# Thomas C. Fraser

November 20th, 2016
154 Quarry Ave. Renfrew ON, Canada
www.tcfraser.com
tcfraser@tcfraser.com
tcfraser@uwaterloo.ca
+1 (226) 868-0557

## Objective

Studying theoretical physics in the areas of quantum foundations, quantum gravity and/or condensed matter. An emphasis on computational physics and teaching is also desired.

## Education

2012 – 2017 **B.Sc., Mathematical Physics, Astrophysics Specialization**
Cumulative Average: **97.79%**
*University of Waterloo, Waterloo, ON*

2008 – 2012 **High School Diploma**
*Renfrew Collegiate Institute, Renfrew, ON*

## Awards & Scholarships

[Awarded by University of Waterloo]

2016 **Mike Lazaridis Scholarship**
*Theoretical Physics Fellowship at Perimeter Institute*

2015 **Xerox Research Centre of Canada Limited Award**
*Best Work-term Report "Acoustic Modelling Using Mel-Frequency Cepstral Coefficients"*

2015 **C. C. Lim Physics Prize**
*Top Marks in Undergraduate Thermodynamics*

2013 **Don E. Brodie Scholarship**
*Highest Experimental Physics Lab Performance*

2012 **A. Donald Maynes Scholarship**
*Outstanding Academic Record*

2012 **BMO Undergraduate Entrance Scholarship**
*Outstanding Academic Average*

2012 – Present **Dean's Honour List**
*Academic Performance*

2012 **President's Distinction Scholarship**
*Entrance Average*

[Awarded by Renfrew Collegiate Institute]

2012 **Governor General's Medallion**
*Top Student*

## Research & Work Experiences

### *Mike Lazaridis Fellow*

Perimeter Institute For Theoretical Physics. Waterloo, ON — May 2016 – September 2016

Research in quantum foundations studying quantum non-locality from the perspective of causal inference. Discovered new causal compatibility inequalities leading to a better understanding of quantum information

resources. Computationally simulated six-entangled qubits and associated measurements to find new entanglement resources. Invented new computational techniques capable of out-performing existing methods when large computational networks are required.

### *Research & Development Data Scientist*
SYSOMOS. TORONTO, ON — SEPTEMBER 2015 – JANUARY 2016

Industry application of varied machine learning methods. Designed algorithms to perform automatic speech recognition on digital video extracted from Twitter. Implemented advanced signal processing techniques to perform acoustic modelling. Worked with a massive parallel computing architecture to process billions of data sources. Designed and built native Android & iOS apps from scratch. Culminated in award winning paper.

### *Game Developer*
LUNARCH STUDIOS. WATERLOO, ON — SEPTEMBER 2014 – MAY 2015

Built an highly-compatible graphics engine that supports dynamic assets loaded asynchronously. Acted as project manager to complete large-scale, internal projects. Developed a highly scalable server platform with integration between multiple software languages. Researched and implemented numerous bin-packing algorithms in order to optimize application performance.

### *Mathematics Tutor*
HUMBER COLLEGE. TORONTO, ON — JANUARY 2014 – MAY 2014

Tutored thousands of students one-on-one in fields such as statistics, technical math, engineering, biomechanics, and business. Lead an initiative to write and produce high quality educational videos to help students with their studies. Developed a multi-platform, browser-based student sign-in system in order to collect meaningful statistics to improve effectiveness of math centre. Designed and produced graphic art to promote and develop a mathematics community.

### *Solar Panel Technician*
OVG SOLAR, INC. RENFREW, ON — JUNE 2011 – AUGUST 2011

Industry level experience engineering, assembling and maintaining numerous solar panel arrays. Worked in a team of carpenters, electricians and skilled engineers under flexible hours across all of eastern Ontario.

## ACADEMIC WORKS

**Invited Talks At Conferences**

NOVEMBER 2016 — Quantum Networks Conference at International Institute for Physics, Natal, Brazil
*Causal Compatibility Inequalities Admitting of Quantum Violations in the Triangle Scenario*

**Course Notes**

WINTER 2016 — *General Relativity*
tensor formalism, Lorentz transformations, Poincare group, foil theories, differential geometry, Einstein field equations, solutions to field equations, black holes & singularities, cosmology, gravitational waves and perturbation theory, lie derivatives, killing vectors, curvature

WINTER 2016 — *Statistical Mechanics*
foundations, statistics, laws of thermodynamics, heat capacities, entropy, ensemble theory, micro canonical/canonical/grand canonical, Helmholtz free energy, equipartition and virial theorems, ideal quantum gases

FALL 2016 — *Applied Probability (In progress)*
FALL 2016 — *Quantum Physics 3 (In progress)*
FALL 2016 — *Electricity & Magnetism 3 (In progress)*
FALL 2016 — *Cosmology (In progress)*

**Project Papers**

APRIL 2016 *Variations in Stellar Metallicity*
Thomas Fraser
The metallicity and age of a star are closely related due to the composition of material left behind parent star(s). Older stars where formed when less metal was present and are expected to have lower metallicities. Does low metallicity provided an explanation as to why we have yet to observe any population III stars?

JANUARY 2016 *Acoustic Modelling Using Mel-Frequency Cepstral Coefficients*
Thomas Fraser
A technical report detailing the effectiveness of using Mel-frequency cepstral coefficients for audio classification tasks. Numerous audio features and signal processing techniques are considered for comparison. Personal implementation achieves classification accuracies commensurate winners of international competitions.

**Manuscripts in Preparation (Drafts Available Upon Request)**

JANUARY 2017 *Causal Compatibility Inequalities Admitting of Quantum Violations in the Triangle Scenario*
Thomas Fraser

JANUARY 2017 *The Definite Extension Procedure for Large-Scale Marginal Satisfiability*
Thomas Fraser

**Acknowledgments**

SEPTEMBER 2016 *The Inflation Technique for Causal Inference with Latent Variables*
Elie Wolfe, Robert W. Spekkens, Tobias Fritz

AUGUST 2016 *Qubit Dynamics in Presence of Thermal Noise*
John Rinehart
Available upon request.

## COMPUTATIONAL SKILLS

| | |
|---|---|
| LANGUAGES | C, C++, Python, Matlab, HTML, CSS, Actionscript, JavaScript, Java, Scheme, Basic, LaTeX |
| METHODS | Machine Learning, Linear Programming, Graph Theory, Group Theory, PDE Solvers, Linux/Unix Systems, Distributed Systems, Android & iOS App development |
| CREATIVE TOOLS | Adobe Suite, AutoCAD 3D, Vector Graphics, Video editing, 3D Animation/Modeling, Graphic Design |

## EXTRACURRICULARS

| | |
|---|---|
| 2015 – PRESENT | Personal Mathematics Blog (tcfraser.com) |
| 2014 – PRESENT | Software Development (github.com/tcfraser) |
| 2016 – PRESENT | Physics Interconnected Mentor |
| 2013 – PRESENT | Undergraduate Year Rep |
| 2016 – PRESENT | Intramural Basketball |
| 2007 – PRESENT | Acoustic Guitar Player |
| 2013 – PRESENT | Elected Treasurer/Media Officer/Secretary of The UW Physics Society |
| 2013 – 2015 | Member of The Canadian Association of Physicists |
| 2013 – PRESENT | Independent Graphic Designer |
| 2012 | Reach-for-the-Top Trivia Team |
| 2012 – 2013 | Residence Council Member |
| 2009 – 2011 | Member of Ottawa Lions Track & Field Club |
| 2009 – 2012 | High School Basketball |