Mathematics > Spectral Theory

A family of anisotropic integral operators and behaviour of its maximal eigenvalue

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We study the family of compact integral operators $\mathbf K_\beta$ in $L^2(\mathbb R)$ with the kernel K_\beta(x, y) = \frac{1}{\pi}\frac{1}{1 + (x-y)^2 + \beta^2\Theta(x, y)}, depending on the parameter $\beta >0$, where $\Theta(x, y)$ is a symmetric non-negative homogeneous function of degree $\gamma\ge 1$. The main result is the following asymptotic formula for the maximal eigenvalue M_β of $\mathbf K_\beta$: M_\beta = 1 - \lambda_1 \beta^{\frac{2}{\gamma+1}} + o(\beta^{\frac{2}{\gamma+1}}), \beta\to 0, where λ_1 is the lowest eigenvalue of the operator $\mathbf A = |d/dx| + \Theta(x, x)/2$. A central role in the proof is played by the fact that $\mathbf K_\beta, \beta>0,$ is positivity improving. The case $\Theta(x, y) = (x^2 + y^2)^2$ has been studied earlier in the literature as a simplified model of high-temperature superconductivity.

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