Job Leon Feldbrugge

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Referees

Prof. Neil Turok, University of Edinburgh, Edinburgh, Scotland and Perimeter Institute for Theoretical Physics, Waterloo, Canada (neil.turok@ed.ac.uk)
Prof. Ue-Li Pen, Academia Sinica, Taipei, Taiwan and Canadian Institute for Theoretical Astrophysics, Toronto, Canada (pen@cita.utoronto.ca)
Prof. Rien van de Weygaert, University of Groningen, Groningen, The Netherlands (weygaert@astro.rug.nl)

Academic positions

2021 - present	**Higgs Fellow** at the Higgs Centre for Theoretical Physics at the University of Edinburgh (Scotland)
2019 - 2021	**Postdoc** at the Perimeter Institute (Canada) and the Department of Physics, Carnegie Mellon University (United States)

Education

2015 - 2019	**PhD** Physics, Perimeter Institute, University of Waterloo
	Advisor: Neil Turok
	Thesis: Path integrals in the sky: Classical and quantum problems with minimal assumptions
	Defence date: October 17, 2019
2014 - 2015	**Master** Part III Mathematics (*with distinction*), University of Cambridge
	Committee: Paul Shellard and Tommaso Giannantonio
	Thesis: Primordial non-Gaussianity and large-scale structure
2012 - 2014	**Master** Physics (*cum laude*), van Swinderen Institute, University of Groningen
2012 - 2014	**Master** Astronomy (*cum laude*), Kapteyn Institute, University of Groningen
2012 - 2014	**Master** Mathematics (*cum laude*), Bernoulli Institute, University of Groningen
	Committee: Rien van de Weygaert (cosmology and large-scale structure formation)
	Diederik Roest (string cosmology)
	Aernout van Enter (statistical mechanics)
	Thesis: Statistics of caustics in large-scale structure formation
2009 - 2012	**Bachelor** Physics (*cum laude*), van Swinderen Institute, University of Groningen
2009 - 2012	**Bachelor** Astronomy (*cum laude*), Kapteyn Institute, University of Groningen
2009 - 2012	**Bachelor** Mathematics (*cum laude*), Bernoulli Institute, University of Groningen
	Committee: Rien van de Weygaert (cosmology and large-scale structure formation)
	Elisabetta Pallante (quantum field theory)
	Gert Vegter (computational geometry)
	Thesis: Analysis of Betti numbers and persistence diagrams of 2D Gaussian random fields
July 2016	**Summer school** It from qubit summer school, Perimeter Institute, Canada (two weeks)
July 2015	**Summer school** Prospects in theoretical physics: new insights into quantum matter, Institute for Advanced Studies, Princeton (one week)
July 2015	**Summer school** Princeton summer school on condensed matter physics (one week)
August 2011	**Summer school** Dealing with environmental heritage, Bath, United Kingdom (two weeks)
July 2010	**Summer school** University of Cambridge international summer school in science (two weeks)

Awards

Scholarships

Research Visits

Publications & talks

JOURNAL ARTICLES

2023	**J. Feldbrugge**, Y. Yan, and R. van de Weygaert, "Statistics of tidal and deformation eigenvalue fields in the primordial Gaussian matter distribution: the two-dimensional case", *Monthly Notices of the Royal Astronomical Society* (2023, R&R). arXiv:2301.07200 [astro-ph.CO]
2023	**J. Feldbrugge**, and R. van de Weygaert, "Cosmic web & caustic skeleton: non-linear constrained realizations - 2D case studies", *Journal of Cosmology and Astroparticle Physics* (2013) no.2, 58. arXiv:2212.07840 [astro-ph.CO]
2023	**J. Feldbrugge**, U.-L. Pen, and N. Turok, "Oscillatory path integrals for radio astronomy," *Annals of Physics* (2023) no.451, 169255. arXiv:1909.04632 [astro-ph.HE]
2023	**J. Feldbrugge**, "Multi-plane lensing in wave optics," *Monthly Notices of the Royal Astronomical Society* (2023) nr.250, 2995-3006. arXiv:2010.03089 [astro-ph.CO]
2022	**J. Feldbrugge**, and N. Turok, "Existence of real time quantum path integrals", *Annals of Physics* (2023, R&R) arXiv:2207.12798 [hep-th]
2022	D. Jow, U.-L. Pen, and **J. Feldbrugge**, "Regimes in astrophysical lensing: refractive optics, diffractive optics, and the Fresnel scale", *Monthly Notices of the Royal Astronomical Society* (2022, R&R). arXiv:2204.12004 [astro-ph.CO]

