$\mathcal{Q} =$
v
i
v

$$i = C\frac{dv}{dt} = C\dot{\mathcal{Q}}$$

(1)

(2.1842186,-0.27296874)C
(4.534219,-0.29296875)L
(2.5142188,1.3670312)i
(0.28421876,-0.25296876)v
Q
Φ

$$\mathcal{L} = \frac{1}{2}Li^2 - \frac{1}{2}Cv^2 = \frac{1}{2}C\left[\frac{1}{\omega_0^2}\dot{\mathcal{Q}}^2 - \mathcal{Q}^2\right]$$

(2)

ω_0

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$\frac{d}{dt}L(Q,\dot{Q})\dot{Q} - L(Q,\dot{Q})Q = 0\ddot{Q} = -\omega_0^2 Q\frac{d^2v}{dt^2} = -\omega_0^2 v$$

(3)

Q

$$P = L\dot{Q} = \frac{C\dot{Q}}{\omega_0^2} = LCi$$

(4)

$$H = P\dot{Q} - L(Q,\dot{Q})\Big|_{\dot{Q}=\omega_0^2 P/C} = \frac{\omega_0^2 P^2}{2C} + \frac{1}{2}CQ^2$$

(5)

$\dot{Q} =$
$H(Q,P)P =$
$\frac{\omega_0^2 P}{C} C\frac{dv}{dt} =$
$i(KCL)$
$\dot{P} =$
$-H(Q,P)Q =$
$-CQL\frac{di}{dt} =$
$-v(KVL)$

$$H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 x^2$$

(6)

x
p

$$H \leftrightarrow Hx \leftrightarrow Qp \leftrightarrow Pm \leftrightarrow LC^2\omega \leftrightarrow \omega_0$$

(7)

$Q =$
v

$$P = L\dot{Q} = \frac{C\dot{Q}}{\omega_0^2} = LCi$$

(8)

$$\{Q,P\} = QQPP - PQQP = 1$$

(9)

$$\frac{1}{j\hbar}[,] \leftrightarrow \{,\}$$

(10)

j
Q
P

$$[Q,P] = [v, LCi] = j\hbar$$

(11)

Lie algebra

$_{SHO} =$
$\sqrt{\frac{m\omega}{2\hbar}}\left(x + \frac{jp}{m\omega}\right) A =$
$\sqrt{\frac{LC^2\omega_0}{2\hbar}}\left(Q + \frac{jP}{LC^2\omega_0}\right)$
$a^\dagger_{SHO} =$
$\sqrt{\frac{m\omega}{2\hbar}}\left(x - \frac{jp}{m\omega}\right) A^\dagger =$
$\sqrt{\frac{LC^2\omega_0}{2\hbar}}\left(Q - \frac{jP}{LC^2\omega_0}\right)$
$\sqrt{\frac{C}{2\hbar\omega_0}}\left(v + \frac{ji}{C\omega_0}\right) annihilationoperator$
$A^\dagger =$
$\sqrt{\frac{C}{2\hbar\omega_0}}\left(v - \frac{ji}{C\omega_0}\right) creationoperator$