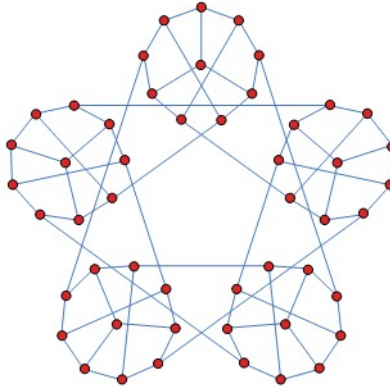


SEMINAR ON
EXPLICIT EXAMPLES OF EXPANDER GRAPHS
(elementary number theory, group theory and graph theory)
WiSe 2014



Target group: 2nd year students, or higher

Time and location: Wednesday 2.15–3.55 pm, probably Sitzungszimmer

Coordinator: Bogdan Nica (perhaps with Thomas Schick)

Contact: bogdan.nica@gmail.com

1st ORGANIZATORIAL MEETING: FR JUL 25, 12:15, Sitzungszimmer (Th. Schick)

Description:

Expander graphs are, roughly speaking, graphs with high connectivity but small number of edges leaving any given vertex (small vertex degree). They first appeared in the 1970's on the 'applied' side of mathematics. Over the years, they have become increasingly important in 'pure' mathematics.

Explicit constructions of expanders are rather difficult. The aim of this seminar is to understand such a construction. We will closely follow the short book

[DSV] G. Davidoff, P. Sarnak, A. Valette: *Elementary number theory, group theory, and Ramanujan graphs*, London Mathematical Society Student Texts 55, Cambridge University Press 2003, x+144 pp.

What makes this seminar interesting is not only the objects we are aiming for, but also the road that will take us there. We will touch on the following subjects:

- GRAPH THEORY: spectral properties, girth, chromatic number;
- NUMBER THEORY: quadratic reciprocity, sums of two and four squares, quaternions;
- GROUP THEORY: $\text{PSL}(2, q)$, representations of finite groups.

The seminar will be run in English. Participants are expected to present the material from [DSV] and to submit occasional homework. There will be two 45-minute presentations per meeting, so as to give participants the chance to talk more than once. There is also the option of writing short projects related to the material encountered in the seminar.

There are no formal prerequisites beyond the material of the first year, and [DSV] is quite self-contained. (But some general knowledge and a certain degree of mathematical maturity are needed.)