If $\omega_2^* \neq 0$ and ω_1^*, ω_3^* are $\approx \epsilon$, write

$\vec{\omega} = \epsilon_1 \hat{e}_1^* + \omega_2^* \hat{e}_2^* + \epsilon_3 \hat{e}_3^*$. The torque free Euler eqns then become

$$\begin{cases} \dot{\epsilon}_1 I_1^* + \omega_2^* \epsilon_3 (I_3^* - I_2^*) = 0 \\ \dot{\omega}_2^* I_2^* + \epsilon_3 \epsilon_1 (I_1^* - I_3^*) = 0 \\ \dot{\epsilon}_3 I_3^* + \epsilon_1 \omega_2^* (I_2^* - I_1^*) = 0 \end{cases}$$

This eqn says $\omega_2^* = \text{cnst} + O(\epsilon^2)$

These equations with $\omega_2^* \simeq$ cnst become

i) $$\dot{\epsilon}_1 + \epsilon_3 \left[\frac{\omega_2^* (I_3 - I_2^*)}{I_1^*} \right] = 0$$

ii) $$\dot{\epsilon}_3 + \epsilon_1 \left[\frac{\omega_2^* (I_2 - I_1)}{I_3^*} \right] = 0$$

Differentiating i) + substituting into ii) $\Rightarrow$

$$\boxed{\begin{aligned} \ddot{\epsilon}_1 + \Omega_2^2 \epsilon_1 = 0 \\ \ddot{\epsilon}_3 + \Omega_2^2 \epsilon_3 = 0 \end{aligned}}$$

where $$\boxed{\Omega_2^2 = \omega_2^{*2} \frac{(I_2^* - I_3^*)(I_2^* - I_1^*)}{I_1^* I_3^*}}$$

Note $I_2^* - I_3^* < 0$ + $I_2^* - I_1^* > 0 \Rightarrow \Omega_2^2 < 0$.

Thus, ϵ_1 + ϵ_2 <u>grow</u> <u>exponentially</u>, + motion is <u>unstable</u>. In the other cases of motion initially about e_1^* or e_3^* we find $\Rightarrow$ Thus this motion is <u>stable</u>.

$$\boxed{\Omega_1^2 = \omega_1^{*2} \frac{(I_1^* - I_2^*)(I_1^* - I_3^*)}{\underbrace{I_3^* I_2^*}} > 0 + \Omega_3^2 = \frac{\omega_3^{*2} (I_3^* - I_1^*)(I_3^* - I_2^*)}{I_2^* I_1^*} > 0}$$