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Asymptotic behaviour and numerical approximation of optimal eigenvalues of the Robin Laplacian

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We consider the problem of minimising the $n^{th}-$ eigenvalue of the Robin Laplacian in $\mbox{mathbb}R}^{N}$. Although for n=1,2 and a positive boundary parameter α it is known that the minimisers do not depend on α , we demonstrate numerically that this will not always be the case and illustrate how the optimiser will depend on α . We derive a Wolf-Keller type result for this problem and show that optimal eigenvalues grow at most with $n^{1/N}$, which is in sharp contrast with the Weyl asymptotics for a fixed domain. We further show that the gap between consecutive eigenvalues does go to zero as n goes to infinity. Numerical results then support the conjecture that for each n there exists a positive value of $\alpha_{n}\$ such that the n^{rm} th} eigenvalue is minimised by n disks for all $0<\alpha_{n}\$ and, combined with analytic estimates, that this value is expected to grow with $n^{1/N}$.

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