2021	G. Wilding, K. Nevenzeel, R. van de Weygaert, G. Vegter, P. Pranav, B.J.T. Jones, K. Efstathiou, and **J. Feldbrugge**, "Persistent homology of the cosmic web. I: Hierarchical topology in ΛCDM cosmologies" *Monthly Notices of the Royal Astronomical Society* (2020) nr.507, 2968-2990. `arXiv:2011.12851 [astro-ph.CO]`
2020	**J. Feldbrugge**, and N. Turok, "Gravitational lensing of binary systems in wave optics," *Physical Review Letters* (2020, R&R). `arXiv:2008.01154 [gr-qc]`
2019	**J. Feldbrugge**, M. van Engelen, R. van de Weygaert, P. Pranav, and G. Vegter, "Stochastic homology of Gaussian vs. non-Gaussian random fields: Graphs towards Betti numbers and persistence diagrams, *Journal of Cosmology and Astroparticle Physics* (2019) no.9, 52–100. `arXiv:1908.01619 [astro-ph.CO]`
2019	A. Di Tucci, **J. Feldbrugge**, J.-L. Lehners, N. Turok, "Quantum incompleteness of inflation," *Physical Review D, 100* (2019) no.6, 63517. `arXiv:1906.09007 [hep-th]`
2019	P. Pranav, R. van de Weygaert, G. Vegter, B.J.T. Jones, R.J. Adler, **J. Feldbrugge**, C. Park, T. Buchert, and M. Kerber, "Topology and geometry of Gaussian random fields I: on Betti numbers, Euler characteristic, and Minkowski functionals" *Monthly Notices of the Royal Astronomical Society, 485* (2019) no.3, 4167–4208. `arXiv:1812.07310 [astro-ph.CO]`
2018	**J. Feldbrugge**, J.-L. Lehners, and N. Turok, "Inconsistencies of the new no-boundary proposal," *Universe, 4* (2018), no.10, 100–115. `arXiv:1805.01609 [hep-th]`
2018	**J. Feldbrugge**, R. van de Weygaert, J. Hidding, and J. Feldbrugge, "Caustic skeleton & cosmic web," *Journal of Cosmology and Astroparticle Physics* (2018) no.05, 27–81. `arXiv:1703.09598 [astro-ph.CO]`
2018	**J. Feldbrugge**, J. Lehners, and N. Turok, "No rescue for the no boundary proposal: Pointers to the future of quantum cosmology," *Physical Review D, 97* (2018), no.2, 23509 `arXiv:1708.05104 [hep-th]`
2017	**J. Feldbrugge**, J.-L. Lehners, and N. Turok, "No smooth beginning for spacetime," *Physical Review Letters, 119* (2017), no.17, 171301. `arXiv:1705.00192 [hep-th]`
2017	**J. Feldbrugge**, J.L. Lehners, and N. Turok, "Lorentzian quantum cosmology," *Physical Review D, 95* (2017), no.10, 103508. `arXiv:1703.02076 [hep-th]`
2016	**J. Feldbrugge**, J. Hidding, and R. van de Weygaert "Statistics of caustics in large-scale structure formation," *The Zeldovich Universe: Genesis and Growth of the Cosmic Web, Proceedings of the International Astronomical Union, IAU Symposium, 308* (2016), 107–114. `arXiv:1412.5121 [astro-ph.CO]`
2013	R. van de Weygaert, G. Vegter, H. Edelsbrunner, B.J.T. Jones, P. Pranav, C. Park, W. Hellwing, B. Eldering, N. Kruithof, E.G.P. Bos, J. Hidding, **J. Feldbrugge**, E. ten Have, M. van Engelen, M. Caroli, and M. Teillaud, "Alpha, Betti and the megaparsec universe: On the topology of the cosmic web," *Transactions on Computational Science XIV: Special Issue on Voronoi Diagrams and Delaunay Triangulation. Lecture Notes in Computer Science, Vol. 6970. Springer Berlin Heidelberg* (2013). `arXiv:1306.3640 [astro-ph.CO]`

