
PETER MÜHLBACHER

+43 660 3409620
peter@muehlbacher.me
peter.muehlbacher.me
[github.com/](https://github.com/petermuehlbacher)
petermuehlbacher

Education

Bachelor, University of Vienna, Mathematics — 2012–2016

Master, University of Cambridge, Mathematical Tripos Part III — 2016–2017

Papers

1. **Bounding the Largest Eigenvalue of Generalised Wigner Matrices**

joint work with L. Erdős ([arXiv:1802.05175](https://arxiv.org/abs/1802.05175))

2. **Gaussian Free Field and Liouville Quantum Gravity**

Part III essay, supervised by J. Miller

3. **Elliptic Curve Cryptography**

won the Dr. Hans-Riegel award worth 600€

4. **Diffusion Maps**

my first Bachelor's thesis on dimensionality reduction and numerical methods for stochastic partial differential equations

5. **High Dimensional Landscapes and Random Matrices**

my second Bachelor's thesis on large deviations of spectral statistics and their applications to spin glasses and neural networks

6. **Protein Docking**

focus on implementation and numerics

Internships

- 1.7.2016–15.9.2016, 15.11.2017–14.3.2018: IST Austria - L. Erdős' group
- 1.7.2015–15.2.2016: Institute for Quantum Optics and Quantum Information

Languages

- German — native speaker
- English — C2 (CAE)
- French — 5 years in school
- Russian — 3 years in school
- Japanese — 3 years, self study
- Chinese — 1 year, self study

Programming Skills

Hands-on experience with *Python* ([protein docking](#), [sound visualisation](#), many random matrix simulations), *Mathematica* (internship at the IQOQI), *Java* (data visualisation, [visual arts](#)) and smaller projects at university with *Matlab*.

Extracurricular Activities

I worked as a paramedic, full-time from July, 2013 to March, 2014, and on a voluntary basis afterwards until I left Austria for my Master's (2016).

Scholarships

- OeAD research work — 2016, 2200€
-

Part III courses

- Advanced Probability
- Mixing Times of Markov Chains
- Percolation & Random Walks
- Stochastic Calculus & Applications
- SLEs
- Gaussian Processes

Original Research

Bounding the Largest Eigenvalue of Generalised Wigner Matrices

Aim of the paper: We present a proof for an improved upper bound on the expectation of the largest eigenvalue of a class of random matrices (essentially Wigner, but without the identically distributed assumption).

Original contribution: From a recursion relation for the diagonal entries of powers of the matrix in question we derive a correspondence between trees and summands of the trace (without lower order error terms which one would get by naïvely generalising the standard moment method proof). We improve the existing bound (derived by Stieltjes transform techniques) by getting statistics on the distribution of lengths of distinct branches in trees of fixed length. Using coupling techniques and the bijection between trees and Dyck paths we go on to reduce this problem to computing the expectation of functionals of up-runs in fair coin tosses (which has already been dealt with in existing literature).

Current state: The paper can be found on [arXiv](#).

Decoherence of Entanglement in a Gravitational Field

Aim of the paper: A space mission proposal for ESA geared towards proving/disproving a non-standard model introduced by T.C. Ralph and J. Pienaar.

Original contribution: Apart from many other people's contributions (a lot of people from different backgrounds ended up working on that project) my main task was to generalise the formulae by Ralph's and Pienaar's paper describing the expected loss of coherence from radially propagating modes to those following arbitrary geodesics and to implement the numerics. The actual challenge was not this generalisation itself (which turned out to be a differential geometry exercise), but rather understanding the general setting (a non-standard quantum optics model, as well as general relativity) just to be able to explicitly state the real problem.

Current state: Even though I completed what I was assigned to, other parts of the project are not proceeding as expected, making its completion uncertain.

Conferences & Colloquia Attended

- Multi-physics geometric PDE's using deformable surfaces: Analysis, modelling, numerics and applications
 - Summer School Alpbach 2015 on quantum physics
 - Weekly colloquia at
 - University of Vienna
 - Institute of Science and Technology Austria
 - University of Cambridge
-