Ugnius Igaris

Lecturer in Theoretical Physics

EMAIL: ugnius.igaris@ff.vu.lt
LINKEDIN: linkedin.com/in/ugnius-igaris-2324201a6
MOBILE: +37069914563

Prospective PhD student in the fields of gravity, cosmology, and quantum field theory. Truth, understanding, and knowledge have always been my aspirations in life, whether they concern our lives or the universe. My primary reason for pursuing physics is to get ever closer to seeing the world as it really is. Ideas, tools and calculations in theoretical physics that further this cause are what interest me.

EMPLOYMENT HISTORY

Lecturer — Sep 2025 – Present

Institute of Theoretical Physics and Astronomy, Vilnius University — *Vilnius, Lithuania*

- In addition to teaching the same courses as in 2024 – 2025, I organise weekly General Relativity seminars and deliver blackboard lectures to students and academics following Sean M. Carroll's book "Spacetime and Geometry"
- Starting a research project with Dr Mindaugas Karčiauskas and Dr Adrián Casado-Turrión on gravitational waves in modified gravity theories

Researcher — Sep 2024 – Aug 2025

Institute of Theoretical Physics and Astronomy, Vilnius University — *Vilnius, Lithuania*

- Teaching problem classes:
  - Introduction to Programming, Python (1st year bachelor's students)
  - Statistical Physics (3rd year bachelor's students)
  - Quantum Field Theory 1 (1st year master's students)
- Collaborating with Dr Latham Boyle and Professor Neil Turok on research:
  - BV quantisation of conformal gravity
  - CPT theorem in curved spacetime

EDUCATION

The University of Edinburgh | *Mathematical Physics MSc* — Sep 2023 – Aug 2024

- Grade: Distinction
- Master's dissertation in mathematical physics with Dr Latham Boyle and Professor Neil Turok OC (79 %): "Propagators in Four-derivative Theories of Gravity"
- Relevant taught courses: "Geometry of General Relativity" (78 %), "Topics in Mathematical Physics B (Applications of Differential Geometry in Physics)" (70 %), "Differential Geometry" (credit received; exam not taken), "Problem Solving in Theoretical Physics" (98 %), "Research Skills for Theoretical Physics" (76 %), "Gauge Theories in Particle Physics" (74 %), "Astrophysics: Galaxies and Cosmology" (65 %)

King's College London | *Physics and Philosophy MSci* — Sep 2019 – Jun 2023

- Grade: First Class Honours
- Master's thesis in physics with Professor John Ellis CBE FRS and Dr Ken Mimasu (72 %): "Searching for New Physics Beyond the Standard Model at the LHC"
- Relevant final year taught courses: "Quantum Field Theory" (77 %), "Strings, Branes and Quantum Gravity" (completed; mark withheld due to UK marking boycott 2023), "Gravitational Wave Physics" (71 %), "Advanced Quantum Field Theory" (86 %)

UK grading: $\geq 70\%$ = First/Distinction (excellent), $60 - 69\%$ = 2:1/Merit (very good).

RESEARCH EXPERIENCE

CPT theorem in curved spacetime — Feb 2025 – Jul 2025

With L. Boyle

- We started this project with Latham in early 2025, aiming to provide a proof of the CPT theorem in curved spacetime. Additionally, we intended to give a systematic explanation of how quantum processes relate to their CPT-transformed counterparts (especially in relation to cosmology), as well as the importance and interpretation of tetrads in these contexts. Progress was made in relating Feynman diagrams, as well as which approaches could or could not potentially work in proving the theorem and why (such as the spinor formalism).

BV quantisation of conformal gravity — Sep 2024 – Dec 2024

With L. Boyle and N. Turok

- The gauge-fixing of conformal gravity during my master's dissertation did not involve ghosts, so a full quantisation procedure was necessary. A conclusion was reached that usual gauge-fixing methods do not straightforwardly apply to conformal gravity, and the application of the Batalin-Vilkovisky (BV) formalism was necessary. However, having made progress in understanding, towards the end of 2024 and after discussing the matter with Damiano Anselmi from Italy, we came to the realisation that this model was too flawed, perhaps even ill-defined, to be studied further.

Propagators in Four-derivative Theories of Gravity — Jun 2024 – Aug 2024

With L. Boyle and N. Turok

- In this project, quadratic (QG) and conformal (CG) theories of gravity were studied. Their graviton contributions to triangle diagrams were of particular interest in future projects (when coupled with the SM), calling for the need for graviton propagators. Both theories were appropriately gauge-fixed, with propagators derived exactly. It was found that, unlike in only diffeomorphism-invariant theories (such as QG), the gauge-fixing procedure for CG requires an even more restrictive choice of gauge due to its additional symmetry. A Mathematica (xAct, xPert) procedure was developed to extract their quadratic sectors, leading to a generalisation of finding the propagator in most gravity theories.

Searching for New Physics Beyond the SM at the LHC — Jan 2023 – Apr 2023

With J. Ellis and K. Mimasu

- In 2022, the CDF collaboration published an experimental result on the mass of the W boson which significantly deviated from the SM prediction. Later, SMEFT analyses found that there are a number of single-field extensions of the SM which would explain the mass discrepancy. In light of this, an extension of the SM with a real heavy scalar triplet was studied in this project exactly: it was confirmed that SMEFT methods identified this field correctly, bounds were put on the vacuum expectation value of the triplet to induce the required shift, and processes through which it could be detected at the LHC were studied.

SUMMER SCHOOLS AND CONFERENCES

29th Central Europe Workshop on Quantum Optics (CEWQO29) — Jun 2025

Higgs School of Theoretical Physics, The University of Edinburgh — Jun 2024

Triangular Conference on Cosmological Frontiers in Fundamental Physics — Apr 2024

3rd Baltic School in High Energy Physics and Accelerator Technologies, Kaunas University of Technology — Aug 2023

INTERESTS AND HOBBIES

Expert advisor on mathematics teaching for Queen Morta School — Sep 2025 – Present

Committee member in the national Physics Olympiad in Lithuania — 2025,2026

I enjoy writing essays on various topics ranging from climate change to mathematical aspects of the Lithuanian pension system