1976-1979 communications in GEO- Hermes
High power communications → smaller dishes
Pretty Heavy → motor 340 kg
Spin Stabilized from Launch to Syncro Orbit

$$0 = \dot{\omega}_1 - \lambda \omega_2$$
$$0 = \dot{\omega}_2 + \lambda \omega_1 \quad \omega_3(t) = \Lambda$$
$$\omega_1(t) = \omega_1(0)\cos(\lambda t) + \omega_2(0)\sin(\lambda t) = \omega_t \sin(\lambda t + \phi)$$
$$\omega_2(t) = \omega_2(0)\cos(\lambda t) - \omega_1(0)\sin(\lambda t) = \omega_t \cos(\lambda t + \phi)$$
$$\phi = \operatorname{atan2}(\omega_2(0), \omega_1(0))$$
$$\left.\begin{aligned} H_1 &= J_t \omega_1 \\ H_2 &= J_t \omega_2 \\ H_3 &= J_a \Lambda \end{aligned}\right\} \rightarrow \text{Just scaled in body frame}$$

Nutation angle θ — space cone ½ angle → $|\theta - \gamma|$
wobble angle γ — body cone ½ angle → γ

$$\lambda = \left(\frac{J_t - J_a}{J_a}\right)\Lambda$$

$$R_{313} = \begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cos\theta \end{bmatrix} \rightarrow \theta = \theta$$ in this case nutation angle constant → θ constant

3-1-3
$$\omega_1 = \dot{\phi}\sin\theta\sin\psi + \cancel{\dot{\theta}^{\,0}\cos\psi}$$
$$\omega_2 = \dot{\phi}\sin\theta\cos\psi - \cancel{\dot{\theta}^{\,0}\sin\psi}$$
$$\omega_3 = \dot{\phi}\cos\theta + \dot{\psi}$$

$$\omega_1^2 + \omega_2^2 = \dot{\phi}^2 \sin^2\theta (\sin^2\psi + \cos^2\psi)^1$$
$$\omega_1^2 + \omega_2^2 = \omega_t^2 \qquad \dot{\phi}^2 = \frac{\omega_t^2}{\sin^2\theta}$$

$$0 = (\dot{\phi}\sin\theta)\cos(\psi)\dot{\psi} - \lambda\dot{\phi}\sin\theta\cos\psi = \dot{\phi}\sin\theta\cos\psi(\dot{\psi} - \lambda) = 0$$
$$\dot{\theta} = 0 \quad \dot{\psi} = \lambda \quad \dot{\phi} = \frac{\Lambda - \lambda}{\cos\theta} \rightarrow \frac{J_a \Lambda}{J_t \cos\theta}$$