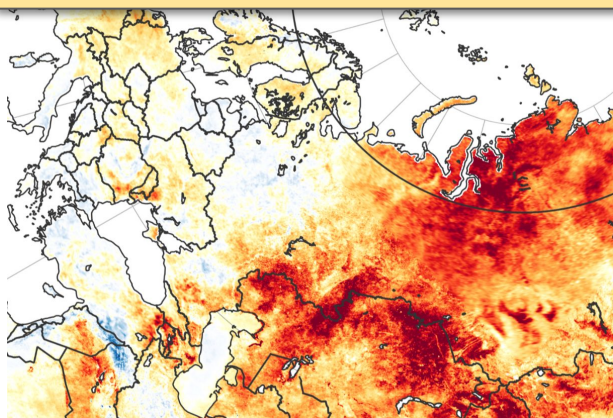
Joe Fitzgerald

<https://sites.google.com/view/joseph-g-fitzgerald/>

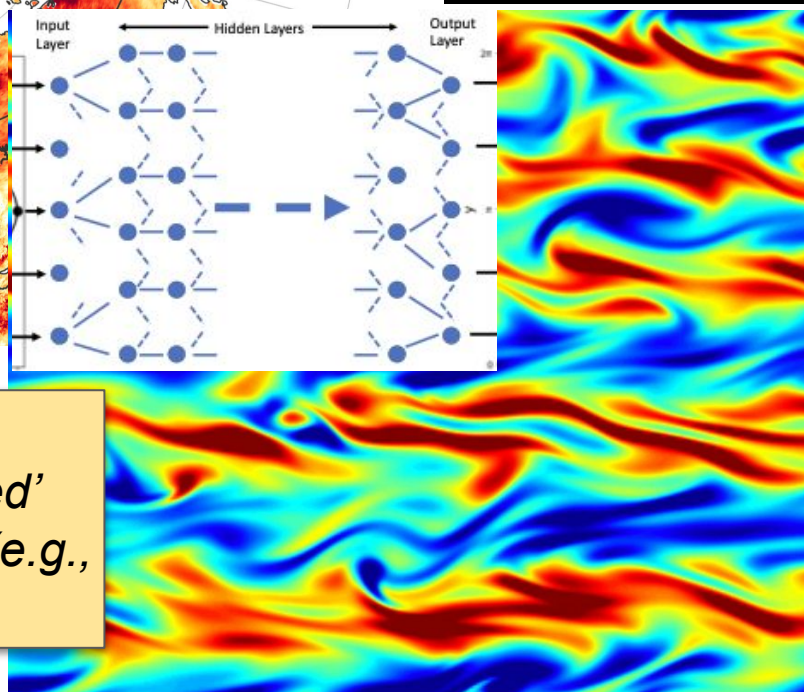
CONTACT ME!! jgfitzgerald@mun.ca



Abrupt Climate Change: How does turbulence shape extreme events (e.g., heat waves/cold snaps)? Can machine learning help us understand?



Fundamental Theory of Turbulence: How do 'banded' flows arise from turbulence (e.g., in Jupiter's atmosphere)?



Current hons. students:

Baasil Sanu (CS)
Ethan Denny (CS)
Sumaiya Anwar (Bio)

Research methods:

Computer simulations
Pencil and paper theory
Machine learning
Data analysis

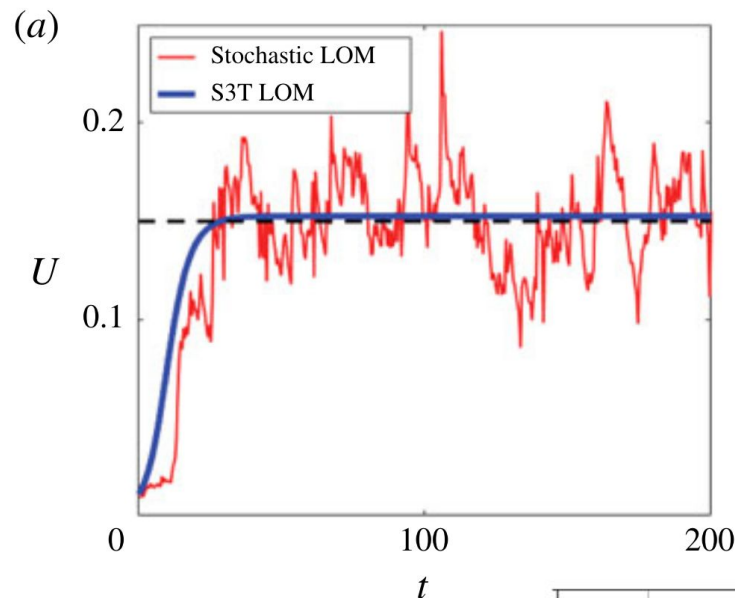
Joe Fitzgerald

A simple model of the turbulence closure problem

jgfitzgerald@mun.ca



Turbulence theories are challenged by the **closure problem**: any exact equation for n th order statistics (e.g., variance) inevitably involves $(n+1)$ th order statistics (e.g., skewness) - an infinite chain. But this chain has rarely been examined in practice, and simple 'closure' ideas based on truncating the chain (SSD theory) can be quite accurate (top figure).

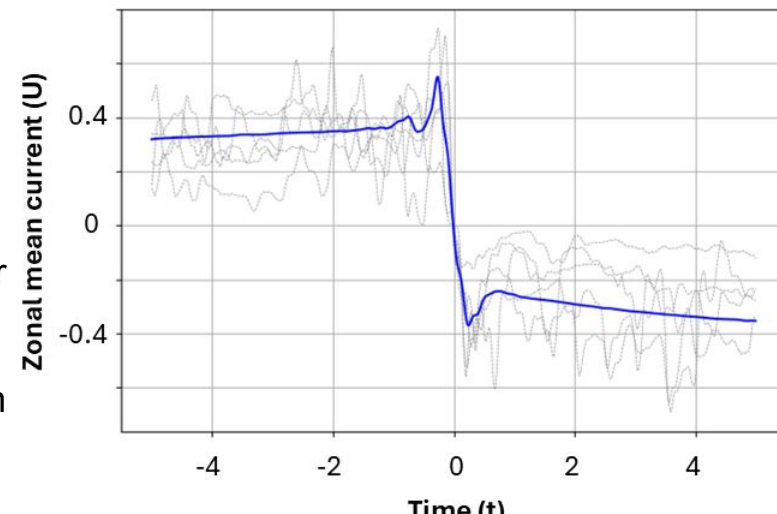


Top: Red curve shows the evolution of the average current $U(t)$ in a simple ocean turbulence simulation. Statistical turbulence theory (SSD, blue curve) predicts the mean flow accurately.

The top figure shows an ocean turbulence simulation with spatially averaged current $U(t)$ (red curve). SSD theory (blue curve) predicts the mean current accurately.

The bottom figure shows an **abrupt climate shift** in which the current abruptly reverses direction. No accepted theory exists for this phenomenon, which is also observed for real ocean currents.

Bottom: An abrupt climate shift in which the average current spontaneously reverses direction (from positive to negative). Grey curves show the behaviour in many individual simulations. Blue curve shows the ensemble mean reversal.



Together, we will attempt to explain this phenomenon using a hierarchy of theories based on averages of fluid equations. Machine learning may be used, depending on student interest.

Methods: Numerical simulations, pencil & paper/symbolic theory, machine learning.

