Honours Thesis Presentations

DATE: Friday, Mar 24, 2023
TIME: 1:00 PM
PLACE: C3024

Speaker: Michael Burke
Supervisor: James LeBlanc
Title: Pyami: A Python Wrapper For The Libami Library

ABSTRACT: We present Pyami, a Python library, to evaluate the temporal integrals encountered in the evaluation of Feynman diagrams. Pyami is binded code from the C++ library, Libami, which implements the Algorithmic Matsubara Integration technique that has been of interest in recent years [1]. By implementing this library into Python, the plethora of mathematical Python libraries are now at one's disposal to evaluate the remaining spatial integrals after the Algorithmic Matsubara Integration process. This results in a setting where, once provided the topologies of the Feynman Diagrams of interest, the values can be computed in an interactive Python environment such as a Jupyter Notebook. We then show example calculations using the Python importance sampling package, VEGAS, to evaluate self-energy diagrams on the real frequency axis by a renormalized perturbation theory scheme described in our recent work [2].

[1] Amir Taheridehkordi, S. H. Curnoe, and J. P. F. LeBlanc. Phys. Rev. B 99, 035120, 2019

[2] M. D. Burke, M. Grandadam, and J. P. F. LeBlanc. arXiv:2211.02453, 2022.

Speaker: Zachary Hoyles
Supervisor: Ivan Booth
Title: Marginally Outer Trapped Surfaces in Space-times with a Cosmological Constant

ABSTRACT: Marginally outer trapped surfaces are slices of apparent horizons of black holes that exist in spacetimes such as the Schwarzschild solution of General Relativity. The focus for this paper is a Schwarzschild De Sitter spacetime where the cosmological constant is non-zero. This describes a non-rotating, neutrally charged black hole in an accelerated expanding space. A Gullstrand–Painlevé coordinate transformation is performed to observe behaviour inside the event horizon. Studying this metric within Mathematica uncovers methods of locating where MOTS are formed by the shooting method, taking interest in ones formed by shooting outside the cosmological horizon. The observed MOTS are categorized into types such as the infinitely looping Schwarzschild cases, ones which are shifted on the radial axis, and asymmetrical cases. The mass of the black hole and the cosmological constant were varied to determine the dependence of the formation of MOTS on these values. This allows for the discovery of new exotic behavior which has the potential to aid in uncovering the real-world behaviors of black holes. As well as furthering the knowledge of general relativity and the behaviours of such solutions.

Speaker: Yiming Huang
Supervisors: Shahrazad Malek and Ivan Saika-Voivod
Title: Simulation of Peptides in Water Nanodroplets

ABSTRACT: Water is an indispensable element to life. Biomolecules may behave differently in nanodroplets compared to bulk. We carried out molecular dynamics simulations of five peptide-nanodroplet systems. The simulation was performed through GROMACS, with the OPLS all-atom force field. We studied the simulation process through analyzing the density profile, distribution of alpha carbon and charged sites, radius of gyration, and secondary structure. From the results, we observed interesting changes in peptide location and conformation from 240 K to 260 K.

Speaker: Kassandra Richard
Supervisor: Len Zedel
Title: Testing an Acoustic Zooplankton Fish Profiler Mounted on a Glider in Trinity Bay

ABSTRACT: Gliders are autonomous underwater vehicles (AUVs) of approximately 2 m in length that are capable of long-term deployments (on the scale of months). They move vertically through the water by altering their buoyancy. Gliders change their displaced volume while keeping their total mass fixed by moving hydraulic oil from a reservoir inside a pressure hull to inflate or deflate a rubber bladder external to the pressure hull. The glider's wings convert the vertical force provided by the variable buoyancy device into forward motion, allowing them to also move in a horizontal fashion. The Acoustic Zooplankton Fish Profiler (AZFP) is a multi-frequency echosounder that is used to detect marine species of various sizes. Its original purpose was to be attached to a stationary structure such as a mooring, but in modern day, the AZFP is being used to augment or replace traditional vessel-based sampling by being attached to ship hulls or gliders. Integrated into small autonomous underwater vehicles such as gliders, AZFPs can collect data at greater depths, closer to the coast-line, and over longer time periods than vessel-based sampling. These special scientific echosounders can hold up to four frequency channels, and possess the capability to study biomass, distribution, and behavior of zooplankton and fish by measuring acoustic backscatter. Effective frequencies are correlated to specific organisms based on their size and associated backscatter. Higher frequencies are optimal for detecting smaller creatures such as krill. The purpose of this particular deployment is to test Memorial University's AZFP mounted on a glider and visualize the water column in Trinity Bay.

ALL ARE WELCOME!