

2011.01.25

物性物理学C

# 非線形振動子と同期現象

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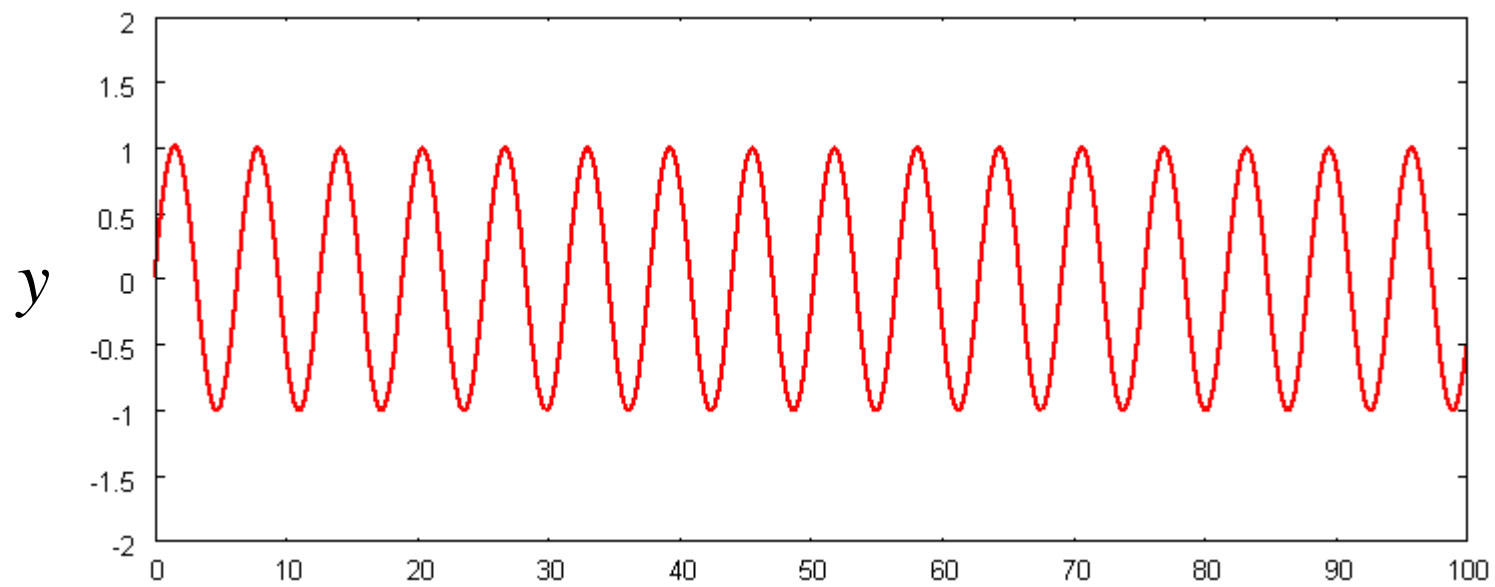
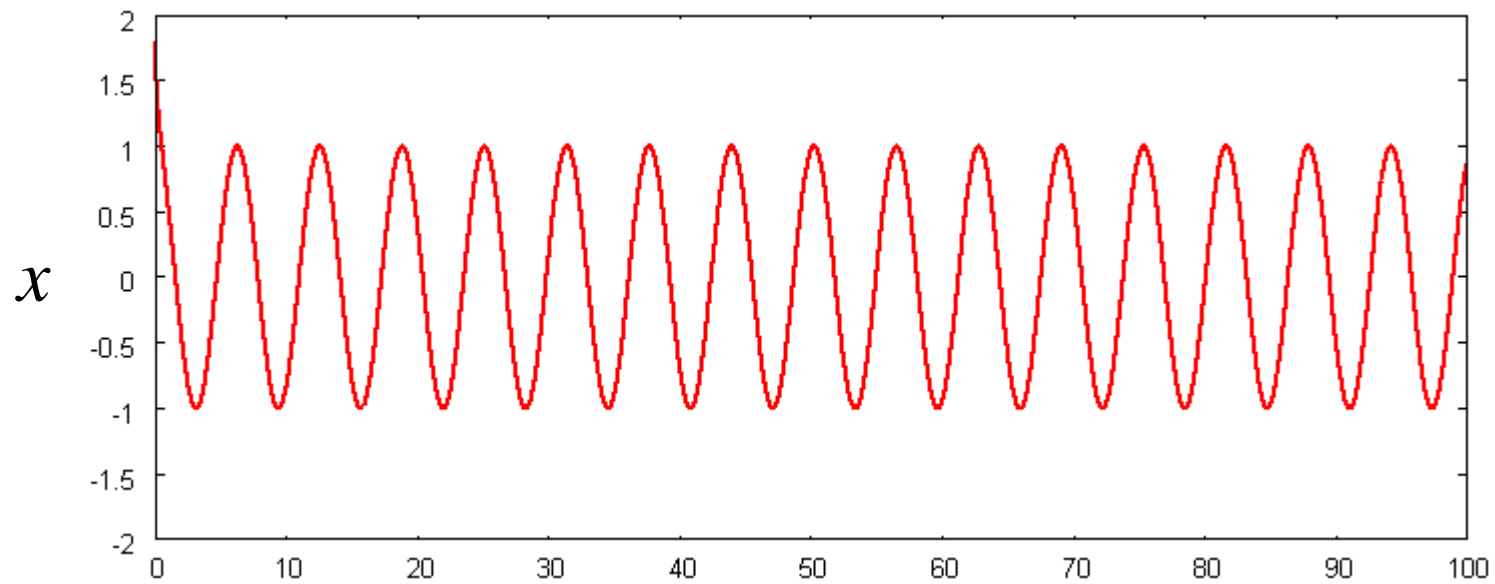
## Stuart-Landau方程式

$$\begin{cases} \frac{dx}{dt} = ax - \omega y - (x^2 + y^2)(x - by) \\ \frac{dy}{dt} = ay + \omega x - (x^2 + y^2)(y + bx) \end{cases}$$

