

## PUBLICATION LIST

- [1] 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  $\Lambda$ CDM cosmologies” (2020). [arXiv:2011.12851](#) [[astro-ph.CO](#)]
- [2] **J. Feldbrugge**, “Multi-plane lensing in wave optics,” (2020). [arXiv:2010.03089](#) [[astro-ph.CO](#)]
- [3] **J. Feldbrugge** and N. Turok, “Gravitational lensing of binary systems in wave optics,” *Physical Review Letters* (2020, R&R). [arXiv:2008.01154](#) [[gr-qc](#)]
- [4] **J. Feldbrugge**, U.-L. Pen, and N. Turok, “Oscillatory path integrals for radio astronomy,” *Physical Review X* (2019, R&R). [arXiv:1909.04632](#) [[astro-ph.HE](#)]
- [5] **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](#)]
- [6] 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](#)]
- [7] 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](#)]
- [8] **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](#)]
- [9] **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](#)]
- [10] **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](#)]
- [11] **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](#)]
- [12] **J. Feldbrugge**, J.L. Lehners, and N. Turok, “Lorentzian quantum cosmology,” *Physical Review D*, 95 (2017), no.10, 103508. [arXiv:1703.02076](#) [[hep-th](#)]
- [13] **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](#)]

- [14] 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](https://arxiv.org/abs/1306.3640) [[astro-ph.CO](https://arxiv.org/abs/1306.3640)]

## MANUSCRIPTS IN PREPARATION

- [15] “The space-time amplitude approach to relativistic quantum mechanics: The Schwinger effect”  
**J. Feldbrugge**, A. Fertig, L. Sberna, and N. Turok.  
*We propose a reformulation of quantum field theory in terms of relativistic quantum mechanics that allows for the propagation between space-time regions. Using this generalization, we develop relativistic weak-value theory, which enables us to study the evolution of a relativistic quantum particle. We apply this novel framework to the Schwinger effect of a charged scalar particle in an electric field.*
- [16] “Lorentzian path integrals on the Lefschetz thimble”  
**J. Feldbrugge**, and N. Turok.  
*We propose a mathematically rigorous definition of the Lorentzian path integral. We deform the space of continuous paths in the complex plane to the Lefschetz thimble of the theory and relate the measure on the thimble to the Wiener  $\sigma$ -measure.*
- [17] “Cosmic web & caustic skeleton in the Zel’dovich formalism”  
**J. Feldbrugge**, R. van de Weygaert, and J. Hidding.  
*We perform a numerical investigation of the three-dimensional caustic skeleton proposed in earlier work. We develop methods for the detection of the caustic skeleton in initial conditions and compare the skeleton to dark matter  $N$ -body simulations at late times.*
- [18] “Gravitational waves from shock waves in the early universe”  
**J. Feldbrugge**, U.-L. Pen, and N. Turok.  
*The curvature perturbations which oscillated after horizon reentry can be shown to steepen in form weak shock waves. Since the intersection region of two shocks can reach superluminal speeds, we demonstrate that these shocks generate gravitational Cherenkov radiation which we can potentially be measured in the next generation gravitational wave detectors.*

## THESES

- [19] **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 (2019). [Available online.](#)
- [20] **J. Feldbrugge**, “Primordial non-Gaussianity and large-scale structure,” Part III Essay, University of Cambridge, supervised by P. Shellard and T. Giannantonio (2015). [Available online.](#)

- [21] **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 (2014). [Available online](#).
- [22] **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 (2012). [Available online](#).