Joe Fitzgerald

Dynamics of Density Layers in Ocean Turbulence

jgfitzgerald@mun.ca

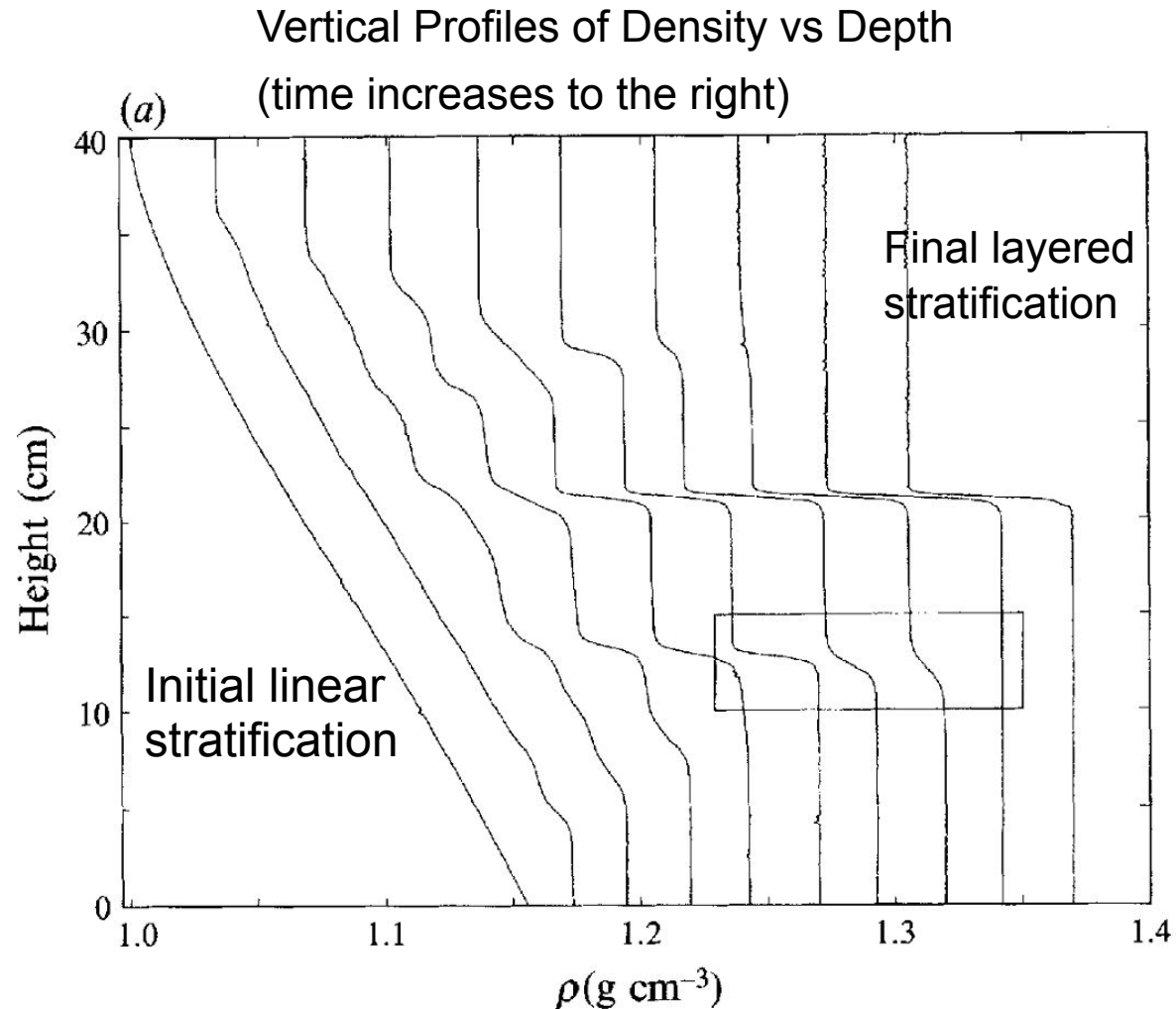


The density of ocean water depends on the depth, with density generally increasing as we go down.

Many field & lab observations show a very interesting pattern known layering (see figure).

In this project, we will explore an existing theory of layering in a new scenario - sharp, fully-developed layers.

Methods: Numerical simulations, machine learning, turbulence theory.





