MICHAEL GENNARI

Permanent Address
3660 Cemetery Road
Hamilton, ON L0R 1C0

mgennari@edu.uwaterloo.ca
(905) 975 – 8277

https://mgennari.github.io/

Current Address
5-195 Erb Street West
Waterloo, ON N2L 1V6

RESEARCH INTERESTS

Ab initio methods for solving the nuclear many-body problem (no-core shell model), low-energy quantum chromodynamics (QCD), chiral effective field theory, particle physics, machine learning

EDUCATION

Candidate for Bachelor of Science 2019 – *University of Waterloo, Waterloo ON 2014 - present*
Honours Co-operative Mathematical Physics

- **Relevant Courses:** Introduction to Particle Physics, Quantum Theory 2, Quantum Physics 3, Introduction to Groups, Introduction to Quantum Information Processing, Quantum Physics 2
- **Research Project:** Ongoing research project in machine learning and the nuclear many-body problem with Dr. Petr Navrátil and Dr. Roger Melko

SUMMARY OF QUALIFICATIONS

- First author of two manuscripts directly resulting from own work on nuclear density in the no-core shell model and collaboration with Dr. Matteo Vorabbi at TRIUMF
- Research on nuclear density and applications to *ab initio* (first principles) theory completed under Dr. Petr Navrátil at TRIUMF
- Machine learning applications to the nuclear many-body problem being developed as part of an undergraduate research project with Dr. Petr Navrátil and Dr. Roger Melko
- Student travel award from the Canadian Institute of Nuclear Physics (CINP) received to fund travel expenses for presenting work completed at TRIUMF
- Candidate for degree in mathematical physics which contained a heavy focus on theoretical physics, with additional pursuit in pure mathematics and advanced quantum theory
- Proficiency as an educator achieved through direct tutoring and volunteering positions

PUBLICATIONS

Microscopic optical potentials derived from *ab initio* translationally invariant nonlocal one-body densities
Michael Gennari, Matteo Vorabbi, Angelo Calci, and Petr Navrátil. Phys. Rev. C 97, 034619 (2018).

Kinetic density from *ab initio* theory
Michael Gennari and Petr Navrátil. arXiv:1808.10537 (2018). Submitted to Phys. Rev. C.

RESEARCH EXPERIENCE

TRIUMF, Theory Group – Vancouver, BC Canada
Researcher in Theoretical Nuclear Physics – January 2017 to present
Supervisor – Dr. Petr Navrátil

- Derived and implemented a translationally invariant (centre-of-mass free) nonlocal nuclear density in the no-core shell model (NCSM), to be used in improving predictions of nuclear reactions and comparisons with density functional theory (DFT)
- Accurate and more consistent optical potentials for nuclear reactions involving light nuclei produced from nonlocal nuclear density and a collaboration with Dr. Matteo Vorabbi at TRIUMF
- Analytic expression for the nuclear kinetic density, an input of DFT, derived from nonlocal nuclear density to view amplified effects of translational invariance and to allow communities to compare centre-of-mass removal techniques across different many-body methods
- Modern two- and three-nucleon chiral effective field theory interactions analyzed
- Natural nucleon orbitals and a related orthogonal transformation using the one-body density matrix being constructed to improve convergence of standard NCSM calculations of exotic nuclei

University of Waterloo, Department of Physics and Astronomy – Waterloo, ON Canada
Research Project in Machine Learning and the Many-Body Problem – September 2018 to present
Supervisor – Dr. Roger Melko and Dr. Petr Navrátil

- Training neural networks to improve infinite basis extrapolation results for nuclear properties, such as the ground state energy of exotic nuclear systems
- Using machine learning in conjunction with natural nucleon orbitals to further improve convergence trends in nuclear many-body calculations
- Novel techniques in extrapolating density matrices to select best nucleon orbitals under study

ACHIEVEMENTS

Student Travel Award from Canadian Institute of Nuclear Physics, 2018 – *University of Waterloo*
- Earned a research award of 500.00 CAD by the Canadian Institute of Nuclear Physics towards travel to the Canadian Undergraduate Physics Conference 2018 (CUPC)

President's Scholarship of Distinction, 2015 – *University of Waterloo*
- Awarded an academic scholarship of 2000.00 CAD by the University of Waterloo