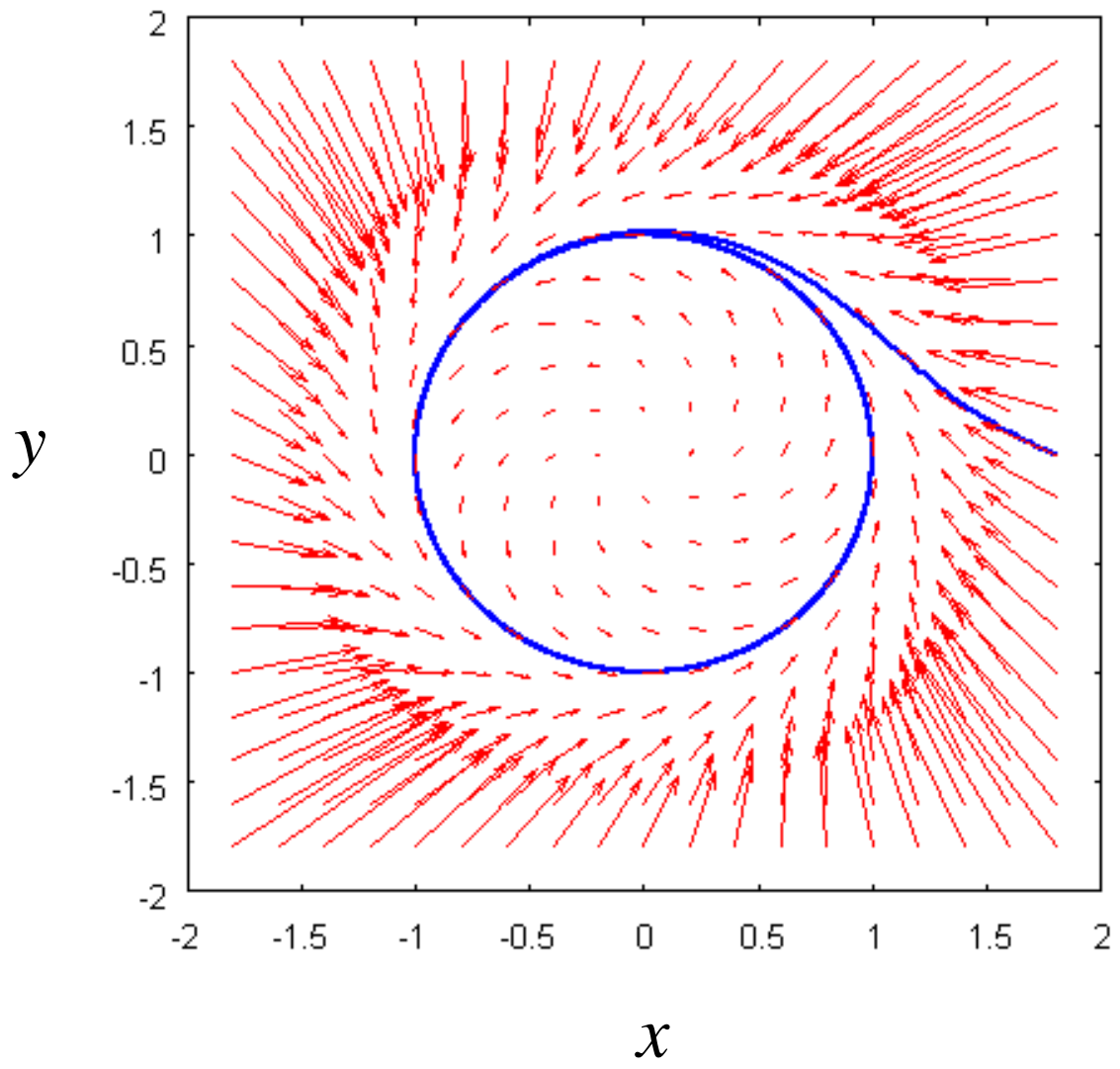
$$\begin{cases} \frac{dr}{dt} = ar - r^3 & r^2 = x^2 + y^2 & a = 1 \\ \frac{d\theta}{dt} = \omega & \frac{y}{x} = \tan \theta & b = 0 \end{cases}$$