Physics for climate-change mitigation

Poduska research team at Memorial University

carbon capture and storage in carbonate minerals and graphitic materials

climate science **communication and advocacy**

www.youtube.com › watch

<https://www.youtube.com/watch?v=leOXt4VeFt8>

Poduska Research Group - YouTube



We're looking for you! Join the **Poduska Lab** at Memorial University! ...
Faculty of Science - Memorial University. Faculty of Science ...

YouTube · Faculty of Science - Memorial University · Nov 18, 2021

Join our team of
physicists, chemists,
earth scientists, and
engineers:



Contact Dr. Kris Poduska

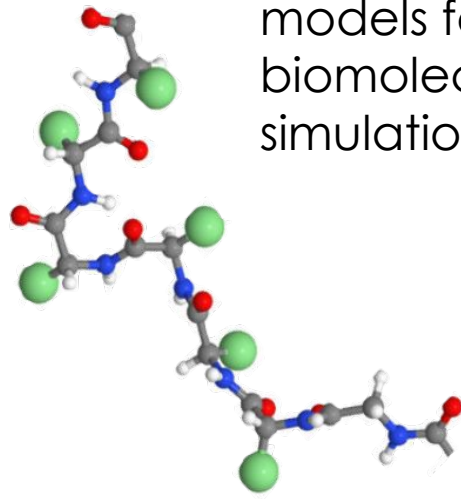
kris@mun.ca

kpoduska.github.io/PoduskaLab/

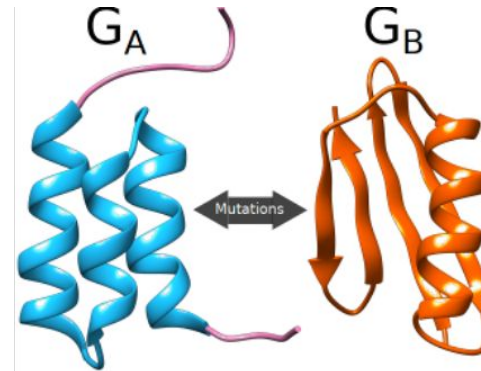
Computational and Theoretical Molecular Biophysics

Stefan Wallin

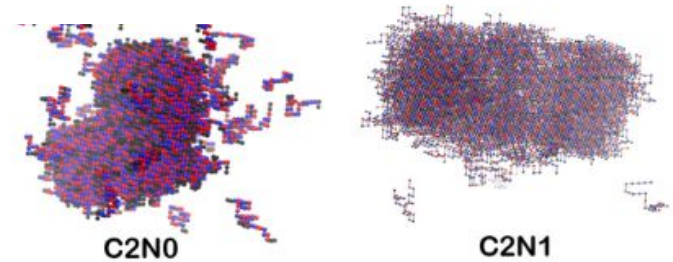
swallin@mun.ca



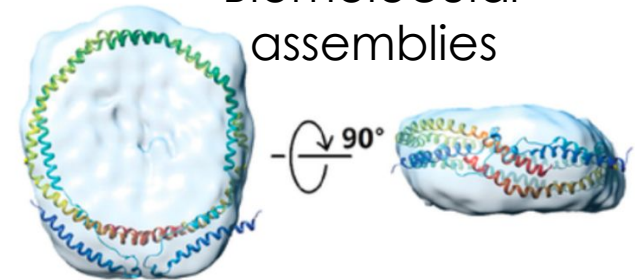
Methods and
models for
biomolecular
simulations



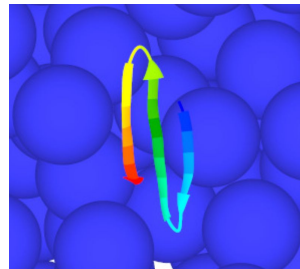
Proteins
switching
structures



Biomolecular
assemblies



**Honours projects
available.**



Proteins in
crowded
spaces

Acoustical Oceanography

Len Zedel

zedel@mun.ca

Dr. Len Zedel: Acoustical Oceanography

Physics and Physical Oceanography

zedel@mun.ca

Research Approach:

