Vincent Pfenninger

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Current Position

Graz University of Technology Graz, Austria
University Project Assistant (Postdoc) Dec 2023 - present
Advisor: Prof. Mihyun Kang

Previous Academic Position

University of Birmingham Birmingham, United Kingdom
Research Fellow in Combinatorics (Postdoc) June 2022 - Nov 2023
Advisor: Prof. Daniela Kühn

Education

University of Birmingham Birmingham, United Kingdom
PhD in Pure Mathematics October 2018 - May 2022
Advisor: Dr Allan Lo
Thesis: Paths and cycles in graphs and hypergraphs

ETH Zurich Zurich, Switzerland
MSc in Mathematics September 2015 - July 2017
Advisors: Prof. Benny Sudakov and Dr Jonathan A. Noel
Thesis: Graph bootstrap processes in complete bipartite graphs

ETH Zurich Zurich, Switzerland
BSc in Mathematics September 2012 - July 2015
Advisor: Prof. Norbert Hungerbühler
Thesis: Non-attacking wazirs on a rectangular chess board

Publications

8. Vincent Pfenninger, **On k-uniform tight cycles: the Ramsey number for $C_{kn}^{(k)}$ and an approximate Lehel's conjecture**, *submitted*, arXiv: 2406.14468, 2024, (19 pages)

   We show that, for each $k \geq 3$, the Ramsey number of the k-uniform tight cycle on kn vertices is $(1 + o(1))(k + 1)n$. This is an extension to all uniformities of previous results for $k = 3$ by Haxell, Łuczak, Peng, Rödl, Ruciński, and Skokan and for $k = 4$ by Lo and the author and confirms a special case of a conjecture by the former set of authors.

   We also prove an approximate version of a generalisation of Lehel's conjecture to k-uniform tight cycles. We show that, for every $k \geq 3$, every red-blue edge-coloured complete k-graph on n vertices contains a red tight cycle and a blue tight cycle that are vertex-disjoint and together cover $n - o(n)$ vertices.

7. Vincent Pfenninger, **A note on Hamilton decompositions of even-regular multigraphs**, *submitted*, arXiv: 2312.09873, 2023, (6 pages)

In this note, we prove that every even regular multigraph on n vertices with multiplicity at most r and minimum degree at least $rn/2 + o(n)$ has a Hamilton decomposition. This generalises a result of Vaughan who proved an asymptotic version of the multigraph 1-factorisation conjecture. We derive our result by proving a more general result which states that dense regular multidigraphs that are robust outexpanders have a Hamilton decomposition. This in turn is derived from the corresponding result of Kühn and Osthus about simple digraphs.

6. Allan Lo and Vincent Pfenninger, **Almost partitioning every 2-edge-coloured complete k-graph into k monochromatic tight cycles**, *published in Innovations in Graph Theory*, doi.org/10.5802/igt.1, 2023, (19 pages)

We show that for $k \geq 3$, every red-blue edge-coloured complete k-graph on n vertices contains k vertex-disjoint monochromatic tight cycles that together cover $n - o(n)$ vertices.

5. Dong Yeap Kang, Tom Kelly, Daniela Kühn, Deryk Osthus, and Vincent Pfenninger, **Perfect matchings in random sparsifications of Dirac hypergraphs**, *published in Combinatorica*, doi.org/10.1007/s00493-024-00116-0, 2023, (34 pages)

