



Tomáš Gonda

Researcher in Applied Category Theory and Quantum Information Theory

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Education

PhD	Perimeter Institute & University of Waterloo , Physics, Quantum Information <ul style="list-style-type: none"> Thesis: <i>Resource Theories as Quantale Modules</i> Supervisor: Dr. Robert W. Spekkens 	Waterloo, ON, Canada Sept 2017 – Nov 2021
MSc	Perimeter Institute & University of Waterloo , Theoretical Physics <ul style="list-style-type: none"> Thesis: <i>Resource Theoretic Approach to Causal Inference</i> Supervisor: Dr. Robert W. Spekkens 	Waterloo, ON, Canada Aug 2016 – June 2017
BSc	University of Edinburgh , Mathematics & Physics <ul style="list-style-type: none"> First class honours, 92% average grade Thesis: <i>Symplectic Geometry</i> Supervisor: Dr. Johan Martens 	Edinburgh, Scotland Oct 2013 – May 2016

Experience

University of Innsbruck , Senior postdoctoral researcher Independent research in applied category theory and quantum information. <ul style="list-style-type: none"> Algebra group, led by Tim Netzer Funded by my FWF ESPRIT Grant Ergodic Theory in Categorical Probability 	Innsbruck, Austria Mar 2025 – present 1 year 1 month
University of Innsbruck , Postdoctoral researcher Conducting research in applied category theory and quantum information theory. <ul style="list-style-type: none"> Mathematical quantum physics group, led by Gemma De Les Coves 	Innsbruck, Austria Jan 2022 – Feb 2025 3 years 2 months
Applied Category Theory Adjoint School , Supervisor / teaching assistant Co-leading a summer school research project with Paolo Perrone. <ul style="list-style-type: none"> Topic: Modelling Uncertainty with Markov Categories 	Oxford, UK June 2024
University of Waterloo & University of Innsbruck , Supervisor / project lead Supervising Master's thesis projects of: <ul style="list-style-type: none"> Yìlè Yìng (MSc, 2022, co-supervised by RW Spekkens); <i>Asymmetry Trade-off Relations: A New Kind of Uncertainty Relations</i> Stefan Kremminger (MSc, 2024); <i>Quantum Conditional Independence</i> 	varied 2022 – present 4 years
University of Waterloo , Teaching assistant <ul style="list-style-type: none"> Conducting tutorials for graduate level courses in Quantum Theory and Statistical Physics. Supervising multiple Master's level winter school projects in Quantum Foundations. 	Waterloo, ON, Canada 2017 – 2021 4 years
ETH Zürich , Visiting researcher Collaborating with researchers in the group of Renato Renner on topics in information theory.	Zürich, Switzerland Summer 2019
InstaEDU , Online tutor Online tutoring of undergraduate students in science and engineering.	remote 2013 – 2016 3 years

University of Edinburgh, Career development internship
A summer project on modelling turbulence in Matlab.
• Topic: *Transition to turbulence in plane Couette flow*

Edinburgh, Scotland
Summer 2015

Personal tutor
In-person tutoring of high school students.

Bratislava, Slovakia
2012 – 2013
1 year

Volunteering

Scientific Journals, Reviewer

remote

Reviewing manuscripts for:

- Philosophy of Science (1)
- Quantum (3)
- Compositionality (2)
- Journal of Pure and Applied Algebra (1)
- Journal of Mathematical Physics (1)
- various conference submissions.

Positive Futures Festival, Organizer

Innsbruck, Austria
2024 – present

Co-organizing an annual two week long music festival with ~40 concerts and ~1000 attendees.

Touch&Play Cologne Festival, Organizer

Germany
2025 – present

Co-organizing and facilitating an annual week long retreat with ~100 attendees.

Awards

ESPRIT Grant Ergodic Theory in Categorical Probability

Mar 2025

The ESPRIT Grant supports young independent researchers in Austria.

Austrian Science Fund

fwf.ac.at/forschungsradar/10.55776/ESP3451824

Napier Medal and Gangadhar Balwant Gadgil Prize

2016

Awarded to the best student in the Year 4 of the Mathematics program at the University of Edinburgh.

University of Edinburgh

Nichol Foundation Scholarship

2015

Awarded to the best overall mark in the Year 3 of Physics degrees at the University of Edinburgh.

University of Edinburgh

Kelland Memorial Prize

2014

Awarded for distinguished performance for direct entrants into the Second year of the program.

