# we cant use omega that alreayd represents the real line givemn that L2(Omega) is useds...

Correct—you have a notation conflict. If Ω already denotes the frequency domain (the real line) in your spectral representation, you cannot use the same symbol for the probability sample space.

### Recommended Alternative Notations

### Option 1: Use a Different Sample Space Symbol

Replace the probability space $(\Omega, \mathcal{F}, \mathbb{P})$ with one of these standard alternatives:

**1a. Using S (common in statistics):**

- Probability space: $(S, \mathcal{F}, \mathbb{P})$
- Sample points: $s \in S$
- Notation: $Z(t, s)$ and $\Phi(\lambda, s)$

**1b. Using Ξ (xi—very common in probability when Ω is taken):**

- Probability space: $(\Xi, \mathcal{F}, \mathbb{P})$
- Sample points: $\xi \in \Xi$
- Notation: $Z(t, \xi)$ and $\Phi(\lambda, \xi)$

**1c. Using P (for "path space"):**

- Probability space: $(P, \mathcal{F}, \mathbb{P})$
- Sample points: $p \in P$
- Notation: $Z(t, p)$ and $\Phi(\lambda, p)$

### Option 2: Use Subscripts to Distinguish

Keep $\Omega$ for both but distinguish via subscripts:

- Sample space: $\Omega_{\text{prob}}$ with elements $\omega \in \Omega_{\text{prob}}$
- Frequency domain: $\Omega_{\text{freq}}$ (but if this is just $\mathbb{R}$, write $\mathbb{R}$ explicitly)

## Recommended Choice

**Use $\Xi$ for the sample space** (Option 1b). This is standard in advanced probability theory when $\Omega$ is unavailable. Your notation statement would be:

**Notation**: Throughout this section, $Z(t)$ and $\Phi(\lambda)$ denote the stochastic process $Z(t, \xi)$ and the random measure $\Phi(\lambda, \xi)$, respectively, where $\xi \in \Xi$ indexes sample paths in the underlying probability space $(\Xi, \mathcal{F}, \mathbb{P})$. For each fixed $\xi \in \Xi$, the mapping $t \mapsto Z(t, \xi)$ is a sample path, and $\lambda \mapsto \Phi(\lambda, \xi)$ is a realization of the random measure. Different sample paths may share the same covariance structure, while each $\xi$ determines a unique measure realization.

This avoids confusion since $\Omega$ remains free for your spectral/frequency domain, and $\Xi$ is recognized notation for sample spaces in probability theory.

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1. https://xlinux.nist.gov/dads/HTML/omegaCapital.html
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19. https://www.reddit.com/r/algorithms/comments/13rcitf/confused_about_bigoh_theta_and_omega_notations/
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