

European Research Council

**ERC Advanced Grant 2010  
Research proposal (Part B1)<sup>1</sup>**

**Discrete and convex geometry:  
challenges, methods, applications**

**DISCONV**

**Cover Page:**

- Name of the Principal Investigator (PI)      *Prof. Imre Bárány*
- Name of the PI's host institution for the project  
*Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences*
- Proposal full title      *Discrete and convex geometry: challenges, methods, applications*
- Proposal short name      *DISCONV*
- Proposal duration in months      *60 months*

**Proposal summary**

Research in discrete and convex geometry, using tools from combinatorics, algebraic topology, probability theory, number theory, and algebra, with applications in theoretical computer science, integer programming, and operations research. Algorithmic aspects are emphasized and often serve as motivation or simply dictate the questions. The proposed problems can be grouped into three main areas:

**(1) Geometric transversal, selection, and incidence problems**, including algorithmic complexity of Tverberg's theorem, weak epsilon-nets, the  $k$ -set problem, and algebraic approaches to Erdos' unit distance problem.

**(2) Topological methods and questions**, in particular topological Tverberg-type theorems, algorithmic complexity of the existence of equivariant maps, mass partition problems, and the generalized HEX lemma for the  $k$ -coloured  $d$ -dimensional grid.

**(3) Lattice polytopes and random polytopes**, including Arnold's question on the number of convex lattice polytopes, limit shapes of lattice polytopes in dimension 3 and higher, the variance of random polytopes, comparison of random polytopes and lattice polytopes, the integer convex hull and its randomized version.

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<sup>1</sup> Instructions for completing Part B1 can be found in the Guide for Applicants for the Advanced Grant 2010 call