# Stuart- Landau方程式の数値計算(プログラム)

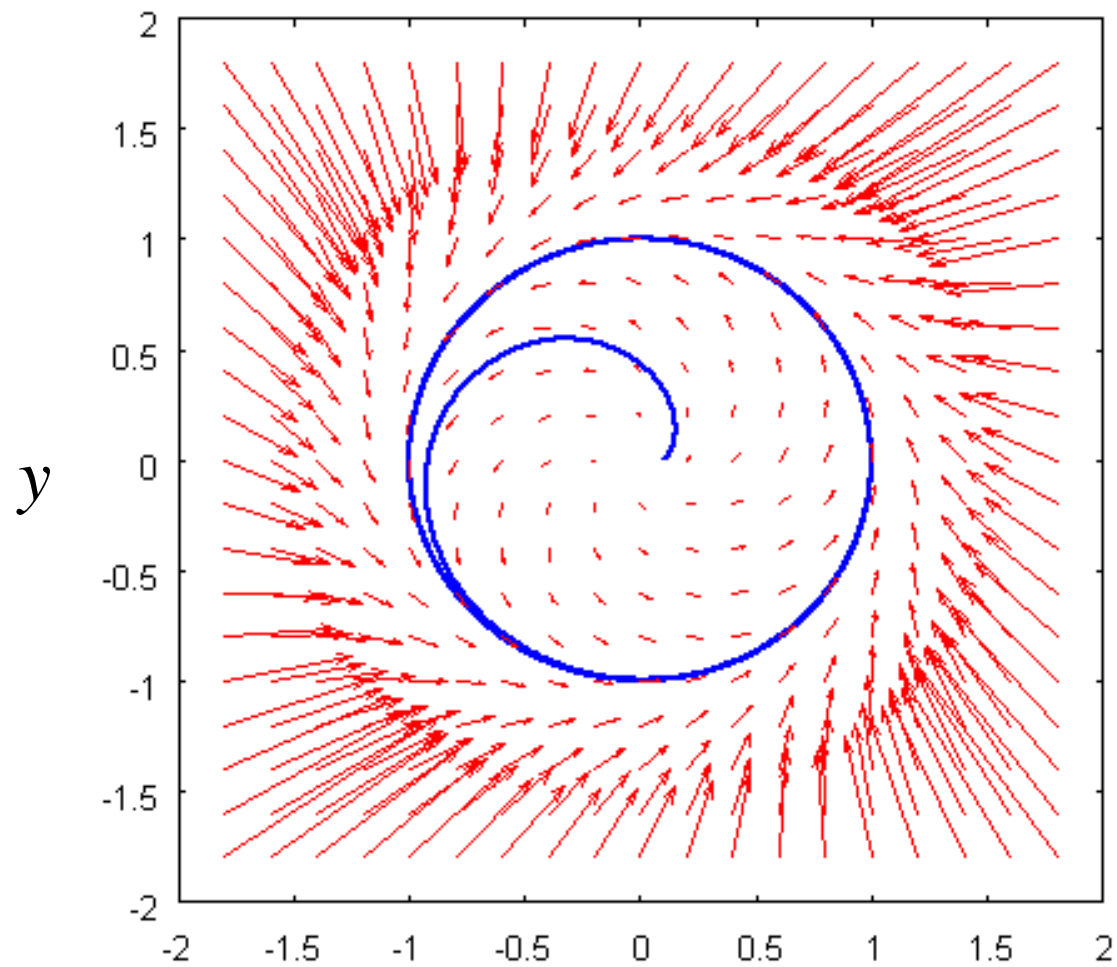




time



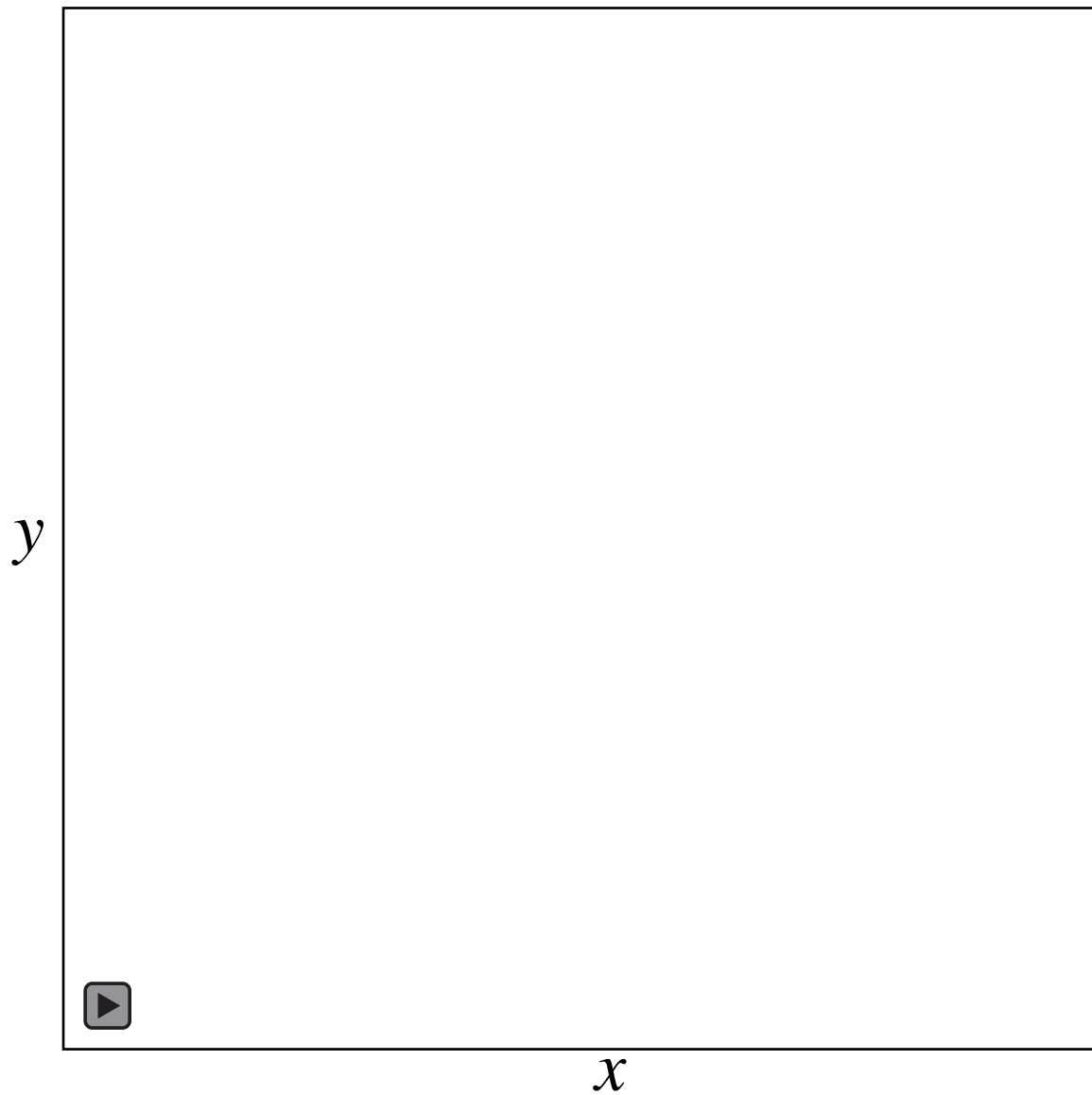