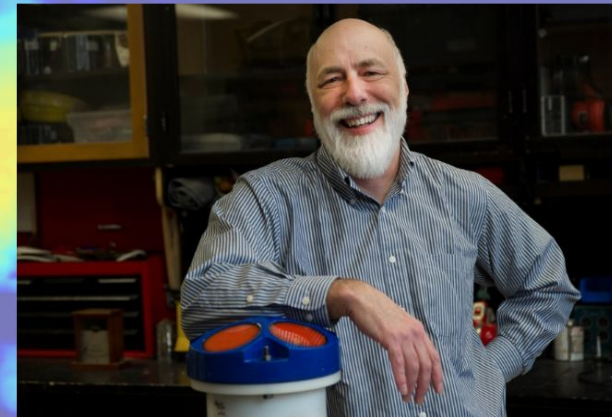
- Ocean Measurements
- Instrument Development
- Signal Processing
- Computer Modelling

Upcoming Projects:

- Doppler sonar for fisheries acoustics
- Doppler sonar for turbulence measurements
- Split beam sonar development
- Acoustic temperature profiling

Students need:

- Strong math/physics skills
- Strong computing/coding
- Interest in instrumentation
- Interest in oceanography



Soft Materials Laboratory



Anand Yethiraj

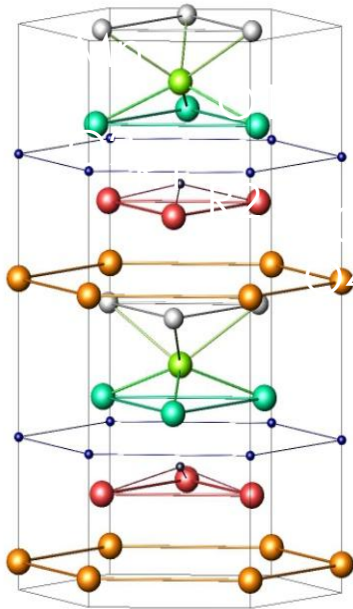
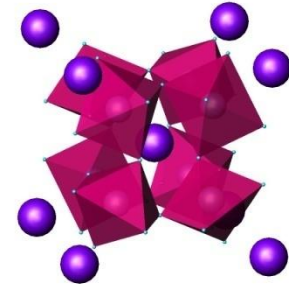
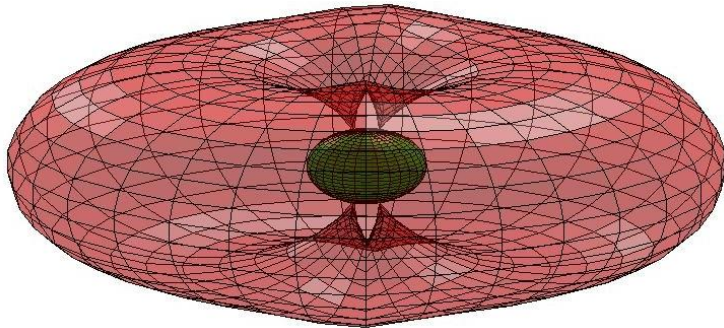
Project: *Laser fluorescence spectroscopy of colloids and proteins*

Photo credit:
Victor Borges

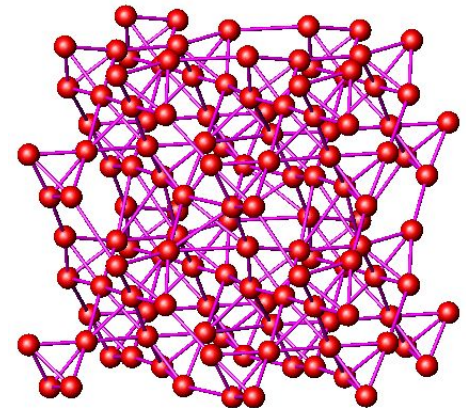
Theoretical Quantum Physics

Stephanie Curnoe

<http://www.physics.mun.ca/~curnoe/> curnoe@mun.ca



- Theory and computation of quantum systems, including frustrated magnets and quantum computers
- Evaluating entanglement in highly symmetric quantum systems

