Burke Brockelbank

Education

2013–2017 **Bachelor of Science with First Class Honors in Physics**, *University of Calgary*, Calgary, Alberta, GPA – 3.9.

- **Solid state physics** – Crystal structure. Classification of solids and their bonding. Fermi surface. Elastic, electric and magnetic properties of solids.
- **Introduction to Optimization** – Examples of optimization problems. Quadratic forms, minimum energy and distance. Least squares, generalized inverse. Location and classification of critical points. Variational treatment of eigenvalues. Lagrange multipliers. Linear programming.
- **Introduction to Nanoscience and Nanotechnology** – Functional definitions of nanoscience and nanotechnology. Understanding/predicting the behaviour of nanomaterials. Investigation of nanomaterials whose properties depend on size. Exploration of a building up approach to design and fabrication of functional nanomaterials. Examination of applications of nanoscience and nanotechnology in society.

Research Experience

2017-2018 **Research Assistant**, *Nasser Moazzen-Ahmadi*, Calgary, University of Calgary.

Investigating the feasibility of upgrading of bitumen with lasers.

One of the products from Alberta's oil sands is bitumen, a extremely viscous hydrocarbon source with heavy, branching organic compounds. In this state it is not usable for fuel, and is difficult to transport. There are many methods of upgrading bitumen into crude oil, a lighter hydrocarbon that is more easily transported and later refined into petroleum products like gasoline. In this project, I lead the development of a novel technique for upgrading bitumen using lasers.

- **Apparatus design** of three separate vacuum cell irradiation chambers and a rotating mount to improve upgrading efficiency by an order of magnitude.
- **Experimental planning** for chemical characterization with NMR and GCMS to definitively show upgrading.
- **Organization** of progress and planning into multimedia log, reports, and presentations to communicate with collaborators and funders.

2016-2017 **Thesis**, *Gilad Gour*, Calgary, University of Calgary.

Maximally entangled multipartite symmetric states

Symmetric states, where exchanging particles leads to no change in the total state are prevalent in nature e.g. identical bosons. In this project I investigated maximal entanglement in these systems.

- **Conducted literature review** to learn about the history and current state of the field.
- **Goal planning** kept the project concise and focused, increasing efficiency.
- **Researched numerical tools** used to develop intuition for project.
- **Developed theoretical solution** by writing a visualization program in python. This visualization allowed solutions to be guessed just by looking at a chart.

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2015–2017 **Summer Researcher**, *Nasser Moazzen-Ahmadi*, Calgary, University of Calgary.
Study of infrared (IR) rovibrational spectroscopy of molecular clusters.
Molecular clusters were formed in vacuum with a supersonic slit-jet. Clusters were probed with a continuous wave laser (QCL and OPO) scanned at high resolution to obtain rotational spectra.

- **Automated** parts of the data calibration process, leading to nearly a doubling of the speed for calibration.
- **Improved** the software design of the LabVIEW program to be more encapsulated and extensible for future development.
- **Communicated** with the scientific community in several poster presentations (PHAS Symposim 2017, Undergraduate Research Night 2016, Quantum Alberta Workshop 2016) and one publication (Three new infrared bands of the He-OCS complex, 2017)
- **Conducted annual safety inspection** to evaluate the state of the lab, leading to several corrections of errors in previous reports.

Personal Projects

2018 **Improving Existing AI with Neural Nets**.
I am working on passion project where a black-box AI is used to train a neural net. The neural net is then trained with deep Q reinforcement learning to surpass the performance of the original AI.

2018 **Analysis of Harm Reduction Data**.
EcstasyData.org is an independent laboratory pill testing program run by Erowid Center with support from Isomer Design and Dancesafe. I am volunteering with Erowid Center to analyze and interpret their data to find regional trends in the misrepresentation of illicit substances. This information is useful for care workers, medical staff, law makers and law enforcement.

Skill Summary

Soft Skills

Creativity Original thinking was paramount in developing a visualizer in my thesis and the apparatus for bitumen irradiation, as well as finding opportunities for automation in my summer research position.

Communication Ability to share scientific ideas in accessibly through presentations. This skill was essential in my success in all of my previous positions.

Organization Juggling multi-faceted problems while keeping detailed records and staying goal oriented the whole time is my normal state of operation. This is best exemplified in my research assistant position where I was the primary organizer of the project.

Hard Skills

Lab skills automation, pressurized gas, vacuum, lasers, optics, cryogenics, electronics, spectroscopy, gas chromatography (GC), mass spectrometry (MS), GCMS, nuclear magnetic resonance (NMR)

Programming In order of familiarity: Python (Scipy, Numpy, Pytorch), LabVIEW, Git, Fortran 77 and 90, Matlab, SQL, shell and batch scripts, makefile

Other LaTeX, MS Word, Windows, Linux, Android, Mac OS.

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