

# Convex and Abstract Polytopes

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The rapid development of polytope theory in the past thirty years has resulted in a rich theory featuring an attractive interplay of several mathematical disciplines. The 2-day Workshop was evidence that polytope theory is very much alive and is the unifying theme of a lot of research activity.

The Workshop provided a much desired opportunity to share recent developments and emerging directions on geometric, combinatorial, and abstract aspects of polytope theory. We had twenty-nine official participants (among them seven women, two graduate students, and many junior faculty), plus a number of graduate student participants not officially registered. With few exceptions, the participants came from North-America. It is noteworthy that the last major meeting on convex and abstract polytopes was the NATO Advanced Study Institute on "Polytopes - Abstract, Convex and Computational" in 1993 at Scarborough, Ontario.

The Workshop focused on two overlapping directions of research,

- the classical theory of convex polytopes (see [2, 4, 5]), and
- the more recent theory of abstract polytopes (see [1, 3]).

The program featured three invited 50-minute lectures and ten 20-minute talks. For convex polytopes, there was an attractive mix of talks about the combinatorial theory (concerning the numbers of faces of different dimensions, the relations among various facial structures, and generalizations such as matroids, oriented matroids, and posets), and the metrical theory (the convex-geometric study of volumes, surface areas, mixed volumes, angles, and projections and sections). One of the major themes to crystallize during the Workshop was the necessity and importance of constructing new classes of polytopes. For abstract polytopes, most talks focused on polytopes with various degrees of combinatorial or geometric symmetry (regular, chiral, or equivelar polytopes, and their geometric realization theory), as well as the structure of their symmetry groups or automorphism groups (reflection groups, Coxeter groups, and C-groups, and their representation theory).

The 2-day Workshop at BIRS was followed by a *Polytopes Day in Calgary* at the University of Calgary on Sunday, May 22, 2005, with two invited 50-minute lectures and five 20-minute talks, as well as two state of the art discussions (problem sessions), one on convex polytopes and one on abstract polytopes.

Both Workshops were very favorably received by the participants and were viewed as a success. In particular, they prompted collaboration among participants with several papers as outcome.

## References

- [1] T.Bisztriczky, P.McMullen, R.Schneider and A.Ivić Weiss (Eds.), *Polytopes – Abstract, Convex and Computational*, NATO ASI Series C440 (Kluwer,1994).

- [2] G.Kalai and G.Ziegler, *Polytopes – Combinatorics and Computation*, Birkhauser, 2000.
- [3] P.McMullen and E.Schulte, *Abstract Regular Polytopes*, Cambridge University Press, 2002.
- [4] J.Richter-Gebert, *Realization Spaces of Polytopes*, Springer-Verlag, 1996.
- [5] G.Ziegler, *Lectures on Polytopes*, Springer-Verlag, 1994.