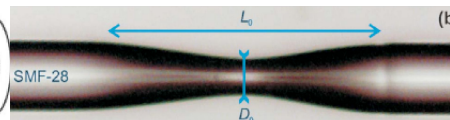
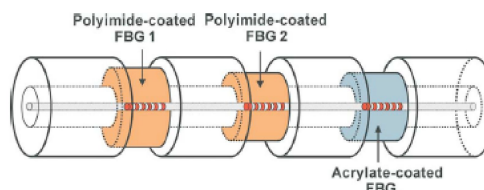
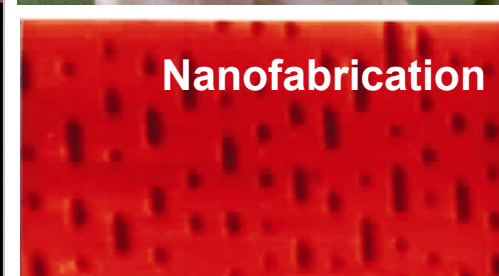
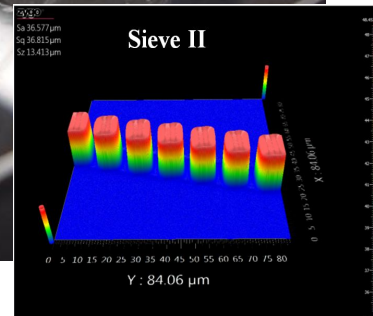
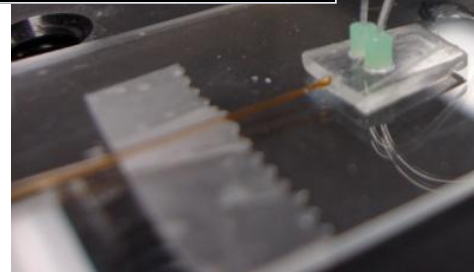
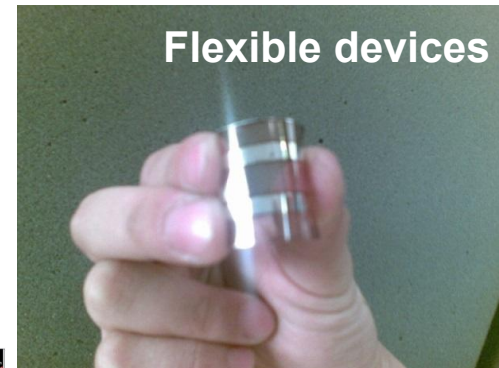
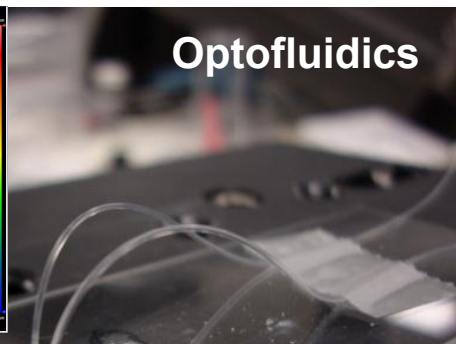
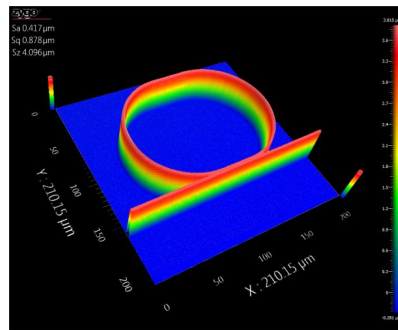
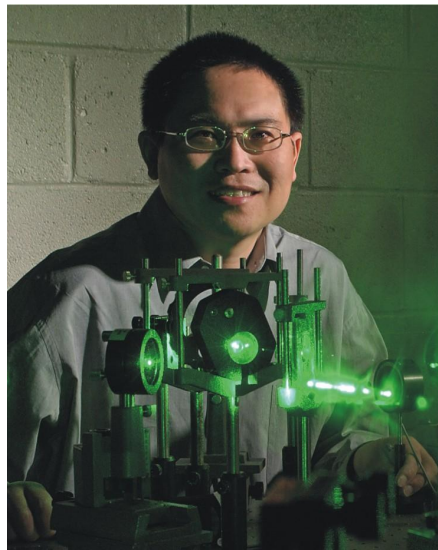


