EXPANDER GRAPHS, WITH APPLICATIONS

Context: The present project aims to solve open problems in *algebra* with potential applications in topology, metric geometry and computer science. Algebra is pervasive in various domains of mathematics, physics and other natural sciences. This research is in the area of *group theory*, we focus on infinite groups and finite or infinite graphs associated with them.

Expander graphs are used in many real life practical problems such as transport networks, medical imaging algorithms, internet routing, computer models of brain, and cryptography. Intuitively, expander graphs are infinite families of finite graphs, becoming larger and larger in size (=number of vertices), which have the following two competing properties:

(1) they are fairly sparse (in terms of number of edges, relative to the number of vertices);
(2) yet they are highly connected, and in fact highly "robust", in a certain sense.

The search for the proof of existence and for explicit constructions of various generalizations and specifications of expander graphs is currently a hot topic in mathematics and computer science.

Major open problem: Is there a large girth super-expander?

Expected background of applicants: students who like graphs, groups, matrices, combinatorics, low-dimensional geometry and who are motivated to learn new things in various exciting areas.

[1] Hoory S.,Linial N.,Wigderson A., *Expander graphs and their applications*, Bull. Am. Math. Soc. 43(4), 439–561 (2006).

[2] Davidoff G.,Sarnak P.,Valette A., *Elementary Number Theory, Group Theory, and Ramanujan Graphs*, Cambridge University Press, Cambridge (2003).