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A logarithmic improvement in the two-point Weyl law

In this talk, we discuss the asymptotic behavior of the spectral function of the Laplace-Beltrami operator on a compact Riemannian manifold M with no conjugate points. The spectral function, denoted $\Pi_\lambda(x, y)$, is defined as the Schwartz kernel of the orthogonal projection from $L^2(M)$ onto the eigenspaces with eigenvalue at most λ^2. In the regime where (x, y) is restricted to a sufficiently small neighborhood of the diagonal in $M \times M$, we obtain a uniform logarithmic improvement in the remainder of the asymptotic expansion for Π_λ and its derivatives of all orders. This generalizes a result of Bérard which established an on-diagonal estimate for $\Pi_\lambda(x, x)$ without derivatives. Furthermore, when (x, y) avoids a compact neighborhood of the diagonal, we obtain the same logarithmic improvement in the standard upper bound for the derivatives of Π_λ itself. We also discuss an application of these results to the study of monochromatic random waves.