For all integers $n \geq k > d \geq 1$, let $m_d(k, n)$ be the minimum integer $D \geq 0$ such that every k-uniform n-vertex hypergraph $\mathcal{H}$ with minimum d-degree $\delta_d(\mathcal{H})$ at least D has an optimal matching. For every fixed integer $k \geq 3$, we show that for $n \in k\mathbb{N}$ and $p = \Omega(n^{-k+1} \log n)$, if $\mathcal{H}$ is an n-vertex k-uniform hypergraph with $\delta_{k-1}(\mathcal{H}) \geq m_{k-1}(k, n)$, then a.a.s. its p-random subhypergraph $\mathcal{H}_p$ contains a perfect matching ($m_{k-1}(k, n)$ was determined by Rödl, Ruciński, and Szemerédi for all large $n \in k\mathbb{N}$). Moreover, for every fixed integer $d < k$ and $\gamma > 0$, we show that the same conclusion holds if $\mathcal{H}$ is an n-vertex k-uniform hypergraph with $\delta_d(\mathcal{H}) \geq m_d(k, n) + \gamma\binom{n-d}{k-d}$. Both of these results strengthen Johansson, Kahn, and Vu's seminal solution to Shamir's problem and can be viewed as "robust" versions of hypergraph Dirac-type results. In addition, we also show that in both cases above, $\mathcal{H}$ has at least $\exp((1 - 1/k)n \log n - \Theta(n))$ many perfect matchings, which is best possible up to a $\exp(\Theta(n))$ factor.

4. Allan Lo and Vincent Pfenninger, **The Ramsey number for 4-uniform tight cycles**, *to appear in the SIAM Journal on Discrete Mathematics*, arXiv: 2111.05276, 2021, (32 pages)

We prove that the Ramsey number for the 4-uniform tight cycle on $4n$ vertices is $(5 + o(1))n$.

3. Victor Falgas-Ravry and Vincent Pfenninger, **1-independent percolation on $\mathbb{Z}^2 \times K_n$**, *published in Random Structures & Algorithms*, doi.org/10.1002/rsa.21129, 2022, (24 pages)

A random graph model on a host graph H is said to be 1-*independent* if for every pair of vertex-disjoint subsets A, B of $E(H)$, the state of edges (absent or present) in A is independent of the state of edges in B. For an infinite connected graph H, the 1-*independent critical percolation probability* $p_{1,c}(H)$ is the infimum of the $p \in [0, 1]$ such that every 1-independent random graph model on H in which each edge is present with probability at least p almost surely contains an infinite connected component.

Balister and Bollobás observed in 2012 that $p_{1,c}(\mathbb{Z}^d)$ is nonincreasing and tends to a limit in $[\frac{1}{2}, 1]$ as $d \to \infty$. They asked for the value of this limit. We make progress towards this question by showing that

$$\lim_{n \to \infty} p_{1,c}(\mathbb{Z}^2 \times K_n) = 4 - 2\sqrt{3} = 0.5358\ldots.$$

2. Peter Allen, Olaf Parczyk, and Vincent Pfenninger, **Resilience for tight Hamiltonicity**, *published in Combinatorial Theory*, doi.org/10.5070/C64163846, 2021, (65 pages)

Using a version of the sparse hypergraph regularity lemma, we prove that random hypergraphs are asymptotically almost surely resiliently Hamiltonian. Specifically, for any $\gamma > 0$ and $k \geq 3$, we show

that, if $p \geq n^{\gamma-1}$, then asymptotically almost surely, every subgraph of the binomial random k-uniform hypergraph $G^{(k)}(n, p)$ in which all $(k-1)$-sets are contained in at least $(\frac{1}{2} + \gamma)pn$ edges has a tight Hamilton cycle.

1. Allan Lo and Vincent Pfenninger, **Towards Lehel's conjecture for 4-uniform tight cycles**, *published in the Electronic Journal of Combinatorics*, [doi.org/10.37236/10604](doi.org/10.37236/10604), 2023, (36 pages)

   Lehel's conjecture says that every red-blue edge-coloured complete graph can be partitioned into a red and a blue cycle. We study a generalisation of this conjecture to hypergraphs. In particular, we prove that every red-blue edge-coloured complete 4-uniform hypergraph contains a red and a blue tight cycle that are disjoint and together cover almost all vertices.