Theses

2019	**J. Feldbrugge**, "Path integrals in the sky: classical and quantum problems with minimal assumptions," PhD thesis, Perimeter Institute, University of Waterloo, supervised by N. Turok. Available online.
2015	**J. Feldbrugge**, "Primordial non-Gaussianity and large-scale structure," Part III Essay, University of Cambridge, supervised by P. Shellard and T. Giannantonio. Available online.
2014	**J. Feldbrugge**, "Statistics of caustics in large-scale structure formation," Master thesis, University of Groningen, supervised by R. van de Weygaert, D. Roest, A.E. van Enter. Available online.
2012	**J. Feldbrugge** and M. van Engelen, "Analysis of Betti numbers and persistence diagrams of two-dimensional Gaussian random fields," Bachelor thesis, University of Groningen, supervised by R. van de Weygaert, E. Pallante, G. Vegter. Available online.

Talks

March 2023	Optimal Transport Theory and Applications to Physics, Ecole Physique, Les Houches, France Presentation: Dissecting the cosmic web with caustics
February 2023	The Co-evolution of the Cosmic Web and Galaxies across Cosmic Time, Kavli Institute for Theoretical Physics, UC Santa Barbara, California, United States Presentation: Dissecting the cosmic web with caustics
September 2022	2nd Roman Juskiewicz Symposium, Nicolaus Copernicus Astronomical Center, Warsaw, Poland Presentation: Dissecting the cosmic web with caustics
July 2022	Cosmology from Home Presentation: Dissecting the cosmic web with caustics
June 2022	Information Universe 4, University of Groningen, Groningen, The Netherlands Presentation: Dissecting the cosmic web with caustics
May 2022	Cosmology seminar, Oxford University, Oxford, England Presentation: Dissecting the cosmic web with caustics

