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10. Partial Differential Equations

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Existence of windows with minimal heat diffusion

Consider the first eigenvalue $\lambda_1 > 0$ of the Laplacian $-\Delta$ on a fixed bounded Lipschitz domain $\Omega \in \mathbf{R}^n$ under varying mixed boundary conditions, namely Dirichlet conditions on some measurable subset $D \subset \partial\Omega$ and Neumann conditions elsewhere. D varies subject to the constraint that its measure A is prescribed.

We show the existence of some D minimizing λ_1. For Ω a ball, the optimal D is a spherical cap. In contrast, the supremum of λ_1 is not attained. Its value is independent of A, and an approximating sequence is obtained by homogenizing D.