Photonic materials, devices, and applications

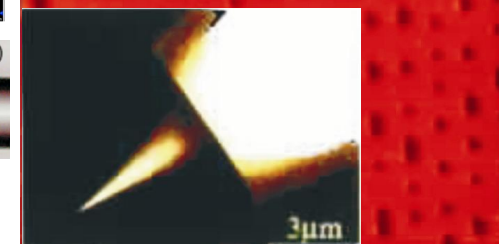
Qiyong Chen (qiyongc@mun.ca)

Research Overview:

- Novel functional materials (nanomaterials & polymers) and thin films
- Photonic micro-/nano-structures with unique functionalities
- Optical technologies for monitoring, sensing, imaging, aided with machine learning
- Development of new applications of photonics technologies (offshore, biomedical, environmental, natural resources, renewable energy...)



Photonic micro-/nano-structures



Computational Condensed Matter Theory

James P.F. LeBlanc

<http://www.physics.mun.ca/~jleblanc/>



We develop computational algorithms and codes to solve correlated electron problems.

Our students:

- Learn high-performance computing practices using Compute Canada systems and coding in c++, python.
- Learn quantum field theory and many-body perturbation theory
- Participate in seminars hosted by the Flatiron Center for Computational Quantum Physics (CCQ) and the Simons Foundation collaboration on the Many Electron Problem.

Scholarships

Departmental Scholarships

This Fall, the Department of Physics and Physical Oceanography is awarding over \$25,000 in scholarships

Department Scholarships

- Noel \$4295
- Kieft \$1923
- Reddy \$1171
- Breckon \$1075
- Hugh Anderson \$18456 – divided over multiple students

Every Scholarship-Eligible Physics student is receiving at least \$1000 from the Department.

SO:

- Maintain scholarship standing*
- Declare yourself a Physics major

*A 75% average over the previous scholarship year Spring 2023 (202203) Fall 2023 (202301) and Winter 2024 (202302) and the successful completion of not less than 30 credit hours over that period.

Awards

Dr. Hugh J. Anderson Junior and Senior Scholarships in Physics and Physical Oceanography

This scholarship was established through a bequest from the Estate of Dr. Hugh J. Anderson, a long-standing member of the Department of Chemistry of Memorial University of Newfoundland. Valued at a portion of the income on the endowment, this scholarship will be awarded annually to students enrolled as majors, or joint majors in the Department of Physics and Physical Oceanography at Memorial University of Newfoundland. These students must be beyond their first year, have attained scholarship standing and show academic excellence. The number and value of the scholarships awarded will be determined on a year-by-year basis at the discretion of the Department of Physics and Physical Oceanography. The recipient must meet the minimum academic requirements for a scholarship as defined by Memorial University of Newfoundland. This scholarship will be awarded by the Senate Committee on Undergraduate Scholarships, Bursaries and Awards based on the recommendation of the Head of the Department of Physics and Physical Oceanography.

Awards

Dr. Hugh J. Anderson Junior and Senior Scholarships in Physics and Physical Oceanography

Recipients

- Afonso, Gavin
- Bragg, Logan
- Chafe, Emily
- Dominie, Francis
- Edwards, Nicholas
- Glynn, Nicholas
- Kacmazer, Deniz
- May, Austin
- Pevie, Jorja
- Pike, Kyle
- Pryor, Cole
- Sherren, Galina
- Tse Pen Ki, Ken
- Vatcher, Benjamin
- Walbourne, Adam

Awards

The Dr. S. W. Breckon Scholarship in Physics

This scholarship, valued at \$1000.00, is the gift of former students and colleagues of Dr. Breckon and is awarded to the full-time honours Physics student who has the best overall academic performance upon completion of the third or fourth year honours Physics program and subsequent enrollment in the following year. The award is made by the Senate Committee on Undergraduate Scholarships, Bursaries and Awards on the recommendation of the Head of the Department of Physics. Applications should be directed to the Head of the Department of Physics.

