

#1 string: 10 01 11 00

QPSK:  $\frac{\pi}{2}, \pi, 0, \frac{\pi}{2}$

#2

( $\theta_0 = \frac{3}{4}\pi$ )  $\frac{\pi}{4}$  QPSK:  $\frac{3}{4}\pi, -\frac{\pi}{4}, \frac{3}{4}\pi, \frac{3}{4}\pi$

AWGN  $\rightarrow$  Additive White Gaussian Noise (加性高斯白雜訊)

① 加性代表 noise 的 signal 可視作 random variable

加在 signal 上, 即  $Y = X + N$   $Y$ : output  $X$ : input

② 白色指 signal 為 constant  $N$ : noise

③ Gaussian  $\rightarrow$  noise 符合高斯分布.

#3 已知 PDF  $f_{X_1}(x_1|m_1) = \frac{1}{\sqrt{\pi N_0}} \exp(-\frac{1}{N_0}(x_1 - s_1)^2)$

'i phase error in basis function:

$$x_1 = \int_0^{T_b} x(t) \phi_1(t) dt = \int_0^{T_b} (\underbrace{\sqrt{E_b} \cos(2\pi f_c t + \phi)}_{s_1(t) + w(t)}) dt$$

$$= \sqrt{E_b} \cos \phi + w_1, \quad w_1 \sim N(0, \frac{N_0}{2}) \quad \text{得 } s_{11} = \sqrt{E_b} \cos \phi$$

$$P_{10} = \int_0^{\infty} f_{X_1}(x_1, m_2=0) dx_1 = \frac{1}{\sqrt{\pi N_0}} \int_0^{\infty} \exp(-\frac{1}{N_0}(x_1 + \sqrt{E_b} \cos \phi)^2) dx_1$$

$$P_{10} = P_{01} = \frac{1}{2} \operatorname{erfc}\left(\sqrt{\frac{E_b \cos \phi}{N_0}}\right) \equiv P_e$$

(\*  $P_e = \frac{1}{2} P_{10} + \frac{1}{2} P_{01} \stackrel{P_{10}=P_{01}}{=} P_{10}$ )

#4 sequence = 1100100010

$\{11, 00, 10, 00, 10\} \Rightarrow \{-\frac{\pi}{4}, \frac{3}{4}\pi, \frac{\pi}{4}, \frac{3}{4}\pi, \frac{\pi}{4}\}$

