Liam Pinchbeck

lcpinchbeck@gmail.com • 0466 597 055 • liamcpinchbeck.github.io

I am a motivated computational astro-particle physicist with expertise in scalable hierarchical Bayesian inference methods and data-driven investigations of dark matter physics in very high energy gamma-ray event data. I have experience in developing and managing large-scale data analysis pipelines, optimizing data workflows, and building inference tools for gamma-ray and gravitational-wave astronomy.

Education

PhD Candidate **2023-**
Monash University *Clayton, VIC, Australia*
Area: Computational Astro-particle Physics
Focus: Statistical methods for gamma-ray event analysis for dark matter parameter inference

Bachelor of Advanced Science Research - Hons. **2023**
Monash University *Clayton, VIC, Australia*
Thesis Title: Sensitivity of the Cherenkov Telescope Array to a Dark Matter signal from the Galactic Centre
Majors: Physics and Mathematics
GPA: 3.969

Experience

Teaching Associate **Mar 2024 –**
Monash University *Clayton, VIC, Australia*
- Guided students through advanced physics and mathematics concepts, enhancing their analytical and problem-solving skills.
- Supervised laboratory sessions, providing hands-on instruction in experimental physics methodologies and data analysis.

PhD Candidate (PhD student) **Feb 2023 –**
Monash University *Clayton, VIC, Australia*
- Developed frameworks that allow one to find indicators for dark matter, a hypothetical particle(s) that makes up most of the matter in the universe, through gamma ray event data.
- This work utilised hierarchical Bayesian inference, code design structures, stochastic sampling methods, variational inference methods and various other fields to develop a code framework called ***GammaBayes*** that allows one to take various approaches to constrain dark matter parameters based on gamma ray event data particularly for the CTA Observatory.

Research Scholarship **Dec 2021 – Jan 2022**
Monash University *Clayton, VIC, Australia*
- Developed a python pipeline to construct quantised multilayer perceptron (MLP) and convolutional (CNN) neural networks to analyse Phase-I COMET data searching for muon to electron events that would only exist outside the standard model of particle physics.
- Project: “Search for muon to electron conversion” under supervision by Dr. Yuki Fujii of Monash University.

Research Scholarship **Dec 2020 – Jan 2021**
Monash University *Clayton, VIC, Australia*

- Investigated and proved various theorems relating to the unique continuation property for solutions to elliptic partial differential equations
- Project: "Topics of unique continuation theorems" under supervision of Dr. Wenhui Shi of Monash University

Research Scholarship **Dec 2020 – Feb 2020**
Monash University *Clayton, VIC, Australia*

- Developed a temperature LabVIEW control code and interface that would control a Peltier module to regulate the temperature of a 2D material for use within a larger 2D material experiment
- Project: "Design a smart PID interface on ultra-precise temperature control with Peltier modules" under supervision by Dr. Shao-Yu Chen of Monash University (at the time of the project).

Select Publications

- **Liam Pinchbeck**, Csaba Balazs, Eric Thrane, *Model-independent dark matter detection with the Cherenkov Telescope Array Observatory.* arXiv preprint, arXiv:2412.17172
- **Liam Pinchbeck**, Eric Thrane, Csaba Balazs, *GammaBayes: a Bayesian pipeline for dark matter detection with CTA*, Journal of Cosmology and Astroparticle Physics **2024**, no. 05 (2024): 020, arXiv: 2401.13876
- Yuki Fujii et al., *Online Machine-Learning-Based Event Selection for COMET Phase-I*, Phys. Sci. Forum ***2023***, 8*(1), 32*

Awards and Scholarships

J.L. Williams Scholarship 2022
Awarded by School of Physics and Astronomy – Monash University

- Among other selection criteria this award, valued at $6000, is given to those enrolling in the Honours program within the School of Physics and Astronomy that have high academic performance and otherwise strong applications.

Dean's List Award 2022
Awarded by Monash University

- Awarded for outstanding academic achievement in the year of 2021.

Dean's List Award 2021
Awarded by Monash University

- Awarded for outstanding academic achievement in the year of 2020.

Dean's List Award 2020
Awarded by Monash University

- Awarded for outstanding academic achievement in the year of 2019.

***Vice-Chancellor's* Scholarship** 2019
Awarded by Monash University

- Awarded to high achieving students from under-represented schools enrolling full-time into a Monash Undergraduate degree (Bachelor). Recipients receive $4000 over the course of their degree.

Skills & Interests

Programming: Python, C++, MATLAB, Mathematica, R, Julia, Kotlin, Fortran, and LabVIEW.
Data Analysis: Bayesian inference, hierarchical modelling, stochastic sampling, variational inference, normalising flows
Tools & Infrastructure: HPC computing, distributed systems, data pipeline optimization, analysis package management