Awards

Dr. & Mrs. Satti Paddi & Parvati Reddy Memorial Scholarship in Physics

This scholarship was established by generous donations from Drs. Sethu, Bharati and Suresh Reddy, the children of the late Dr. & Mrs. Satti Paddi & Parvati Reddy. Dr. S.P. Reddy was a faculty member and former Department Head of the Department of Physics and Physical Oceanography and Professor Emeritus. Valued at a portion of the income on the endowment, it will be awarded annually to a student who is a declared major in the Department of Physics and Physical Oceanography and who is beyond their first year. The recipient must meet the minimum academic requirements for a scholarship as defined by Memorial University of Newfoundland. This scholarship will be awarded by the Senate Committee on Undergraduate Scholarships, Bursaries and Awards on the recommendation of the Head of the Department of Physics and Physical Oceanography.

Awards

Harry Kiefte Scholarship

This scholarship was established by a generous donation from the employees of the Department of Physics and Physical Oceanography in memory of their colleague, Dr. Harry Kiefte (1942-1997). Harry Kiefte inspired many with his wisdom, warm heart, integrity, and spirit of possibility. He was a respected and accomplished physicist, passionate naturalist, teacher, and family cornerstone. Valued at a portion of the income on the endowment, it will be awarded annually to a student who is enrolled in any year of any Physics and Physical Oceanography undergraduate degree program in the Faculty of Science. The recipient must meet the minimum academic requirements for a scholarship as defined by Memorial University of Newfoundland. The scholarship will be awarded by the Senate Committee on Undergraduate Scholarships, Bursaries, and Awards on the recommendation of the Head, Department of Physics and Physical Oceanography.

Awards

Thomas Corbin Noel Scholarship

This scholarship, in memory of Thomas Corbin Noel Senior and Junior, was established through a bequest by Ella Noel as a tribute to her late husband and son. Corbin Noel Senior was a retired professor of Physics and former assistant vice-president (administration/ physical operations) at Memorial University of Newfoundland. Tommy Noel was a student at Memorial University of Newfoundland when a tragic accident took his life. Valued at a portion of the income on the investment, the scholarship will be given to a student majoring in Physics on the basis of scholarship standing. The scholarship will be awarded by the Senate Committee on Undergraduate Scholarships, Bursaries and Awards on the recommendation of the Head, Department of Physics.

Summer Research (and other) Jobs

Funding Sources

- NSERC Undergraduate Summer Research Award (USRA)
 - ~\$8000 for 16 weeks (\$6000 NSERC + \$2900 Supervisor)
 - Canadian Citizens and Permanent Residents
- Faculty of Science Undergraduate Research Award (SURA)
 - FoS Equivalent to NSERC USRA
 - Canadian and international students are eligible
- <https://www.mun.ca/science/undergraduates/how-to-apply-for-usra-and-sura-awards/>
 - Application window opens January 4, 2024 and closes January 29, 2024
 - FoS will hold an information Webex meeting in January
- Direct hire from supervisor grant (~ \$17 / hr)
- [MUCEP](#), [ISWEP](#), [SWASP](#)

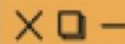
MUN PHYSICS AND PHYSICAL OCEANOGRAPHY SOCIETY

Join our Discord!



WHO ARE WE?

PAPOS is a student-run member club of MUNSU, and represents all undergraduate Physics & Physical Oceanography students at MUN!



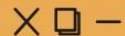
MUN Physics and Physical Oceanography Society - PAPOS



@munpapos



munpapos@gmail.com



WHAT DO WE DO?

We serve as a bridge between students and faculty, and help Physics students feel connected to their peers. We regularly organize socials, research talks, fundraisers and more!