Ben Bert

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Profile

I am a Masters student in theoretical physics at the University of Cape Town (UCT), South Africa. I have expertise in both computational and analytical methods in theoretical physics; these skills having been developed through my MSc research which is directed in two orthogonal directions:

1. **Phenomenological perturbative QCD** - This project is primarily reliant on numerics and modelling; the objective is to better understand the collective dynamics of the nuclear fireball that filled the early Universe in the moments following the Big Bang. More specifically, this line of research is geared towards modelling how event-by-event fluctuations in the initial state of the Quark Gluon Plasma affect the observed azimuthal anisotropies in the hadron spectra at relativistic colliders such as RHIC and the LHC.
2. **Mathematical physics** - The approach of this project is analytic, and is directed towards understanding the subtleties that arise when applying Hamilton's principle in the presence of non-holonomic—*i.e.* derivative-dependent—gauge conditions, such as the Lorenz and Coulomb gauges.

Although my career is still in its early stages, I have already contributed in meaningful ways to the theoretical physics community through numerous talks at conferences, seminars, lectures and publications. In the short term, I aim to continue developing my research in QCD phenomenology and the mathematical aspects of field theory, through the goal of pursuing a PhD in high-energy theoretical physics. In the long term, my goal is to secure a research position at a leading academic institution, where I can continue researching theoretical physics at the highest of levels.

Papers

- Ben Bert, Coleridge Faraday, and William A. Horowitz, **Energy loss predicts no v_2 in small systems**, arXiv:2603.21861 [hep-ph] (2026)
- Coleridge Faraday, Ben Bert, Jack Brand, Werner Vogelsang, and William A. Horowitz, **From Lead to Helium: Discovery Potential for Jet Quenching in the Smallest Collision Systems**, arXiv:2512.17832 [hep-ph] (2025).
- Ben Bert and William A. Horowitz, **Integrable Non-Holonomic Constraints and Gauge Fixing in Classical Field Theory**, arXiv:2505.20684 [hep-th] (2025)
- Ben Bert, Coleridge Faraday, and William A. Horowitz, **Parameterizing the Geometry of the QGP on an Event-by-Event Basis**, in The Proceedings of SAIP2025, the 69th Annual Conference of the South African Institute of Physics, pp. 986 - 991. ISBN: 978-1-0492-1907-3.
- Ben Bert, Coleridge Faraday, and William A. Horowitz, **Modeling the Geometry of the Quark Gluon Plasma**, in The Proceedings of SAIP2024, the 68th Annual Conference of the South African Institute of Physics, pp. 618 - 623. ISBN: 978-1-0370-2645-4

Conferences, Seminars and Presentations

- Center for Theoretical and Mathematical Physics (2026) (*Title of Presentation:* **Energy loss predicts no v_2 in small systems**, `https://youtu.be/HIcIp1xw9Lw?si=KDe3EQXdCc16RH_r`)
- QGP@Mzansi (2026) (*Title of Presentation:* $R_{AA} \otimes v_n$ **From Energy Loss in Small Systems**)
- Center for Theoretical and Mathematical Physics Special Lecture (2025) (*Title of Presentation:* **Functional Derivatives in Physics**, `https://youtu.be/AgmBgifwC0M`)
- 69th Annual Conference of the South African Institute of Physics (2025) (*Title of Presentation:* **Parameterizing the Geometry of the QGP on an Event-by-Event Basis**)
- Quark Matter (2025)
- High energy probes of the initial stages (2025)
- Postgraduate Showcase - UCT Physics Department (2025) (*Title of Presentation:* **Nuclear Fireball Physics**)
- Center for Theoretical and Mathematical Physics Seminar (2025) (*Title of Presentation:* **Integrable Non-Holonomic Constraints and Gauge Fixing in Classical Field Theory**)
- Celebrating scientific excellence and global partnerships with 15 Years of SA-CERN (2025)
- String Theory Honours Project Presentation (2024) (*Title of Presentation:* **BRST in String Theory**)
- Honours Thesis Presentation (2024) (*Title of Presentation:* **Modeling the Geometry of the Quark Gluon Plasma**)
- 68th Annual Conference of the South African Institute of Physics (2024) (*Title of Presentation:* **Modeling the Geometry of the Quark Gluon Plasma**)
- Undergraduate Seminar Series University of Pretoria (2023) (*Title of Presentation:* **Prime**

Factorization via Shor's Algorithm)

Education

UCT — Masters — 2025–2026

- ◇ **MSc**, Physics
- ◇ Programme type: Research only
- ◇ Supervisor: A. Prof. W.A. Horowitz
- ◇ Research Topics: Non-holonomic constraints in classical field theory and phenomenological perturbative quantum chromodynamics

UCT — Honours — 2024

- ◇ **Honours Bachelor of Science**, Physics
- ◇ **Modules**: Electrodynamics 1, Electrodynamics 2, Quantum Mechanics 1, Quantum Mechanics 2, Quantum Field Theory 1, Quantum Field Theory 2, String Theory, Statistical Physics
- ◇ **Selected topics covered in QFT courses**: Renormalization of ϕ^4 scalar field theory, Feynman rules for Quantum Electrodynamics, BRST quantization of non-abelian gauge field theories, Path integrals for fermions.
- ◇ **Honours Thesis**: Modeling the Geometry of the Quark Gluon Plasma (High Energy Physics), supervised by A. Prof. W.A. Horowitz
- ◇ GPA: 85% (Distinction)

University of Pretoria — Undergraduate — 2020–2023

- ◇ **Bachelor of Science**, Physics
- ◇ **Second Major**: Pure Mathematics
- ◇ **Final Year Modules**: Real Analysis (96%), Quantum Mechanics (97%), Electromagnetism (95%), Particle Physics (96%), Statistical Mechanics (93%), Partial Differential Equations (92%), Abstract Algebra (90%)
- ◇ **Bachelor's Thesis**: Predicting Absorption Spectra using Artificial Neural Networks (Biophysics), supervised by Prof. T.P.J. Krüger

Scholarships and Awards

- ◇ National Institute for Theoretical and Computational Sciences (NITheCS) Scholarship (2025–2026)
- ◇ SA College Croll Scholarship (2025)
- ◇ SA-CERN Excellence Bursary (2025–2026)
- ◇ University of Pretoria Best Student in Physics — Highest GPA (2022–2023)
- ◇ University of Pretoria Academic Merit Award (2020–2023)

Referee Experience

◇ Electronic Research Archive of AIMS Press

Tutoring Experience

◇ Honours quantum mechanics — PHY4000 (UCT, 2026)
◇ Honours quantum mechanics — PHY4000 (UCT, 2025)
◇ 1^{st} year physics for engineering — PHY1012F (UCT, 2024)
◇ 2^{nd} year abstract algebra — WTW221 (University of Pretoria, 2023)
◇ 2^{nd} year linear algebra — WTW211 (University of Pretoria, 2023)
◇ 1^{st} year physics — PHY124 (University of Pretoria, 2022)
◇ 1^{st} year physics — PHY114 (University of Pretoria, 2022)
◇ High school physics, chemistry and mathematics privately (2020 – Present)

Mentorship Roles

◇ **Tiaan van der Merwe**: Mentoring and helping with honours and MSc projects on phenomenological energy loss at UCT
◇ **Jack Brand**: Mentoring and helping with honours and MSc projects on phenomenological energy loss at UCT