初期値を変えても

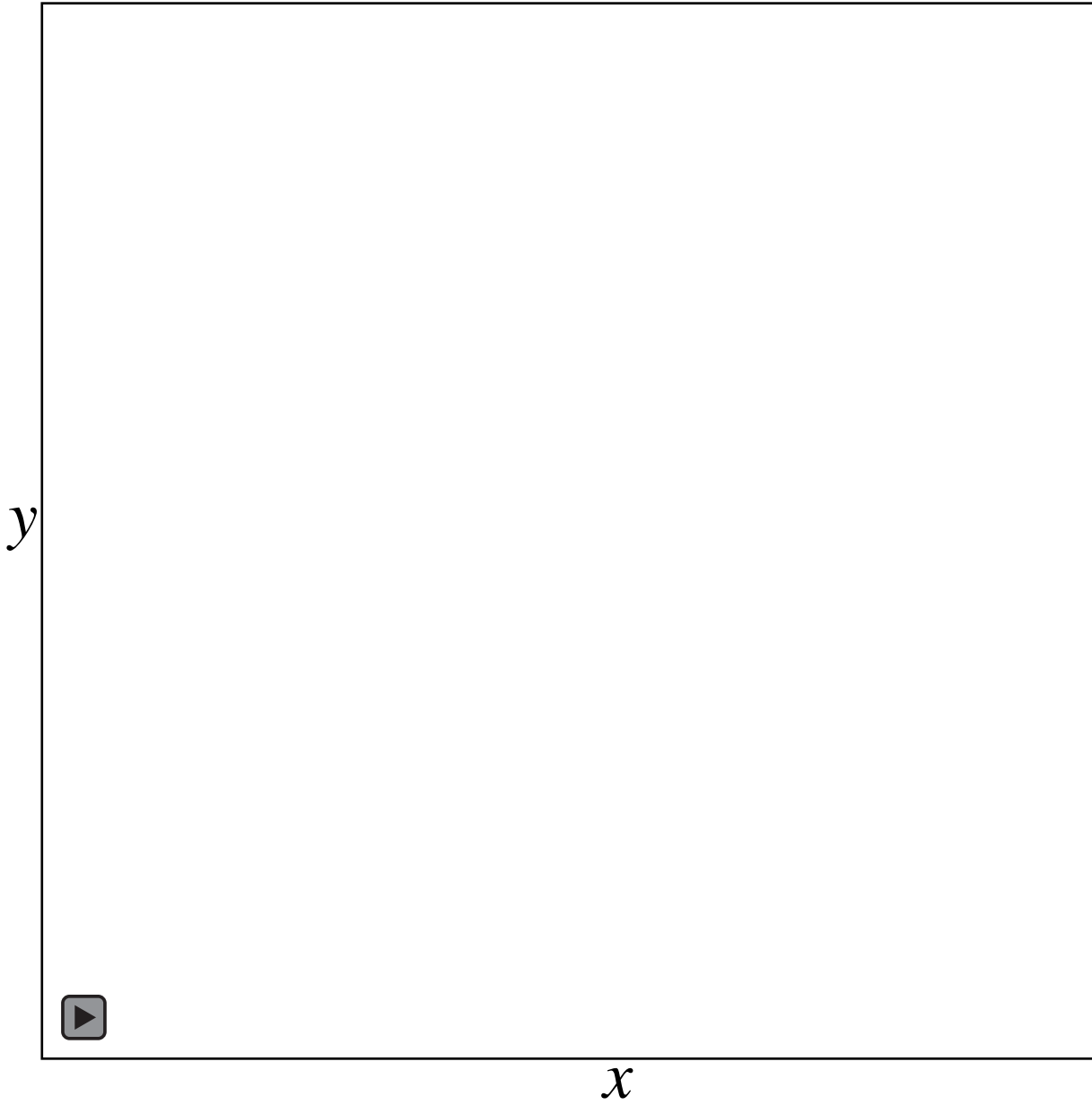


$x$

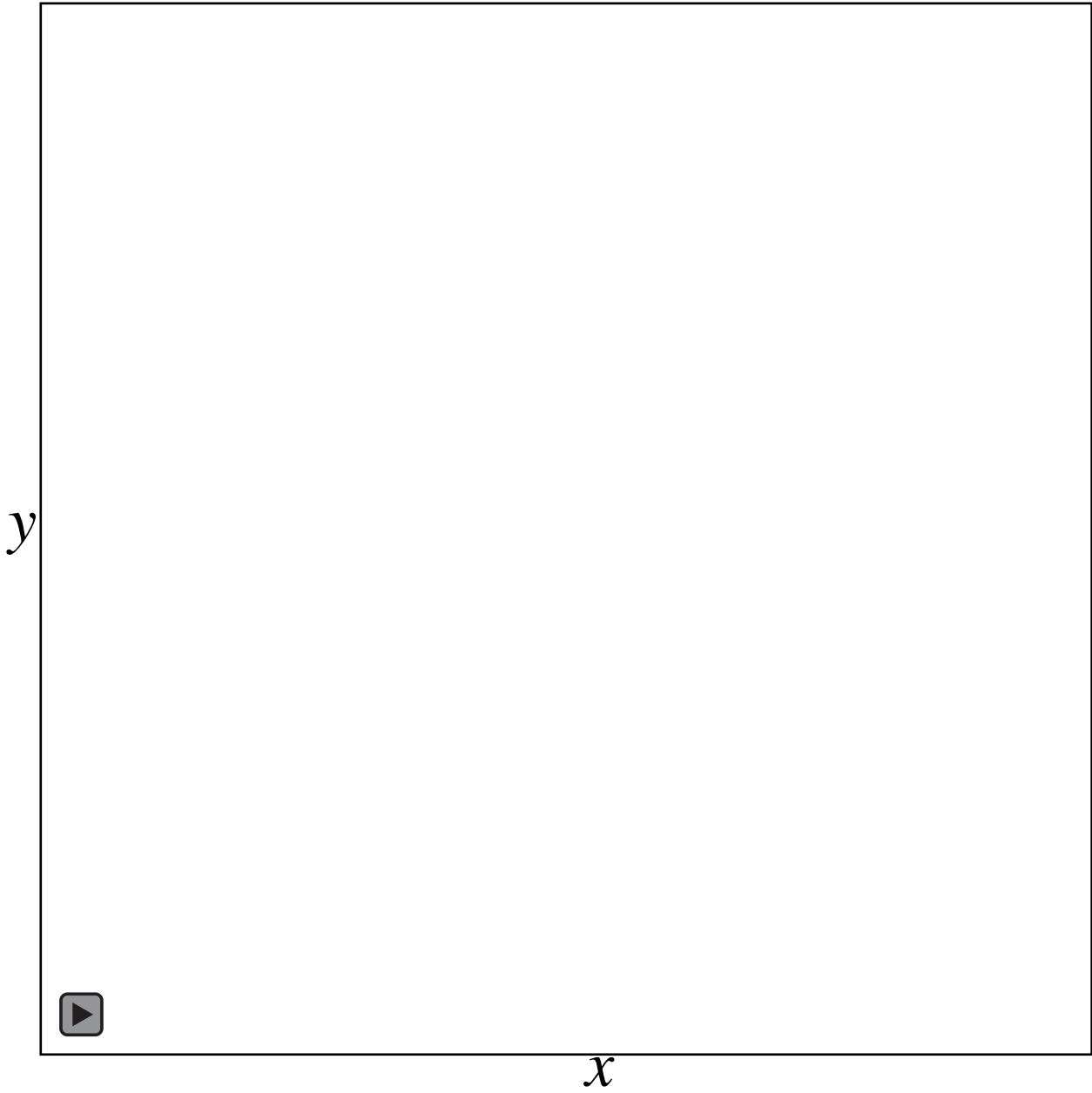
Limit Cycle (極限軌道)

