Report on the Trimester Program

Dynamics: Topology and Numbers

January - April 2020

Organizers: Manfred Einsiedler (Zürich), Martin Möller (Frankfurt), Anke Pohl (Bremen), Tom Ward (Leeds)

Topics

The program was focused on modern aspects of dynamical systems, with dynamics on homogeneous spaces as the core topic. Interactions with Teichmüller dynamics, Diophantine approximation, thermodynamic formalism and quantum chaos were the main themes of the planned activities. The classification of ergodic invariant measures and orbit closures of higher rank actions on homogeneous spaces is a highly active area of research, and experts were brought together to report on work in this area. Results in this area find application to equidistribution phenomena and Diophantine problems of many sorts.

Goals

The objectives were to bring together leading researchers in the topic areas to promote collaborative work, and to also invite younger workers and research students for high-level instructional short courses.

Organization

The original intention was to have a mix of longer-term visitors and four periods of intense activity as follows:

1. 'Winter School on Dynamics: Topology and Numbers', January 13–17, 2020. This ran as planned, with three short courses:

    - Manfred Einsiedler (ETH, Zürich) and Alex Gorodnik (University of Zürich) on (Effective) Homogeneous Dynamics;

- Omri Sarig (Weizmann Institute of Science, Rechovot) on Introduction to the transfer operator method;
- Jon Chaika (University of Utah) on The horocycle flow on moduli spaces of translation surfaces

2. 'Conference: Transfer operators in number theory and quantum chaos', February 3-7, 2020. This comprised 16 seminars by active researchers, together with periods of collaborative work. It was well visited with the number of participants matching the capacity of the available room.

3. 'Conference: Dynamics on homogeneous spaces', March 16–20, 2020. This was intended to follows a similar pattern but was already heavily disrupted by the Covid pandemic, which prevented many of the planned participants from attending in person. Nonetheless it could spontanteously be turned into a hybrid meeting thanks to the great support of the HIM staff. The distance-respecting conference photo of the local participants (see here) became one of the first of a long series.

4. 'Conference: Dynamics on flat surfaces and their moduli spaces', April 20–24, 2020. This had to be cancelled as a physical gathering, but was replaced by the BISTRO (Billiards and Surfaces à la Teichmüller and Riemann, Online) online seminar (https://sites.google.com/view/bistro-seminar/). We were all finding our feet during the planned period, but the online seminar BISTRO has proven to be of great value, and continued beyond the period of the trimester.

In addition, a weekly Trimester Seminar Series was organized in which participants presented their recent research results. This continued seamlessly as on online seminar during the lockdown period and permitted fruitful scientific exchange with participants who needed to return home early or couldn't arrive at all. Further, a group of PhD students organized a reading group on selected journal publications.

Results

The environment of the HIM facilitated much collaborative work, and all the participants benefited from that. The publications that the organisers are aware of that flowed from the work and collaborations that resulted from the trimester include:

1. Bandtlow, Oscar; Pohl, Anke; Schick, Torben; Weiße, Alexander: Numerical resonances for Schottky surfaces via Lagrange–Chebyshev approximation,
Stochastics and Dynamics (2020a01).

2. Fairchild, Samantha; Goering, Max; Weiß, Christian: Families of well approximable measures
https://arxiv.org/abs/2003.13122

3. Prohaska, Roland: Aspects of Convergence of Random Walks on Finite Volume Homogeneous Spaces
https://arxiv.org/abs/1910.11639

4. Costantini, Matteo; Möller, Martin; Zachhuber, Jonathan: The Chern classes and the Euler characteristic of the moduli spaces of abelian differentials
https://arxiv.org/abs/2006.12803

5. Costantini, Matteo; Möller, Martin; Zachhuber, Jonathan diffstrata – a Sage package for calculations in the tautological ring of the moduli space of Abelian differentials
https://arxiv.org/abs/2006.12815

6. Arana-Herrera, Francisco Effective lattice point count on Teichmüller space
https://arxiv.org/abs/2010.03123

7. Aka, Menny; Luethi, Manuel; Michel, Philippe; Wieser, Andreas: Simultaneous supersingular reductions of CM elliptic curves
https://arxiv.org/abs/2005.01537

8. Dajani, Karma; Kalle, Charlene: A First Course in Ergodic Theory, First Edition To appear, Chapman and Hall/CRC, ISBN 9780367226206

9. Khalil, Osama; Luethi, Manuel: Random Walks, Spectral Gaps, and Khintchine's Theorem on Fractals
https://arxiv.org/abs/2101.05797

10. Quackenbush, Blaine; Samuel, Tony; West, Matt: Periodic Intermediate β-Expansions of Pisot Numbers, Mathematics 2020
https://www.mdpi.com/2227-7390/8/6/903/htm

11. Einsiedler, Manfred; Lindenstrauss, Elon: Rigidity properties for commuting automorphisms on tori and solenoids
https://arxiv.org/abs/2101.11120

12. M. Bell, V. Delecroix, V. Gadre, R. Gutiérrez-Romo, S. Schleimer The flow group of rooted abelian or quadratic differentials
https://arXiv:2101.12197

13. V. Delecroix, J. Schmitt, J. van Zelm admcycles – a Sage package for calculations in the tautological ring of the moduli space of stable curves
https://arXiv:2002.01709

14. V. Delecroix, E. Goujard, P. Zograf, A. Zorich, Large genus asymptotic geometry of random square-tiled surfaces and of random multicurves, `arXiv:2007.04740` (2020), submitted.

15. V. Delecroix, E. Goujard, P. Zograf, A. Zorich, Masur–Veech volumes, frequencies of simple closed geodesics and intersection numbers of moduli spaces; to appear in Duke Math. Journal
https://arXiv:2011.05306

Several more publications are in preparation and will be added to the online publications lists (see here) as soon as they are finished.

Acknowledgements

The organisers thank the Hausdorff Institute for Mathematics for funding and hosting this ambitious programme, and for the excellent organisational support. While the pandemic inevitably had an enormous impact on what was possible, the energy and skill with which the staff of HIM supported the few people able to remain physically in Bonn, and the pivot to online seminars, was impressive and much appreciated.