

Blockseminar on Geometric Group Theory Karlsruhe-Münster-Regensburg

March 18-20th 2015 in Karlsruhe

In this year's edition of the KMR Blockseminar we will learn about

Expanders

We will get to know the classical existence result, learn about explicit constructions and higher dimensional generalizations. Our main source is [3].

Below you will find a preliminary list of talks together with Speaker.

See <http://www.math.kit.edu/iag2/seite/kmr/> for further information.

Program

Wednesday March 18th 2015

13:30 - 14:00	Welcome
14:00 - 15:00	Expander graphs (Anja Randecker, KIT)
15:10 - 16:10	Spectra (Benjamin Brück, WWU Münster)
Coffee break	
16:30 - 17:30	Geometry of Expanders (Sabine Braun, KIT)

Thursday March 19th 2015

08:45 - 09:45	Marguli's construction (Svenja Knopf)
10:00 - 11:00	Ramanujan graphs (Julia Heller, KIT)
Coffee break	
11:30 - 12:30	Zig-Zag products (Ann Kiefer, Uni Bielefeld)
Lunch break	
14:30 - 15:30	Cayley expander graphs (Nils Leder, WWU Münster)
Coffee break	
15:50 - 16:50	Expansion for $SL_2(\mathbb{F}_q)$ I (David Weniger, KIT)
Workshop dinner	

Friday March 20th 2015

08:45 - 09:45 Expansion for $SL_2(\mathbb{F}_q)$ II (Daniel Skodlerak, Univ. of East Anglia)
10:00 - 11:00 Higherdimensional expander I (Petra Schwer, KIT)

Coffee break

11:30 - 12:30 Higherdimensional expander II (Stefan Witzel, Uni Bielefeld)

Lunch break

14:00 - 15:00 The bigger picture (Roman Sauer, KIT)

Talks

Classical theory

Talk 1 (Expander graphs). Motivation, combinatorial definition and proof of existence

Speaker: **Anja Randecker (KIT)**

Literature: section 1, 2.1 and 2.2 of [3]

Talk 2 (Spectra). adjacency matrices and their eigenvalues, expander mixing lemma, spectral gap

Speaker: **Benjamin Brück (WWU Münster)**

Literature: section 2.3 to 2.5 (maybe 2.6.5), 4.3.1, 4.5 in [3]

Talk 3 (geometry of expanders). isoperimetric inequalities and spherical functions, d-regular trees

Speaker: **Sabine Braun (KIT)**

Literature: section 4.1, 4.2, 5.1, 5.2 in [3]

Constructions and families of Expanders

Talk 4 (Margulis' construction). first explicit construction of a family of expanders

Speaker: **Svenja Knopf (WWU Münster)**

Literature: section 8 and 4.3 in [3],

Talk 5 (Ramanujan graphs). introduction to Ramanujan Graphs, coverings and Eigenvalues

Speaker: **Julia Heller (KIT)**

Literature: section 5.3, some of 6 and 7 in [3]

Talk 6 (Zig-Zag-Product). introduce this product and its properties; construction of Expander families

Speaker: **Ann Kiefer (Uni Bielefeld)**

Literature: section 9 (without 9.5) in [3]

Talk 7 (Cayley expander graphs). presentations of finite groups; construction via semidirect products; expander and groups

Speaker: **Nils Leder (WWU Münster)**

Literature: Kapitel 11 aus [3]

New results and higher dimensions

Talk 8 (Expansion for $SL_2(\mathbb{F}_q)$ I). Uniform bounds and Expansions for Cayleygraphs of $SL_2(\mathbb{F}_q)$

this talk should be prepared together with talk 9

Speaker: **David Weniger (KIT)**

Literature: [1], section 5 in [6]

Talk 9 (Expansion für $SL_2(\mathbb{F}_q)$ II). Uniforme Schranken an Expansion für Cayleygraphen $SL_2(\mathbb{F}_q)$

this talk should be prepared together with talk 8

Speaker: **Daniel Skodlerack (University of East Anglia)**

Literature: [1], section 5 in [6]

Talk 10 (Higherdimensional expander I). introduction to Ramanujan complexes and generalizations of expanders to higher dimensions.

this talk should be prepared together with talk 11

Speaker: **Petra Schwer (KIT)**

Literature: section 3 in [8]; [9]

Talk 11 (Higherdimensional expander II). introduction to Ramanujan complexes and generalizations of expanders to higher dimensions.

this talk should be prepared together with talk 10

Speaker: **Stefan Witzel (Uni Bielefeld)**

Literature: section 3 in [8]; siehe auch [9]

Talk 12 (The bigger picture). Open problems, connection to the Baum-Connes Conjecture

Speaker: **Roman Sauer (KIT)**

Literature: section 13 in [3], [11]

References

- [1] Bourgain and Gamburd, *Uniform expansion bounds for Cayley graphs of $SL_2(\mathbb{F}_p)$.*
- [2] Helfgott, *Growth and generation in $SL_2(\mathbb{Z}/p\mathbb{Z})$.*
- [3] Hoory, Wigderson, and Linal, *Expander graphs and their applications.*
- [4] Kassabov, *Symmetric groups and expander graphs.*
- [5] Kassabov, Lubotzky, and Nikolov, *Finite simple groups as expanders.*
- [6] Kowalski, *Expander graphs.*
- [7] Lubotzky, *Expander graphs in pure and applied maths.*
- [8] ———, *Ramanujan complexes and high dimensional Expanders.*
- [9] Lubotzky and Vishne, *Ramanujan complexes of type \tilde{A}_d .*
- [10] Reingold, Vadhan, and Wigderson, *Entropy waves, ZigZag graph products and new constant degree Expanders.*
- [11] Valette, *On the Baum-Connes assembly map for discrete groups.*