# リミットサイクル上の運動

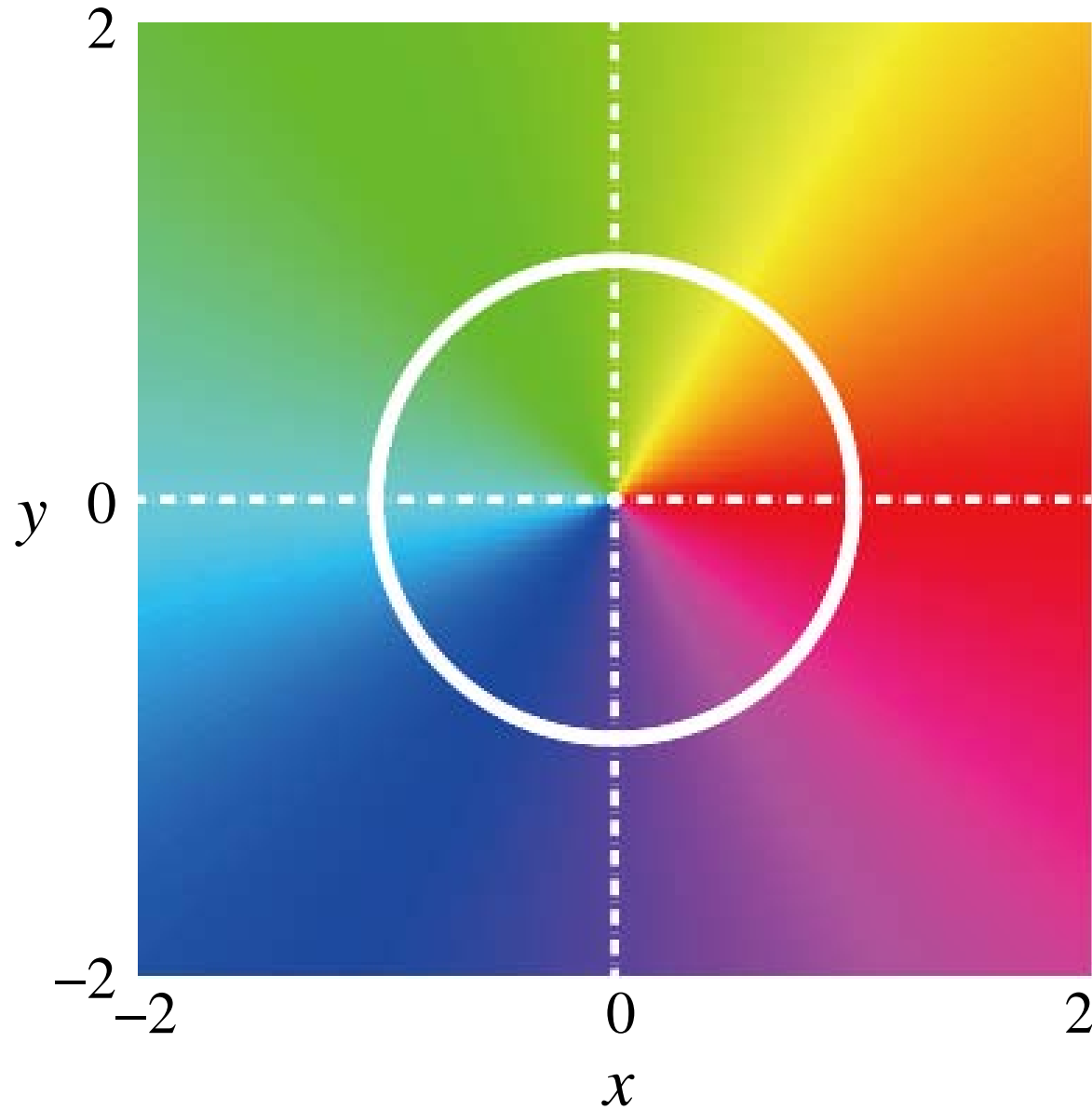








# 等位相面



$$\theta = \arctan\left(\frac{y}{x}\right)$$

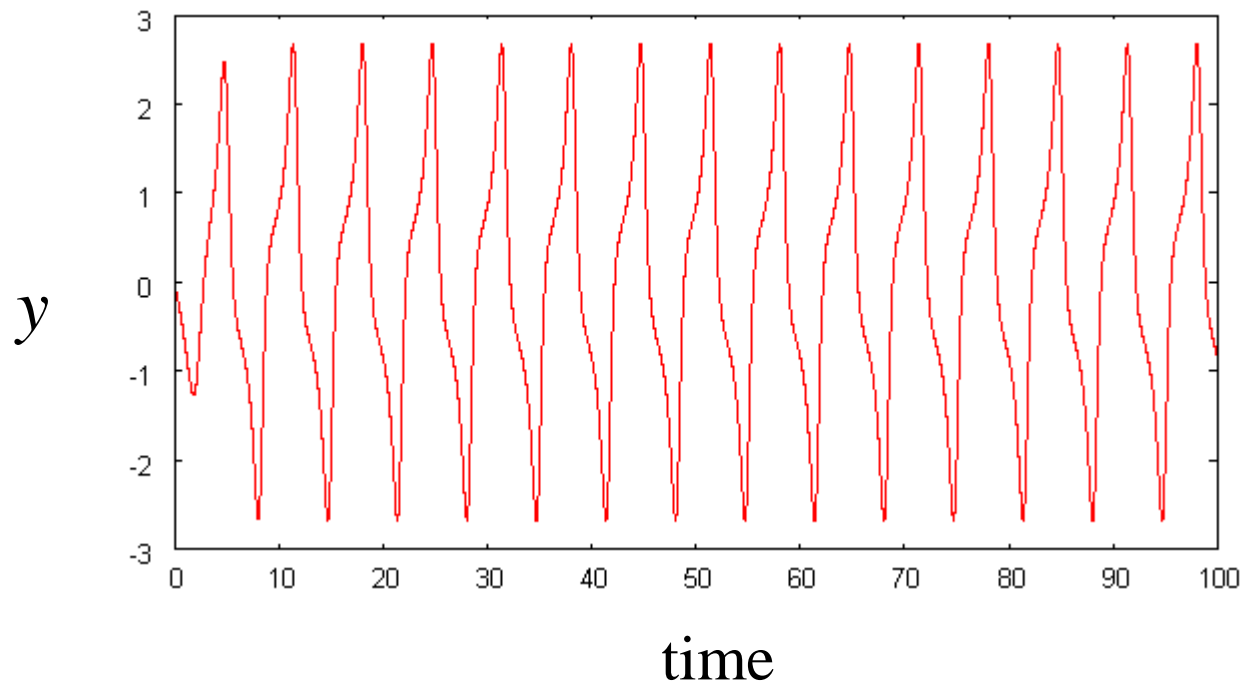
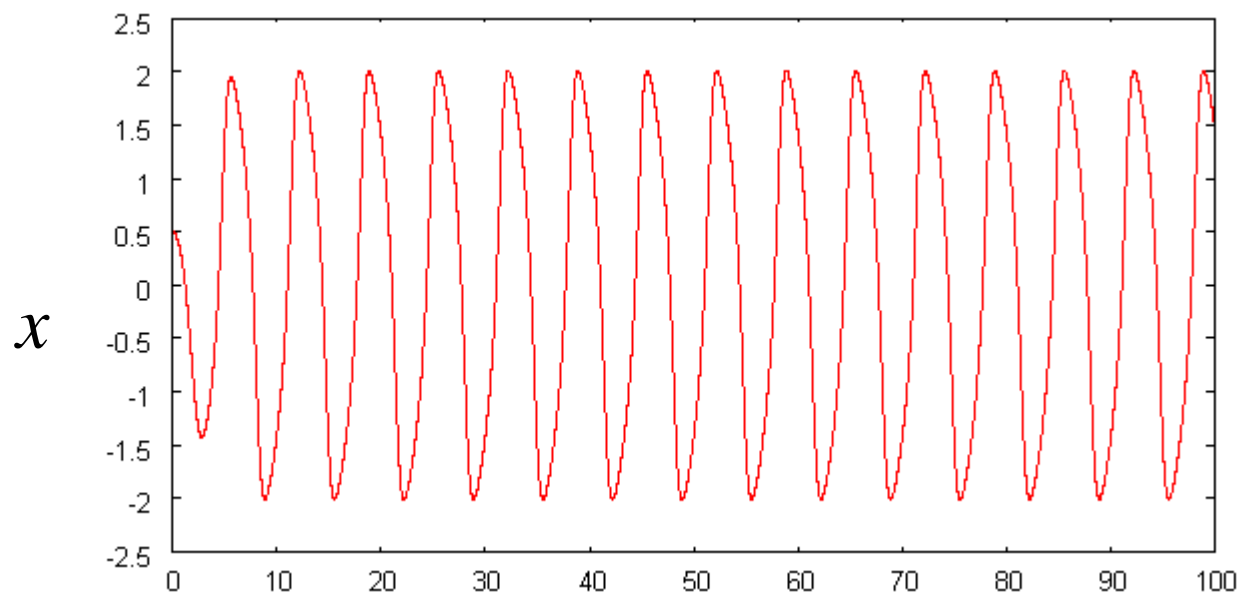
van der Pol 方程式 ~ 丸くなくても...

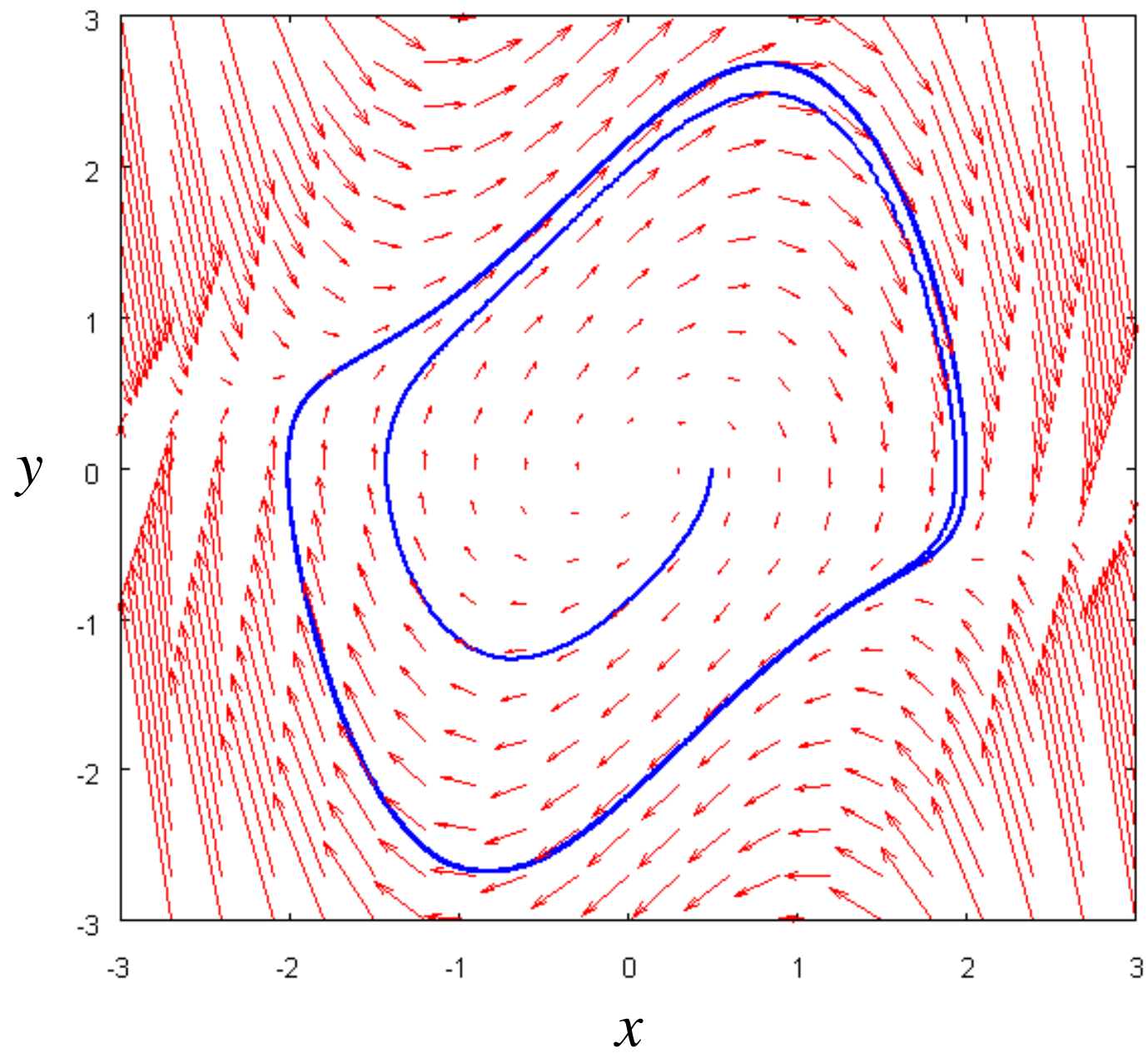
$$\frac{d^2 x}{dt^2} + \alpha(x^2 - 1)\frac{dx}{dt} + x = 0$$

$$\left\{ \begin{array}{l} \frac{dx}{dt} = y \\ \frac{dy}{dt} = -\alpha(x^2 - 1)y - x \end{array} \right.$$