University of Edinburgh

Selected Publications

Empirical measures and strong laws of large numbers in categorical probability

Mar 2025

We introduce axioms for empirical sampling morphisms, which are abstract notions of empirical measures within the framework of categorical probability. Using these, we prove abstract versions of the de Finetti theorem, the Glivenko–Cantelli theorem, and the strong law of large numbers, and show that classical results are recovered via the category of partial Markov kernels.

Tobias Fritz, **Tomáš Gonda**, Lorenzin, Antonio, Perrone, Paolo, Mohammed, Areeb Shah
arxiv.org/abs/2503.21576 (preprint)

De Finetti's theorem in categorical probability

Sept 2021

A novel proof of de Finetti's Theorem characterizing permutation-invariant probability measures of infinite sequences of variables. The proof is phrased in the language of Markov categories, which provide an abstract categorical framework for probability and information flow. The diagrammatic and modular nature of the arguments makes the proof intuitive and easy to follow.

Tobias Fritz, **Tomáš Gonda**, Perrone, Paolo
repository.lsu.edu/josa/vol2/iss4/6 (Journal of Stochastic Analysis)

Epistemic horizons from deterministic laws: Lessons from a nomic toy theory

Mar 2025

A study of what embedded observers can learn about the rest of the world made up of classical particles. We show that, in spite of deterministic physical laws, they face an epistemic horizon — properties such as position and momentum cannot be known simultaneously.

Johannes Fankhauser, **Tomáš Gonda**, Gemma De Les Coves
link.springer.com/article/10.1007/s11229-024-04852-0 (Synthese)

A framework for universality in physics, computer science, and beyond

Aug 2024

First steps towards an abstract theory of universality, generalizing universal Turing machines, universal spin systems, completeness for complexity classes, and much more.

Tomáš Gonda, Tobias Reinhart, Sebastian Stengele, Gemma De Les Coves
compositionality.episciences.org/14134 (Compositionality)

Monotones in general resource theories

Aug 2023

Resource theories offer an abstract framework for comparing resources for all kinds of tasks. We provide a general theory for quantifying the cost and yield of a resource, generalizing a plethora of known constructions.

Tomáš Gonda, Robert W. Spekkens
compositionality.episciences.org/13526 (Compositionality)

Selected Presentations

Introduction to categorical probability

Waterloo, ON, Canada

A 4-lecture mini-course at the Perimeter Institute

Oct 2025

- Online recordings: pirsa.org/c25054

Introduction to categorical probability

Vienna, Austria

IQQI Vienna Seminar

Sept 2025

- Youtube recording: youtube.com/watch?v=eVfFuIGEZxc

Resource dependence relations and contextuality in asymmetry trade-offs

Varna, Bulgaria

Quantum Physics and Logic (QPL) Conference

July 2024

Epistemic horizons from deterministic laws: Lessons from a nomic toy theory

Oxford, UK

OASIS — The Oxford Advanced Seminar on Informatic Structures

June 2024

- Invited talk

A framework for universality in physics, computer science, and beyond

remote

NYC category theory seminar

Sept 2023

- Invited talk
- Youtube recording: youtube.com/watch?v=8_ZX2vpqBZU

Supports and idempotent splitting in Markov categories

Maryland, USA

Applied Category Theory Conference

Aug 2023

- Youtube recording: youtube.com/watch?v=3QJzfdZu8_g

A framework for universality in physics, computer science, and beyond Category Theory at Work in Computational Mathematics and Theoretical Informatics (CATMI) <ul style="list-style-type: none"> Invited talk 	Bergen, Norway June 2023
De Finetti's theorem in categorical probability Applied Category Theory Conference	Cambridge, UK July 2021
Blackwell-Sherman-Stein Theorem in categorical probability Applied Category Theory Conference <ul style="list-style-type: none"> keynote presentation Youtube recording: youtube.com/watch?v=fgWUV-hE0CI 	remote July 2020
Almost quantum correlations are inconsistent with Specker's principle Quantum Information Processing (QIP) Conference	Boulder, CO, USA Jan 2019
Almost quantum correlations are inconsistent with Specker's principle Q-Turn Conference <ul style="list-style-type: none"> Youtube recording: youtube.com/watch?v=u2XwLiktTI8 	Florianopolis, Brazil Nov 2018
The ontological nature of causality Rethinking Foundations of Physics Workshop <ul style="list-style-type: none"> Youtube recording: youtube.com/watch?v=3QJzfdZu8_g 	Cambridge, UK July 2018
Peculiarities of quantum theory FKS Summer School	Bratislava, Slovakia Aug 2017

Languages

Slovak

Native

Czech

Fluent

English

Fluent (C1/C2)

German

Fluent (B2)