Research Interests

Extremal and probabilistic combinatorics, graph and hypergraph theory, Ramsey theory, monochromatic cycle partitions, Lehel's conjecture, extremal set theory, asymptotic distribution of graph parameters in random graphs

Seminars and Invited Talks

Almost partitioning every 2-edge-coloured complete k-graph into k monochromatic tight cycles, Graz Combinatorics Seminar, January 2024

Perfect matchings in random sparsifications of Dirac hypergraphs, Ilmenau Discrete Mathematics Seminar, June 2023

Perfect matchings in random sparsifications of Dirac hypergraphs, University of Birmingham Combinatorics Seminar, March 2023

Perfect matchings in random sparsifications of Dirac hypergraphs, Canadian Discrete and Algorithmic Mathematics conference (CanaDAM), June 2023 **(invited mini-symposium speaker)**

Large monochromatic tight cycles in 2-edge-coloured complete 4-uniform hypergraphs, LSE PhD Seminar, October 2021

Large monochromatic tight cycles in 2-edge-coloured complete 4-uniform hypergraphs, Umeå University Discrete Seminar, February 2021

Large monochromatic tight cycles in 2-edge-coloured complete 4-uniform hypergraphs, e-PCC Seminar Series, February 2021

Large monochromatic tight cycles in 2-edge-coloured complete 4-uniform hypergraphs, University of Birmingham Combinatorics Seminar, November 2020

Contributed Talks

Almost partitioning every 2-edge-coloured complete k-graph into k monochromatic tight cycles, British Combinatorial Conference (BCC), July 2024

Perfect matchings in random sparsifications of Dirac hypergraphs, Random Structures and Algorithms conference (RSA), June 2023

Perfect matchings in random sparsifications of Dirac hypergraphs, Discrete Maths Meeting at the Institute of Science and Technology Austria, April 2023

1-independent percolation in $\mathbb{Z}^2 \times K_n$, Random Structures and Algorithms Conference, Gniezno, August 2022

1-independent percolation in $\mathbb{Z}^2 \times K_n$, British Combinatorial Conference, Lancaster University, July 2022

The Ramsey number for 4-uniform tight cycles, European Conference on Combinatorics, Graph Theory and Applications, Barcelona (online), September 2021

The Ramsey number for 4-uniform tight cycles, British Early Career Mathematicians' Colloquium, University of Birmingham (online), July 2021

The Ramsey number for 4-uniform tight cycles, British Combinatorial Conference, Durham University (online), July 2021

Resilience for tight Hamiltonicity in random hypergraphs, Bringing Young Mathematicians Together Conference (online), December 2020

Towards Lehel's conjecture for 4-uniform tight cycles, Polish Combinatorial Conference (online), September 2020

Monochromatic cycle partitioning, British Early Career Mathematicians' Colloquium, University of Birmingham, July 2020

Monochromatic cycle partitioning, British Combinatorial Conference, University of Birmingham, July 2019

Monochromatic cycle partitioning, Postgraduate Combinatorial Conference, University of Oxford, June 2019

Research Visits, Workshop and Research School

Research visit to TU Ilmenau to work with Alberto Espuny-Daz, June 2023

Research visit to the Institute of Science and Technology Austria (ISTA) to collaborate with Matthew Kwan, April 2023

Research visit to Umeå University to collaborate with Victor Falgas-Ravry, January to June 2021

Summer School on Random Walks and Complex Networks, Université Nice Sophia Antipolis, France, July 2019

Workshop on Structure and Randomness in Hypergraphs, London School of Economics, December 2018

Teaching Experience

University of Birmingham Birmingham, United Kingdom

Co-supervising a Master's thesis September 2022 - May 2023

Together with Deryk Osthus I supervised the Master's thesis of Ella Williams. Ella was awarded a graduation prize for her thesis.

Lecturing Graph Theory October 2022

I gave 12 lectures and 3 example classes on Graph Theory in the autumn term of 2022.

Postgraduate Teaching Assistant October 2018 - May 2022

During my time at the University of Birmingham, I was a teaching assistant for various courses including Graph Theory, Mathematical Modelling and Problem Solving and Real Analysis.

ETH Zurich Zurich, Switzerland
Teaching Assistant September 2016 - December 2016

When I did my master's degree at ETH, I was a teaching assistant for a course on discrete mathematics.

Scholarship

My PhD was jointly funded by an EPSRC DTP award and a scholarship from the School of Mathematics at the University of Birmingham.

Languages

I am fluent in both English and German.