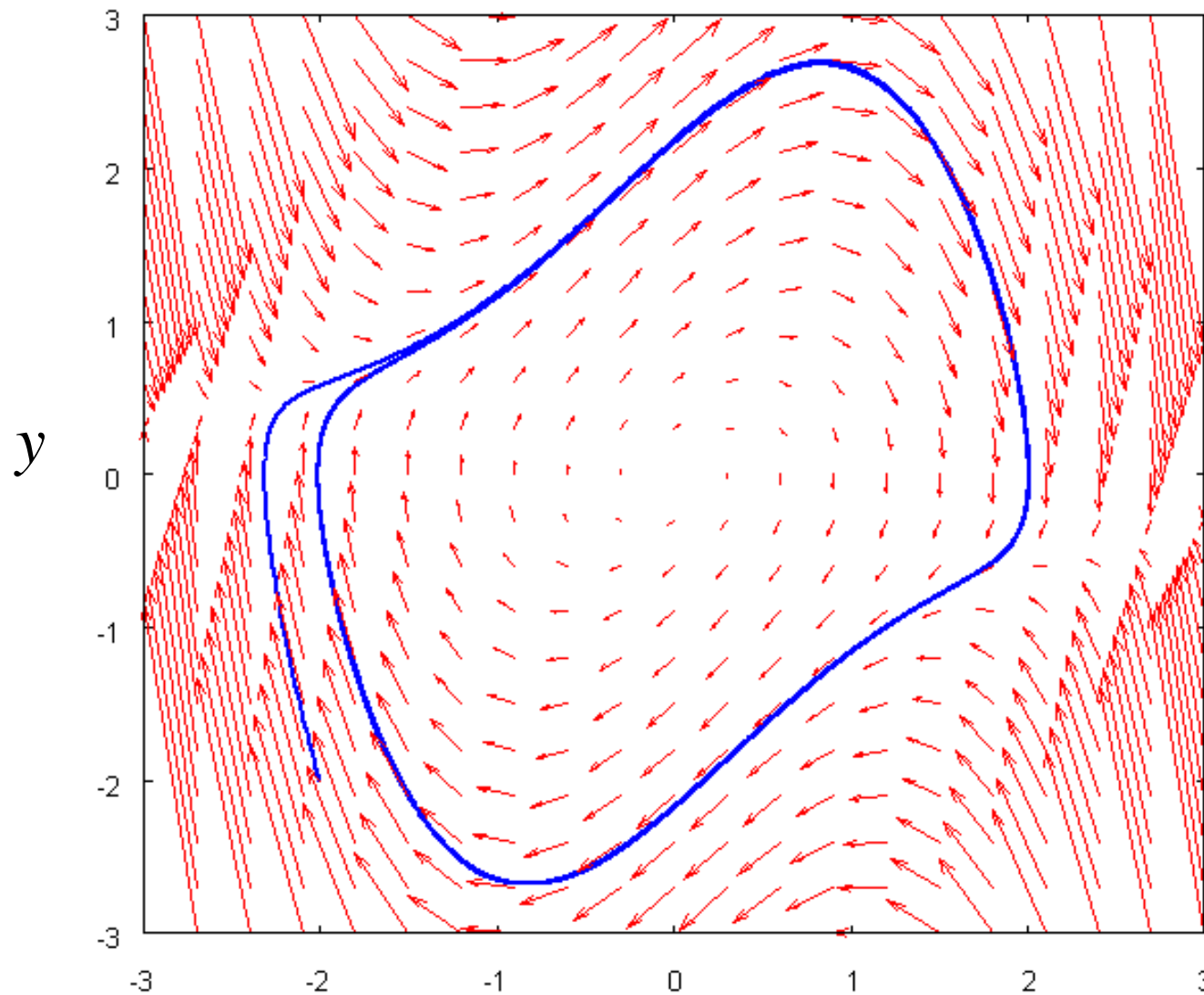
# van der Pol 方程式の数値計算(プログラム)







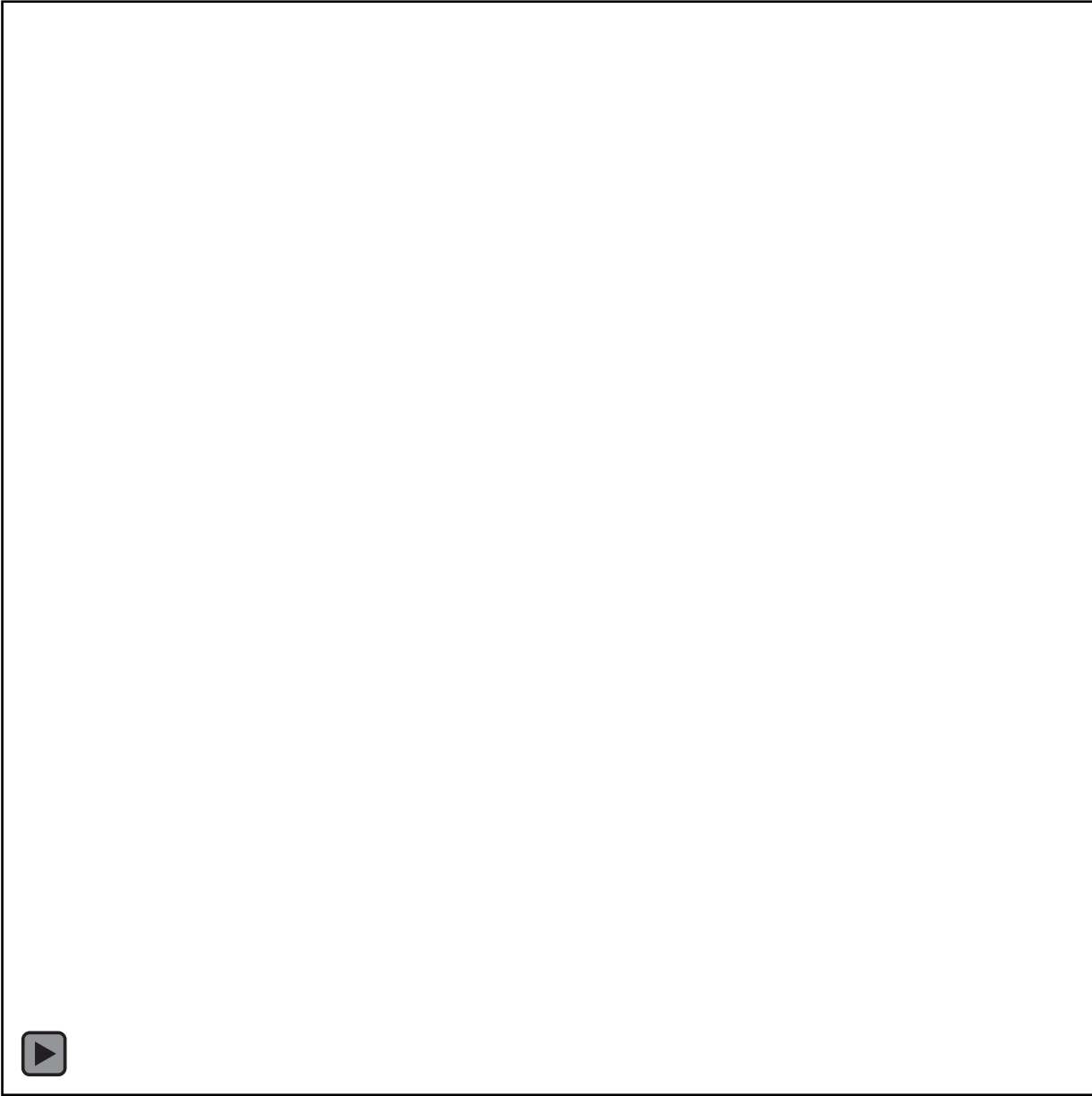
初期値を変えても



Limit Cycle (極限軌道)

