FACULTY OF NUCLEAR SCIENCES AND PHYSICAL ENGINEERING CTU IN PRAGUE

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Small angle asymptotics for Robin Laplacians on infinite circular cones

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For $\varepsilon > 0$ and $n \in \mathbb{N}$ consider the infinite cone $\Omega_\varepsilon := \{(x_1, x') \in (0,\infty) \times \mathbb{R}^n : |x'| < \varepsilon x_1\}$ and the operator Q_ε^α acting as the Laplacian $u \mapsto -\Delta u$ on Ω_ε with the Robin boundary condition $\partial_\nu u = \alpha u$ at $\partial\Omega_\varepsilon$, where ∂_ν is the outward normal derivative and $\alpha > 0$. It is known from numerous earlier works that the essential spectrum of Q_ε^α is $[-\alpha^2, +\infty)$ and that the discrete spectrum is finite for $n = 1$ and infinite for $n \geq 2$, but the behavior of individual eigenvalues with respect to the geometric parameter ε was only addressed for $n = 1$ so far. In the present work we consider arbitrary $n \geq 2$ and look at the spectral asymptotics as ε becomes small, i.e. as the cone becomes "sharp" and collapses to its central axis. Our main result is as follows: if $n \geq 2$, $\alpha > 0$ and $j \in \mathbb{N}$ are fixed, then the jth eigenvalue $E_j(Q_\varepsilon^\alpha)$ of Q_ε^α behaves as $E_j(Q_\varepsilon^\alpha) = -\frac{n^2\alpha^2}{(2j+n-2)^2\,\varepsilon^2} + O\left(\frac{1}{\varepsilon}\right)$ as $\varepsilon \to 0^+$.

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