Jeffrey Morais

Theoretical Physics BSc

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Educational Background

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

Experience

Summer 2022 **Research Assistant: Theoretical Cosmology**, *McGill University*

- **Increased efficiency of extracted signals** from cosmic strings within cosmological **non-linear noise** functionals occurring in string cosmology.
- Created the cosmic string signal and **developed numerical algorithms** in **Python** to recognise its profile with **more accuracy than previous statistics** with correlation functions.
- Classified the string stability and isolated its signal with **wavelet** and **match-filtering statistics** from the spacetime dependent noise.

Winter 2022 **Research Assistant: Theoretical Quantum Optics**, *McGill University*

- **Demonstrated the efficiency of photon-recycling propulsion in Python** through quantum field theory corrections and perturbative non-linear quantum optics.
- Concluded that light interference does not hinder relativistic energy transfer in a **Fabry–Pérot cavity**.
- **Developed techniques to characterize the stability** of moving cells and efficiency of photon-recycling with loop level corrections.

Fall 2021 **Research Assistant: Computational Astrophysics**, *McGill University*

- Characterized fast radio burst signals captured by the **CHIME telescope** for use of radio astronomy experiments in Canada & the United States.
- **Developed computational methods in Python** for decoupling the signals from non-linear radio noise.
- **Coordinated with 10+ physicists** to optimize the calculation of decorrelation bandwidths of the burst via **bash scripts used in Canada Compute**.
- **Established a method for finding the position of the bursts** using spatial correlations in the linear radio noise.

2019 **Research Assistant: Quantum Theory**, *Vanier College*

- **Developed a novel approach** to **solve non-linear PDE** Hamilton-Jacobi equations of motion and generated quantum trajectories in pilot-wave theory.
- Developed algorithms in **Python** using the **Crank-Nicolson method** and **recurrent neural networks** to produce trajectories for arbitrary potentials.
- Reformulated and **numerically solved** the the time-dependent **Schrödinger equation**.

Programming

Python:

- **Multi-threading Markov chain Monte Carlo simulations** in arbitrary dimensions.
- **Object-oriented programming** data analysis using wavelet and match filtering statistics.
- **Scripting with supercomputers** owned by Canada Compute Cedar.
- Specific packages: **pyCICY, gymCICY, cymetric, 21cmFAST, TensorFlow**