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Global heat kernel estimates for symmetric Markov processes dominated by stable-like processes in exterior $C^{1,\eta}$ open sets

Abstract

In this paper, we establish sharp two-sided heat kernel estimates for a large class of symmetric Markov processes in exterior $C^{1,\eta}$ open sets for all $t > 0$. The processes are symmetric pure jump Markov processes with jumping kernel intensity

$$\kappa(x, y)\psi(|x - y|)^{-1}|x - y|^{-d-\alpha}$$

where $\alpha \in (0, 2)$, ψ is an increasing function on $[0, \infty)$ with $\psi(r) = 1$ on $0 < r \leq 1$ and $c_1 e^{\gamma_1 r^\beta} \leq \psi(r) \leq c_2 e^{\gamma_2 r^\beta}$ on $r > 1$ for $\beta \in [0, \infty]$. A symmetric function $\kappa(x, y)$ is bounded by two positive constants and $|\kappa(x, y) - \kappa(x, x)| \leq \kappa_1 |x - y|^\rho$ for $|x - y| < 1$ and $\rho > \alpha/2$. As a corollary of our main result, we estimate sharp two-sided Green function for this process in $C^{1,\eta}$ exterior open sets.