(2.179) the poincare variables (1)

The transformation of the Delauny variables.

$$\Gamma = \alpha\left(1-\sqrt{1-\epsilon^2}\right) \qquad \gamma = \begin{matrix} -\bar{\omega} \\ -\omega - \Omega \end{matrix}$$

$$R = K_1 \epsilon^2 + K_2 \epsilon'^2 + K_3 \epsilon \epsilon' \cos(\bar{\omega} - \bar{\omega}')$$

$$\left\{ \begin{matrix} \frac{d\epsilon}{dt} \\ \frac{d\bar{\omega}}{dt} \end{matrix} \right.$$

$\gamma = -\bar{\omega}$

$\Gamma = \epsilon^2/2$ Taylor expansion

$$\frac{d\gamma}{dt} = \partial R/\partial\Gamma \qquad \frac{\partial\Gamma}{\partial t} = -\partial R/\partial\gamma$$

$$-\frac{d\bar{\omega}}{dt} = \frac{1}{\epsilon}\partial R/\partial\epsilon$$

$$\epsilon\, d\epsilon/dt = \partial R/\partial\bar{\omega}$$

Canonical Variables

$p, q \longrightarrow \partial H/\partial q = -\dot{p} \qquad \partial H/\partial p = \dot{q}$

complex canonical variables

$$z = \sqrt{p}\, e^{iq} \qquad z^* = z' = \sqrt{p}\, e^{-iq}$$

$$z = \sqrt{\Gamma}\, e^{i\gamma} \qquad dz/dt = i\, \partial H/\partial z^*$$

$$z = \sqrt{r}\, e^{i\gamma} = \frac{e}{\sqrt{2}}\, e^{-i\bar{\omega}}$$ (2)

$$\langle R \rangle = 2k|z|^2 + k_3 e' \sqrt{2}\, |z| \left\{ \frac{e^{-i(\gamma+\bar{\omega}')} + e^{i(\gamma+\bar{\omega}')}}{2} \right\} + k_3 e' \frac{\sqrt{2}}{2} \left(z\, e^{i\bar{\omega}'} + z' e^{-i\bar{\omega}'} \right)$$

$$\frac{dz}{dt} = i\left[2kz + \frac{\sqrt{2}}{2} k_3 \underbrace{e' e^{-i\bar{\omega}'}}_{z^*} \right]$$

$$\frac{dz}{dt} = i[az + bz']$$

$$\frac{dz}{dt} = iaz \rightarrow z = C_0\, e^{iat}$$

$$\frac{dz}{dt} = i(\omega_0 z + bz')$$

$$dz/_{dt} - i\omega_0 z = ibz'$$

$$z = e\,e^{i\bar{\omega}} \qquad \frac{d}{dt}\left\{ z\, e^{-i\omega_0 t} \right\}$$

$$e^{i\omega_0 t} \left\{ \dot{z}\, e^{-i\bar{\omega}_0 t} + z(-i\omega_0)\, e^{-i\bar{\omega}_0 t} \right\} = \bar{z}_{-i\omega_0 ?}$$

$$\epsilon^{i\omega_0 t} \frac{d}{dt}\left[z\epsilon^{-i\omega_0 t}\right] = ibz$$

$$\Rightarrow \frac{d}{dt}\left[z\epsilon^{-i\omega_0 t}\right] = \epsilon^{-i\omega_0 t}\left[ibz'\right]$$

$$z\epsilon^{-i\omega_0 t} = -\frac{b}{\omega_0} z' \epsilon^{-i\omega_0 t} + C$$

$$z = -\frac{b}{\omega_0} z' + C\epsilon^{i\omega_0 t}$$

$$\begin{bmatrix} \frac{dz_s}{dt} \\ \frac{dz_J}{dt} \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \\ A_{22} & A_{22} \end{bmatrix} \begin{bmatrix} z_s \\ z_J \end{bmatrix}$$