DIRICHLET HEAT KERNELS AND EXIT TIMES FOR SUBORDINATE BROWNIAN MOTIONS

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Let $B(t)$ be a d-dimensional Brownian motion and T_t be an independent subordinator with its Laplace exponent being a complete Bernstein function. We consider the behaviour of the heat kernel (transition density) of the subordinate process $Y(t) = B(T_t)$ killed after exiting an open set D. One of the most important examples is a rotationaly invariant stable process for which the heat kernel $p_D(t, x, y)$ is approximately factorized as a product of the heat kernel of the free process (transition density of the free process) and the corresponding survival probabilities $P^x(\tau_D > t)P^y(\tau_D > t)$, at least for small values of t. We show that under some regularity assumptions on the subordinator the same type of behaviour holds for the underlying subordinate Brownian motion for a bounded open set with sufficiently smooth boundary. In some more particular cases we extend these type estimates to unbounded exterior sets. We also provide two-sided sharp estimates of the survival probability $P^x(\tau_D > t)$ in terms of the Laplace exponent of the subordinator.