Dean's Honours List, 2015 – *University of Waterloo*

Distinction in Science, 2014 – *Saltfleet District High School*
- Received an academic scholarship of 400.00 CAD towards university education

Distinction in Mathematics, 2014 – *Saltfleet District High School*
- Received an academic scholarship of 300.00 CAD towards university education

CONFERENCES, WORKSHOPS AND PRESENTATIONS

Canadian Undergraduate Physics Conference (University of Alberta, Canada – August, 2018)

- Obtained one of four 500.00 CAD student travel awards from the Canadian Institute of Nuclear Physics to attend the largest undergraduate conference in North America

Data Science and Quantum Computing Workshop (TRIUMF, Canada – June, 2018)

- Attended a workshop dedicated to exploring how machine learning and quantum computing can be used to enhance research output in high performance and large-scale computing

WestGrid Research Computing Summer School (University of British Columbia, Canada – June, 2018)

- Summer school covering introductory and advanced topics in high performance computing, parallel programming (FORTRAN, C, Python), parallelization with CUDA, and scientific visualization

10th International Conference on Direct Reactions with Exotic Beams (Matsue, Japan – June, 2018)

- Presented poster on nuclear density from *ab initio* theory at DREB 2018, a conference devoted to the latest experimental and theoretical research in nuclear reactions with exotic nuclei

Nuclear Science Summer School (Michigan State University, U.S.A. – May, 2018)

- Summer school covering introductory topics in nuclear physics such as experimental techniques, modern detectors, and recent advancements in theoretical work

Progress in Ab Initio Techniques in Nuclear Physics (TRIUMF, Canada – February, 2017 and 2018)

- Attended and presented at TRIUMF workshop focused on new developments in *ab initio* nuclear theory, with focuses on progress in first-principles nuclear structure and reaction calculations

American Physical Society Division of Nuclear Physics (Pittsburgh, U.S.A. – October, 2017)

- Presented work during the conference experience for undergraduates (CEU) poster session

Advisory Committee on TRIUMF Theory Group Session (TRIUMF, Canada – W2017, F2018, W2018)

- Presented to National Research Council of Canada on nonlocal nuclear density and applications to the nuclear kinetic density

TEACHING AND VOLUNTEER EXPERIENCE

Department of Physics and Astronomy, University of Waterloo – September 2015 to present

Physics Interconnected Mentor

- Volunteering in the Department of Physics and Astronomy with a first-year mentorship and tutoring program for incoming physics majors
- Meeting on a weekly basis with multiple students for several hours to provide academic and community support

Guelph - Humber Math Centre – January 2016 to April 2016

Math Centre Staff

- Tutored mathematics, physics, and engineering, breaking down challenging concepts during both one on one and group sessions
- Improvements to Math Centre techniques determined by collecting and analyzing data on the effectiveness of math centre tutoring and advertising strategies

TECHNICAL SKILLS

- Knowledge of high performance scientific computation and parallelization (OpenMP and MPI) techniques using FORTRAN
- Research experience with machine learning (Pytorch), data science and visualization in Python
- Experienced with utilizing high performance computing (HPC) grids for calculations, such as Oak (University of British Columbia), Cedar (Simon Frasier University), and Cougar (TRIUMF)
- Proficient with shell scripting and Linux based operating systems
- Fluent in LaTeX
- Experience with HTML, CSS, JavaScript (with AngularJS framework), R, some C++

CURRENT VISITOR STATUS

- **TRIUMF, Theory Group** in Vancouver, Canada

ACADEMIC REFERENCES

Dr. Petr Navrátil
- Theory Group Leader
- TRIUMF, Theory Group in Vancouver BC
- navratil@triumf.ca
- Supervisor

Dr. Roger Melko
- Associate Professor
- Perimeter Institute and University of Waterloo in Waterloo ON
- rgmelko@uwaterloo.ca
- Supervisor

Dr. Matteo Vorabbi
- Postdoctoral Research Associate
- TRIUMF, Theory Group in Vancouver BC
- mvorabbi@triumf.ca
- Co-supervisor

Dr. Anna McCoy
- Postdoctoral Research Associate
- TRIUMF, Theory Group in Vancouver BC
- amccoy@triumf.ca
- Colleague