May 2022	UK Cosmo Meeting 2022, Newcastle University, Newcastle, England
	Presentation (keynote): Dissecting the cosmic web with caustics
March 2022	Cosmic Cartography 2022: Exploring the Cosmic Web and Large-Scale Structure, Kavli IPMU, Kashiwa, Japan
	Presentation: The caustic web and non-linear constrained Gaussian random fields
October 2021	Higgs hour, University of Edinburgh, Edinburgh, Scotland
	Presentation: Interference, caustics and oscillatory integrals
October 2021	Tuorla-Tartu meeting 2021, University of Turku, Turku, Finland
	Presentation: Caustic skeleton of the cosmic web
May 2021	Seminar Universidad Nacional Autonoma de Mexico, Mexico city
	Presentation (invited): Interference phenomena in lensing and quantum physics
May 2021	Sirius A symposium 2021: To infinity and beyond
	Presentation (invited): The caustic skeleton of the cosmic web
October 2020	Pusar group meeting, CITA, Toronto, Canada
	Presentation: Multi-plane lensing and gravitational binary lensing in wave optics
October 2020	Quantum & Gravity Seminar, Radboud Universiteit, Nijmegen, The Netherlands
	Presentation: Lorentzian quantum cosmology
September 2020	Cosmology from home 2020, virtual conference on all aspects of cosmology.
	Presentation: The caustic skeleton of the cosmic web
March 2020	Topological statistics group meeting. Department of statistics at Carnegie Mellon University, Pittsburgh, United States
	Two presentations: Cosmology and topology I, and Cosmology and topology II
February 2020	The centre for the universe Waterloo Centre for Astrophysics day, Waterloo, Canada
	Presentation: Path integrals for radioastronomy and gravitational lensing II
February 2020	Cosmology group meeting, Perimeter Institute, Waterloo, Canada
	Presentation: The caustic skeleton of the cosmic web
January 2019	The cosmic web in the local universe, Lorentz center, Leiden, The Netherlands
	Presentation: The caustics skeleton of the cosmic web
November 2019	Scintillometry 2019, Max Planck Institute for Radio Astronomy, Bonn, Germany
	Presentation (invited): Oscillatory path integrals for radio astronomy
October 2019	The Future of Astronomy, Waterloo Centre for Astrophysics, Waterloo, Canada
	Poster: Oscillatory path integrals for radio astronomy
September 2019	Theory group meeting, Carnegie Mellon University, Pittsburgh, United States
	Presentation: Interference and Picard-Lefschetz theory
September 2019	Simplicity III, Perimeter Institute, Waterloo, Canada
	Presentation: Fun with path integrals II
August 2019	Graduate student meeting, Perimeter Institute, Waterloo, Canada
	Presentation: Oscillatory integrals in the complex plane
June 2019	Probabilities in cosmology, University of Groningen, The Netherlands
	Presentation: Lorentzian beginnings of the universe
June 2019	The cosmic web: from galaxies to cosmology, Edinburgh, United Kingdom
	Presentation: Caustic skeleton of the cosmic web
May 2019	Cosmology group meeting Perimeter Institute, Waterloo, Canada
	Presentation: lenses and oscillatory integrals
June 2018	2018 Rotman summer institute in philosophy of cosmology, Godrich, Canada
	Presentation (invited): Lorentzian quantum cosmology (two lectures)
May 2018	Albert Einstein Institute group meeting, Potsdam, Germany
	Presentation: Classical and weak trajectories
November 2017	Path integral of gravity, Perimeter Institute, Waterloo, Canada
	Presentation: Quantum incompleteness of inflation II
September 2017	Cosmology group meeting CITA, Canada
	Presentation: The instability of the no-boundary proposal
July 2017	Cosmic web day, University of Toronto, Toronto, Canada
	Presentation: The caustic skeleton of the cosmic web
May 2017	PI-day, Perimeter Institute, Waterloo, Canada
	Presentation: Lorentzian quantum cosmology
May 2017	Theory Canada 12, York University, Toronto, Canada
	Presentation: Lorentzian quantum cosmology
May 2017	Cosmology group meeting Perimeter Institute, Waterloo, Canada
	Presentation: Caustics in large-scale structure

May 2017	String cosmology group meeting Van Swinderen Institute, Groningen, Netherlands
	Presentation: Lorentzian quantum cosmology
April 2017	New Thoughts 3: About the universe and more, Ely, United Kingdom
	Presentation: Lorentzian quantum cosmology
April 2017	British gravity meeting 2017, University of Oxford, Oxford, United Kingdom
	Presentation: Lorentzian quantum cosmology
September 2016	CITA-PI day: Gravitational non-linear instability, CITA, Toronto, Canada
	Presentation (invited): Shocks in the early universe and gravitational waves
June 2016	Cosmology group meeting CITA, Canada
	Presentation: Statistics of caustics in large-scale structure
May 2016	Cosmology group meeting Perimeter Institute, Canada
	Presentation: Statistics of caustics in large-scale structure
March 2016	Statistics of extrema of large-scale structure, Lorentz center, Leiden, The Netherlands
	Presentation: Statistics of caustics in large-scale structure
June 2014	IAUS 308: The Zel'dovich universe, Tallinn, Estonia
	Presentation: Statistics of caustics in large-scale structure formation
October 2012	Structure of the cosmic web, Leibniz institute astrophysics, Potsdam, Germany
	Presentation: Analysis of Betti numbers and persistence diagrams in 2D GRFs

CONFERENCES AND WORKSHOPS (ATTENDED ONLY)