$x$

$y$



$y$

$x$

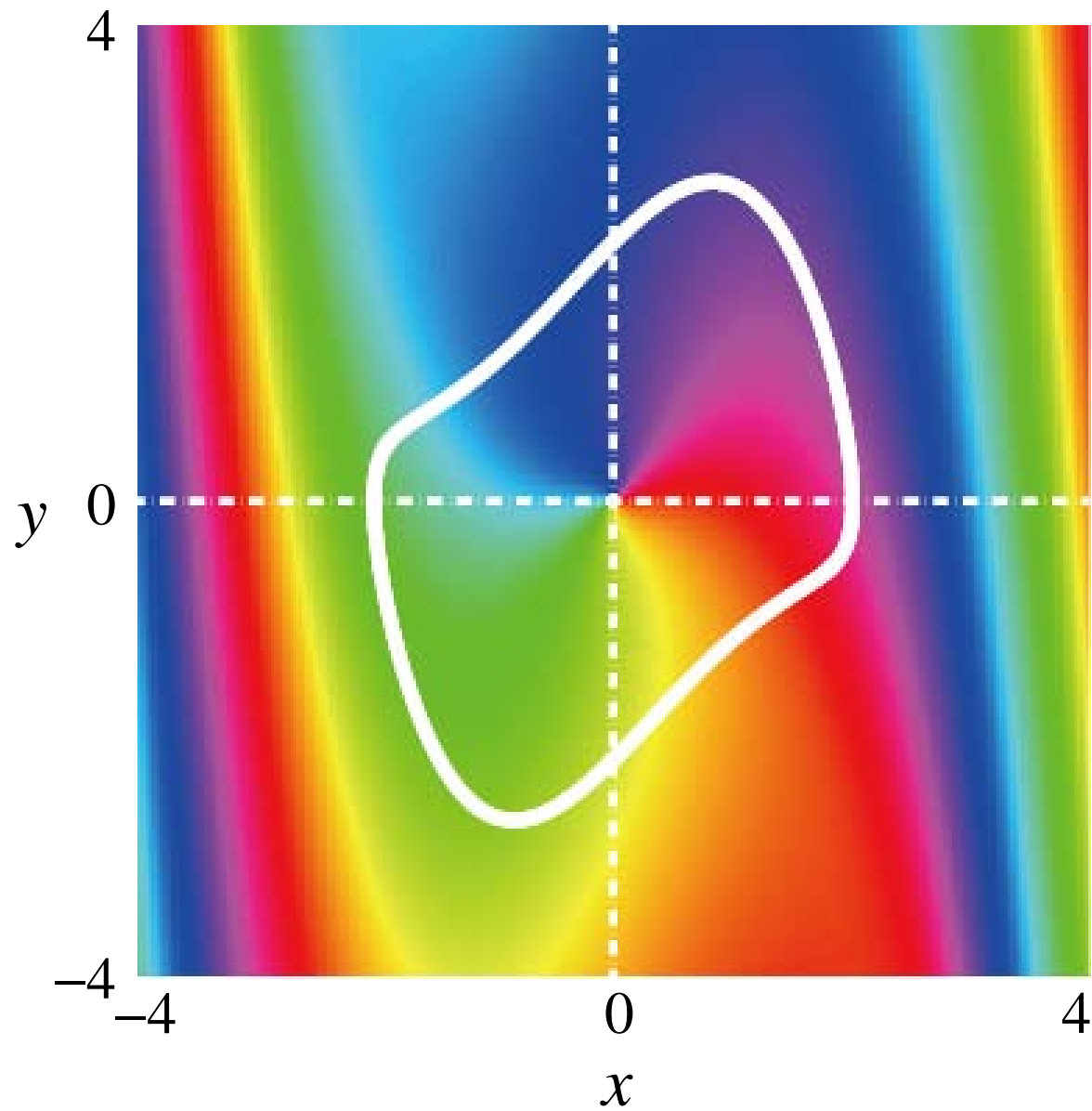


$y$



$x$

# 等位相面



# さまざまな非線形振動子

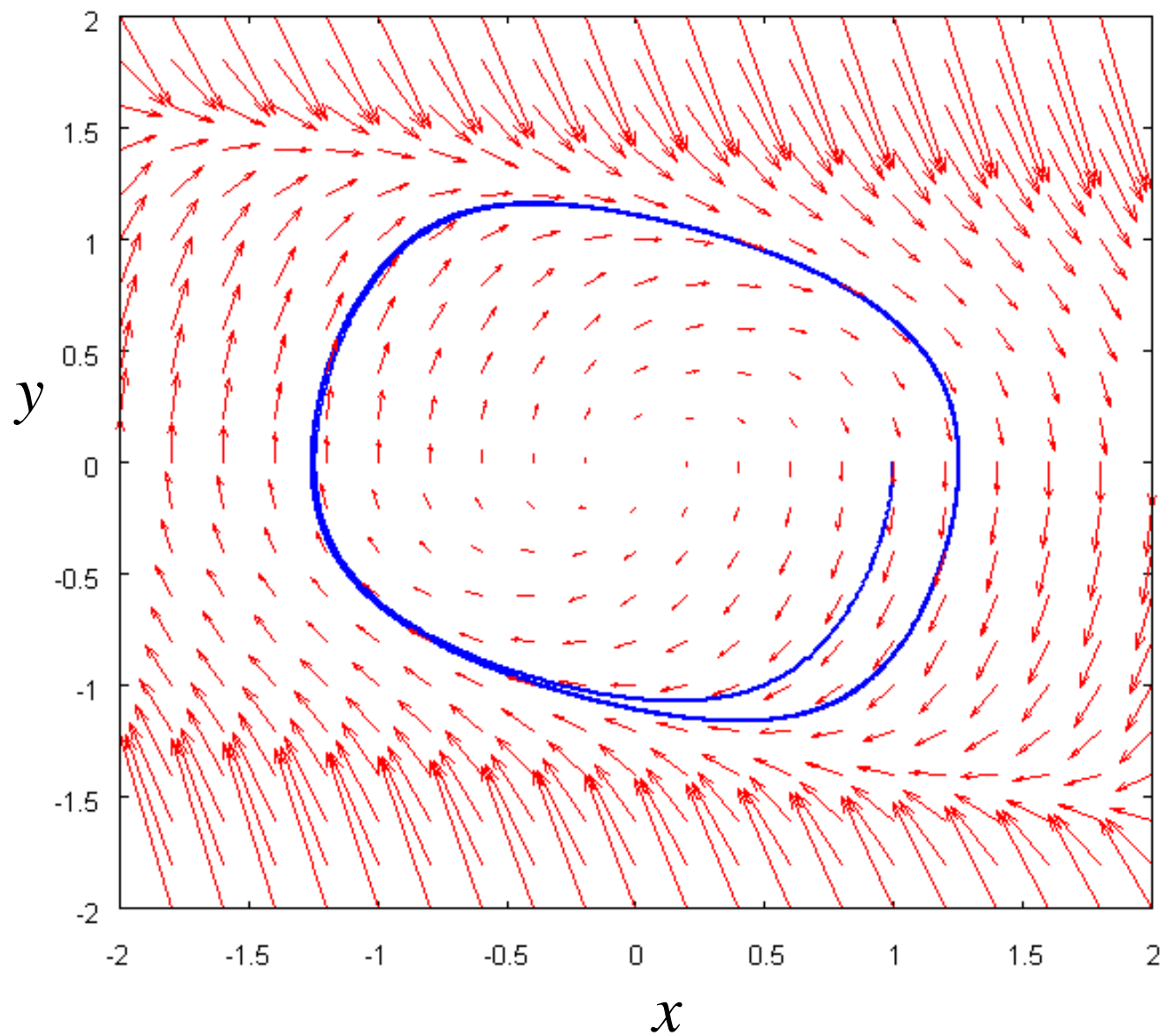
Rayleigh方程式

$$\frac{d^2 x}{dt^2} + \alpha \left( \left( \frac{dx}{dt} \right)^2 - 1 \right) \frac{dx}{dt} + x = 0$$

FitzHugh-Nagumo方程式

$$\begin{cases} \frac{dx}{dt} = \frac{1}{\varepsilon} (x - x^3 - y) \\ \frac{dy}{dt} = x - y + b \end{cases}$$

