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Blaschke–Santaló Diagrams: An Essential Tool for Studying Isoperimetric Inequalities

A fundamental question that frequently arises in mathematics is to understand inequalities between different quantities and, ideally, identifying the sharpest ones. Blaschke–Santaló diagrams provide an elegant and effective way to visualize the best possible inequalities relating various quantities.

As an example, in this talk, we focus on the spectrum of the Laplace operator with Dirichlet boundary conditions on $\partial\Omega$, where $\Omega \subset \mathbb{R}^d$, specifically its first eigenvalue, also known as the fundamental frequency $\lambda_1(\Omega)$. Unfortunately, an explicit formula for $\lambda_1(\Omega)$ is generally unavailable. This motivates the search for estimates using other functionals that are easier to manipulate, such as the perimeter $P(\Omega)$ and the volume $|\Omega|$.

We fully describe the diagram for open sets, demonstrating that no inequalities exist beyond the classical Faber–Krahn and the isoperimetric inequalities. This motivates the exploration of other classes of sets, such as convex ones, for which we provide an advanced description of the corresponding diagram. Finally, we discuss the use of numerical tools and shape optimization methods to obtain an optimal characterization of such diagrams, illustrating our results with various examples. This talk is based on a joint work with Jimmy Lamboley (Sorbonne University, France).

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Zu diesem Vortrag laden wir Sie herzlich ein.

gez. Leon Bungert