$$dX_t = \mu(X_t)\,dt + \sigma(X_t)\,dW_t$$

$$\mu(X_t) = \begin{bmatrix} 4(1-x^2-y^2)x + y \\ 4(1-x^2-y^2)y - x \end{bmatrix}$$

$$\sigma(X_t) = \sigma I_2 \qquad D = \frac{\sigma\sigma^T}{2} = \frac{\sigma^2}{2} I_2$$

$$\frac{\partial p}{\partial t} = -\sum_{i=1}^{2} \frac{\partial}{\partial x_i}(\mu_i p) + \frac{\sigma^2}{2}\Delta p$$

$$\frac{\partial}{\partial x}(\mu_1 p) = \frac{\partial \mu_1}{\partial x} p + \mu_1 \frac{\partial p}{\partial x} = \left(4(1-x^2-y^2) - 8x^2\right) p + \mu_1 \frac{\partial p}{\partial x}$$

$$\frac{\partial}{\partial y}(\mu_2 p) = \frac{\partial \mu_2}{\partial y} p + \mu_2 \frac{\partial p}{\partial x} = \left(4(1-x^2-y^2) - 8y^2\right) p + \mu_2 \frac{\partial p}{\partial y}$$

$$+ \quad = \left[8(1-x^2-y^2) + 8(-x^2-y^2)\right] p + \mu_1 \frac{\partial p}{\partial x} + \mu_2 \frac{\partial p}{\partial y}$$

$$= \left[16(1-x^2-y^2) - 8\right] p + \mu_1 \frac{\partial p}{\partial x} + \mu_2 \frac{\partial p}{\partial y}$$

$$= \left[-4z - 8\right] p + \mu_1 \frac{\partial p}{\partial x} + \mu_2 \frac{\partial p}{\partial y}$$

$$z = 4(x^2+y^2-1)$$

$$\frac{\partial p}{\partial t} = 4(z+2)\,p - \mu_1 \frac{\partial p}{\partial x} - \mu_2 \frac{\partial p}{\partial y} + \frac{\sigma^2}{2}\Delta p$$

$$\frac{\partial p}{\partial t} = 4(z+2)p - (-xz+y)\frac{\partial p}{\partial x} - (-yz-x)\frac{\partial p}{\partial y} + \frac{\sigma^2}{2}\Delta p$$

$$= 4(z+2)p + (xz-y)\frac{\partial p}{\partial x} + (yz+x)\frac{\partial p}{\partial y} + \frac{\sigma^2}{2}\Delta p$$

$$p = e^{-f}$$

$$\frac{\partial p}{\partial t} = -p\frac{\partial f}{\partial t}, \quad \frac{\partial p}{\partial x} = -p\frac{\partial f}{\partial x}, \quad \frac{\partial p}{\partial y} = -p\frac{\partial f}{\partial y}$$

$$\frac{\partial^2 p}{\partial x^2} = -\frac{\partial p}{\partial x}\frac{\partial f}{\partial x} - p\frac{\partial^2 f}{\partial x^2} = p\left(\frac{\partial f}{\partial x}\right)^2 - p\frac{\partial^2 f}{\partial x^2}$$

$$\Delta p = -p\left[\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} - \left(\frac{\partial f}{\partial x}\right)^2 - \left(\frac{\partial f}{\partial y}\right)^2\right]$$

$$\frac{\partial f}{\partial t} = -4(z+2) + (xz-y)\frac{\partial f}{\partial x} + (yz+x)\frac{\partial f}{\partial y} + \frac{\sigma^2}{2}\left[\Delta f - \left(\frac{\partial f}{\partial x}\right)^2 - \left(\frac{\partial f}{\partial y}\right)^2\right]$$

$$D = \frac{1}{\beta}, \quad \sqrt{2D} = \sigma \Rightarrow \sigma = \sqrt{\frac{2}{\beta}} \Rightarrow \frac{\sigma^2}{2} = \frac{1}{\beta} = D = 0.1$$