# Rayleigh方程式

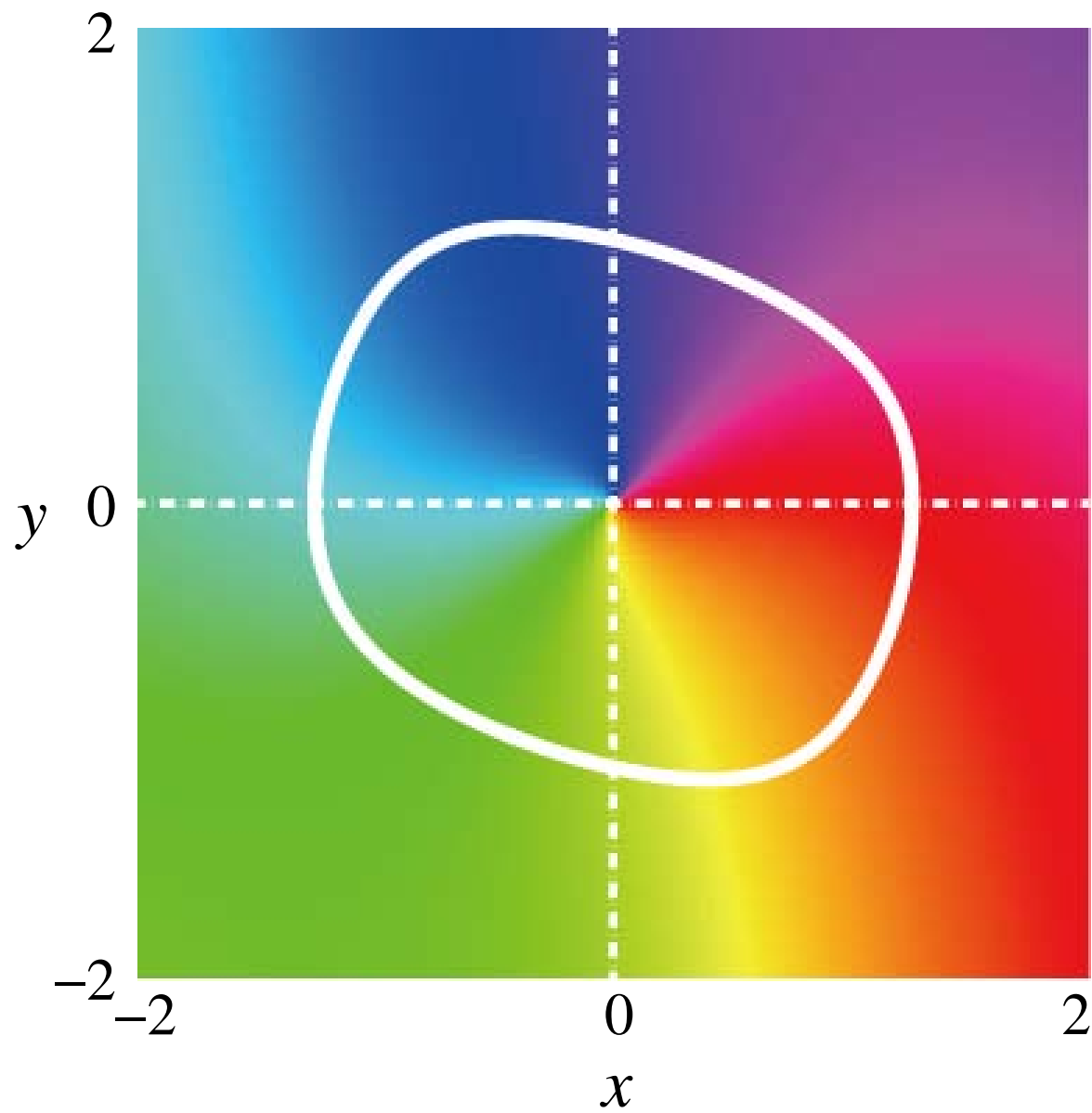


$y$

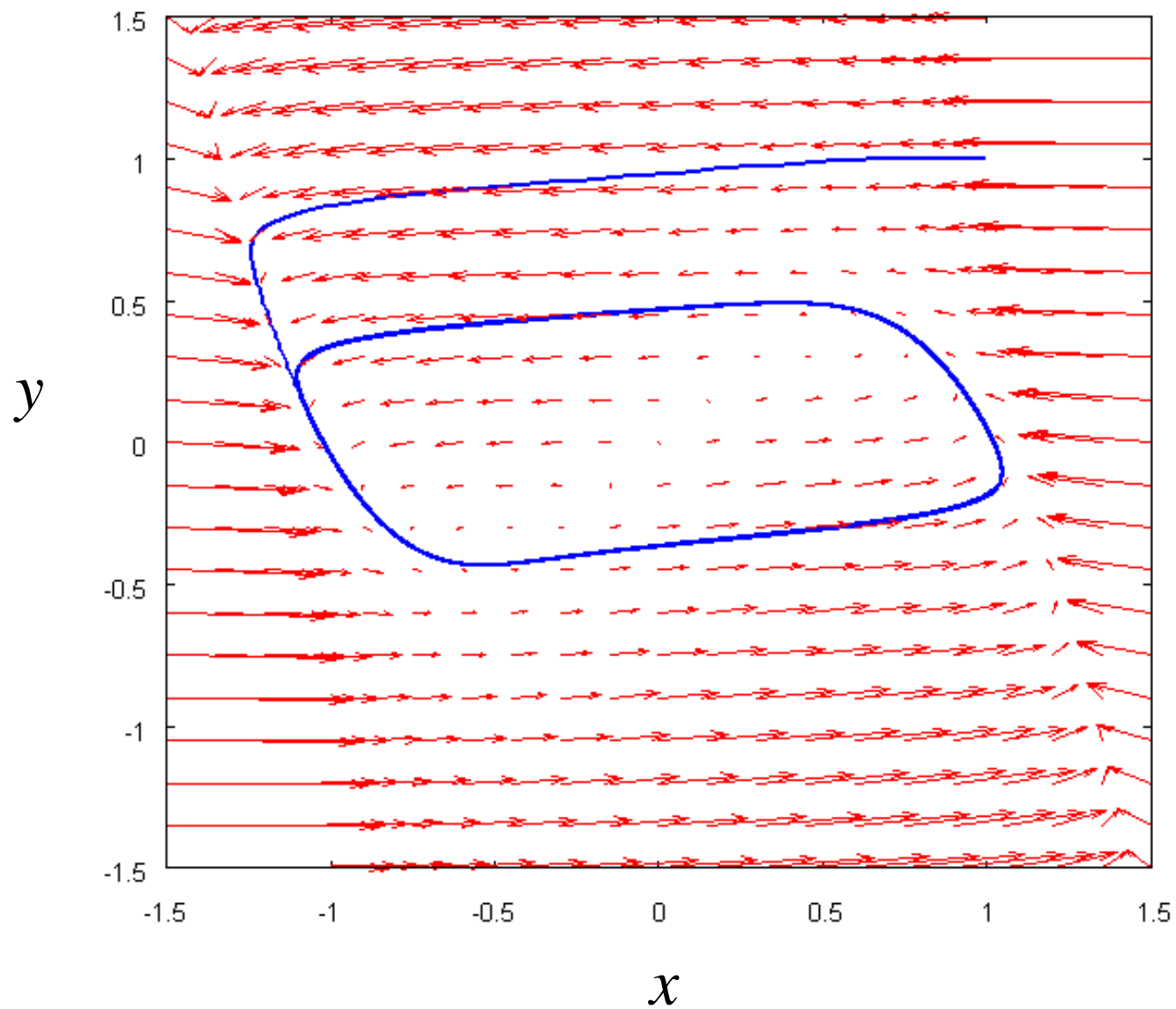


$x$

# 等位相面



# FitzHugh-Nagumo方程式



$y$



$x$



# 等位相面

