

Hardy inequality and heat semigroup estimates for Riemannian manifolds with singular data

M. van den Berg, P. Gilkey, K. Kirsten, A. Grigor'yan

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Upper bounds are obtained for the heat content of an open set D in a geodesically complete Riemannian manifold M with Dirichlet boundary condition on $\text{bd}(D)$, and non-negative initial condition. We show that these upper bounds are close to being sharp if (i) the Dirichlet-Laplace-Beltrami operator acting in $L^2(D)$ satisfies a strong Hardy inequality with weight r^2 , (ii) the initial temperature distribution, and the specific heat of D are given by r^{-a} and r^{-b} respectively, where r is the distance to the boundary, and $1 < a < 2$, $1 < b < 2$.

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