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Osaka J. Math.
29 (1992), 771–788

A CHARACTERIZATION OF THE CLOSABLE PARTS OF PRE-DIRICHLET FORMS BY HITTING DISTRIBUTIONS

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(Received October 15, 1991)

1. Introduction

Let X be a locally compact separable metric space with an extra point Δ such that $X_\Delta \equiv X \cup \{\Delta\}$ is a one point compactification and let m be a positive Radon measure with supp $[m]=X$. When X is compact, Δ is adjoined as an isolated point. For a subset B of X, we denote $B_\Delta = B \cup \{\Delta\}$. We consider a C_0-regular Dirichlet space $(\mathcal{E}, \mathcal{F})$ on $L^2(X, m)$ having a nice core $\mathcal{C}$ (see Section 2) and $\boldsymbol{M}=(\Omega, \mathcal{F}_t, X_t, P_x, x\in X)$ the associated m-symmetric Hunt process. We say that a subset B of X is $\mathcal{E}_1$-polar if it is of zero capacity. Let $\{T_t, t\geqq 0\}$ be the L^2-semigroup associated with $(\mathcal{E}, \mathcal{F})$. We say that a Borel set B of X is T_t-invariant if $T_t(I_B u)=I_B T_t u$ for any $u\in L^2(X, m)$, and $t>0$. $(\mathcal{E}, \mathcal{F})$ is called irreducible if for any T_t-invariant set B, B or $X-B$ is m-negligible. A Borel set B of X is $\boldsymbol{M}$-invariant if $P_x(X_t\in B_\Delta, X_{t-}\in B_\Delta$, for any $t>0)=1$, for any $x\in B$. M. Fukushima-K. Sato-S. Taniguchi [10] investigated the closable part of general symmetric bilinear form on a real Hilbert space. They characterized the closable part of a pre-Dirichlet form under the changes of underlying measures and gave a necessary and sufficient condition for the closability. They used the analytic characterization of the time changed Dirichlet space formulated in K. Kuwae-S. Nakao [12]. In these mentioned articles assumed is that $(\mathcal{E}, \mathcal{F})$ is either transient or irreducible in order to make a reduction to the transient case, but the irreducibility is not easily checked.

In this paper, we will not assume the irreducibility of $(\mathcal{E}, \mathcal{F})$ nor its transience. In Section 2 and Section 3 we prepare some quasi-notions and decomposition theorems of the state space X. In particular, we give a decomposition

$$X = X^{(c)} + X^{(d)} + N,$$

where $X^{(c)}$ (resp. $X^{(d)}$) is an $\boldsymbol{M}$-invariant conservative (resp. dissipative) part of X, and N is a properly exceptional set. In Section 4 we give a characterization of the regular Dirichlet space associated with the time changed process using the above decomposition. In Section 5 we fix a closed set Y and consider the space $\mathcal{C}|_Y = \{u\in C_0(Y);\, u=\tilde{u}|_Y, \text{ for some } \tilde{u}\in\mathcal{C}\}$. We then introduce, for each