January 2023	New Directions in Theoretical Physics 4, University of Edinburgh, Edinburgh, Scotland
June 2022	Analogue Models of Gravity and Fluctuation-Induced phenomena, University of Edinburgh, Edinburgh, Scotland
June 2022	Online Workshop "Physics of the Early Universe"
January 2021	Cosmology 2021: the rise of field theory, University of Cambridge, Cambridge, The United Kingdom
October 2020	The information universe: What is the role of information in our Universe? University of Groningen, Groningen, The Netherlands
January 2020	First Dutch Mathematical Relativity Day, Radboud University Nijmegen, Nijmegen, The Netherlands
September 2019	Cosmological frontiers in fundamental physics 2019, Perimeter Institute, Waterloo, Canada
November 2018	Quantum universe, in celebration of Neil Turok's 60th birthday, Centro de Estudio Cientificos (CECs), Valdivia, Chile
August 2018	Cosmology and gravitational physics with lambda, Nordita, Stockholm, Sweden
June 2018	Scanning new horizons: Emergent space-time, black holes and quantum information, Van Swinderen Institute, Groningen, The Netherlands
January 2018	Gravity in the early universe, Princeton University, Princeton, United States
June 2017	Bounce scenarios in cosmology, Perimeter Institute, Waterloo, Canada
January 2017	Fundamentals of the universe, Van Swinderen Institute, Groningen, The Netherlands
January 2017	New directions in theoretical physics II, Higgs center for theoretical physics, Edinburgh, United Kingdom
October 2016	Midwest relativity meeting, Perimeter Institute, Waterloo, Canada
June 2016	Time in cosmology, Perimeter Institute, Canada
June 2016	Concepts and paradoxes in a quantum universe, Perimeter Institute, Canada
June 2016	Cosmological frontiers in fundamental physics 2016, Perimeter Institute, Canada
June 2015	Convergence, Perimeter Institute, Canada
April 2014	Quantum universe 4, University of Groningen, The Netherlands
March 2013	Quantum universe 3, University of Groningen, The Netherlands

Advising and Teaching

2023 - present	Co-advisor PhD project, Ariadna Metidieri, Radboud University, Nijmegen, The Netherlands Advisor master student Joshua Jones, University of Cambridge, United Kingdom
2022 - present	Co-advisor bachelor project Yonatan Sklansky, University of Pennsylvania, United States
2022 - present	Advisor research project Yihan Yan, University of Waterloo, Canada
2020 - 2022	Co-advisor PhD student Georg Wilding, University of Groningen, The Netherlands
2021 - 2022	Advisor bachelor project Yihan Yan, Waterloo University, Canada
2020 - 2021	Co-advisor PhD student Varun Rustagi, University of Groningen, The Netherlands
2018 - 2022	Co-supervisor master student Kevin Bixerman, University of Groningen, The Netherlands
June 2018	2018 Rotman summer institute in philosophy of cosmology, Godrich, Canada
	Two lectures on Lorentzian quantum cosmology
January 2018	PSI winter school, co-supervisor project 'Pair creation in de Sitter spacetime', Huntsville, Canada

2010 - 2015	Physics lecturer, exam training for secondary school students, UOCG Market BV
2013 - 2014	Developer of teaching material for exam training in physics, UOCG Market BV
2008 - 2014	Tutoring in mathematics and physics for secondary school students

Service

2022	Co-organizer of the conference New Directions in Theoretical Physics 4 at the University of Edinburgh
2018 - present	Reviewer for Physical Review Letters (PRL), Physical Review D (PRD), the Journal of Cosmology and Astroparticle Physics (JCAP), the Journal of High Energy Physics (JHEP), and Universe.
2013 - 2014	Chairman of the professor Hendrik de Waard foundation
2012 - 2013	Treasurer of the professor Hendrik de Waard foundation
2011 - 2012	Member of the education committee mathematics, chairman of the student council
2010 - 2014	Guide at the Gratama telescope of the Blaauw observatory, Groningen, at stargazing events

Languages

Dutch	Mother tongue	English	Fluent
German	Elementary	French	Elementary
Latin	Elementary		

Programming experience

Mathematica	Fluent	C++	Fluent
Python	Moderate	Matlab	Moderate
Swift	Moderate	Julia	Elementary
Fortran	Elementary	R	Elementary