Jeffrey Morais

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Educational Background

2019 - 2023	**B.Sc. in Honours Physics**, *McGill University*, Montréal, Canada. GPA: 3.84/4.0

Research Experience

Present   **Researcher**, *Fudan University*, Shanghai, China

Using topological quantum neural networks and topological quantum field theory, we look at stochastic Ricci flow for renormalization group flow in quantum gravity. We also look at connecting this to topological wormhole networks.

Supervisor: Prof. Antonino Marcianò

Summer 2023   **Undergraduate Researcher**, *NSERC, University of Alberta*, Edmonton, Canada

Study of topological wormholes and holographic entanglement occurring in quantum gravity. We relate wormholes to quantum tunneling events in entangled networks of qubits in potential well lattices with the use of instanton effects in the complex time plane.

Supervisor: Prof. Igor Boettcher

2022 - 2023   **Honours Bachelor Thesis**, *McGill University*, Montréal, Canada

Study of the problematic non-existence of vacua with de Sitter isometries occurring in type II string theory and M-theory. We studied generalized coherent states over super Minkowski space with these isometries to allow for non-singular compactifications to the de Sitter spacetime dS_4, a candidate to model our Lorentzian universe.

Supervisor: Prof. Keshav Dasgupta

Summer 2022   **Undergraduate Researcher**, *NSERC, McGill University*, Montréal, Canada

Characterization of U(1) topological defect — cosmic string — signals occurring in a class of renormalizable quantum field theories. We developed statistics to extract these signals from primordial ΛCDM background noise in 21cm signal cosmological observations.

Supervisor: Prof. Robert Brandenberger

Spring 2022   **Undergraduate Researcher**, *McGill University*, Montréal, Canada

Study of the interaction of light and dynamical Casimir effect occurring in photon recycling via scalar quantum field theory. We computed the quantum corrections to the radiation force with loop diagrams using a spatially-dependent interaction vertex and relativistically moving boundary conditions for the mirrors.

Supervisor: Prof. Andrew Higgins

Fall 2021   **Undergraduate Researcher**, *McGill University*, Montréal, Canada

Numerical computations of scintillation densities for fast radio bursts and their corresponding black-white hole tunneling events in quantum cosmology. The fast radio burst signals are embedded in non-linear cosmological noise given by primordial perturbations.

Supervisor: Prof. Victoria Kaspi

Summer 2021   **Undergraduate Researcher**, *McGill University Health Center*, Montréal, Canada

Construction and training of models administering tumour suppressing radiation with neural networks. We investigated dose volume tensor estimation models with helically distributed electromagnetic waves.

Supervisor: Prof. Marija Popovic

Summer 2020 **Undergraduate Researcher**, *SURA, McGill University*, Montréal, Canada

Study of γ-rays and Cherenkov radiation in superluminous supernovae and tidal disruption events with the NASA Fermi-LAT: Unbinned/binned likelihood analyses, upper limit analyses, extended source analyses. ☑

Supervisor: Prof. Kenneth Ragan

2019 - 2020 **Undergraduate Researcher**, *Vanier College*, Montréal, Canada

Numerically solved the quantum Hamilton-Jacobi equations of motion and generated trajectories for de Broglie-Bohm theory with recurrent neural networks and the Crank-Nicolson method. ☑

Supervisor: Prof. Ivan Ivanov

Summer 2018 **Undergraduate Researcher**, *Concordia University*, Montréal, Canada

Study of topological confinement in a nanobeam microcavity. We characterized resonant modes of electromagnetic waves in nano-scale photonic crystal ring resonators with MIT Electromagnetic Equation Propagation. ☑

Supervisor: Prof. Pablo Bianucci

Presentations

July 2023 **8th Interstellar Symposium**, *McGill University*, Montréal, Canada

Presented the effects of light interference and the dynamical Casimir effect in photon recycling via scalar quantum field theory. ☑

May 2019 **Physics & AI Workshop**, *McGill University*, Montréal, Canada

Presented numerically computed quantum Hamilton-Jacobi trajectories for de Broglie–Bohm Theory using recurrent neural networks and the Crank-Nicolson method. ☑

Awards and Distinctions

May 2023 **NSERC USRA - Undergraduate Student Research Award**, *University of Alberta, Department of Physics*.

May 2022 **NSERC USRA - Undergraduate Student Research Award + FRQNT Supplement**, *McGill University, Department of Physics*.

May 2021 **BSA - Banner Student Award**, *McGill University Faculty of Medicine, Medical Physics Unit*.

May 2020 **SURA - Science Undergraduate Research Award**, *McGill University, Department of Physics*.

Relevant Extracurricular Activity

2022 - 2023 **Group Seminar**, *Superstring Theory*, Organized a graduate seminar on superstring theory based off modern HEP research papers and textbooks by Kiritsis, & Polchinski.

Spring 2022 **Review Paper**, *String Cosmology*, Review of the observational constraints of dark matter candidates in cosmology via type II string theory. ☑

Spring 2022 **Group Seminar**, *Gauge Theory*, Organized a graduate seminar on non-abelian gauge theory based off Baez's *Gauge Fields, Knots and Gravity* textbook, as well as Kibble's *Classification of Topological Defects and Their Relevance to Cosmology* paper.

Fall 2021 **Physics Hackathon**, *McGill University*, Montréal, Canada

Numerically reproduced the interference pattern in the double slit experiment with path integrals using the Metropolis-Hastings algorithm and Glauber dynamics for the Markov chain Monte Carlo method.