L37 Spin precession

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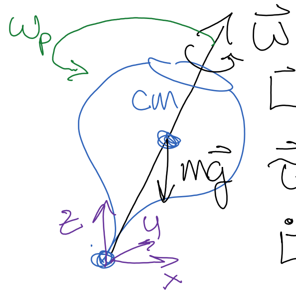
- Similar to the precession of a Foucault pendulum (Coriolis couples x,y modes), Torque perpendicular to the z-axis couples x,y components of angular momentum. Solved using the same technique (also charge in B-field, …)



$$\vec{L} = \overleftrightarrow{I}\vec{\omega} \qquad \overleftrightarrow{I} = \begin{pmatrix} x & & 0 \\ & x & \\ 0 & & I \end{pmatrix} \qquad I = \int dm\, \rho^2 \qquad \rho^2 = x'^2 + y'^2$$

$$\vec{\tau} = \vec{r}_{cm} \times m\vec{g}$$

$$\dot{\vec{L}} = \vec{\tau} = \vec{r} \times m\vec{g} = -\underbrace{\frac{r_{cm} m g}{I\omega}}_{\omega_p} \hat{z} \times \vec{L} \qquad \text{let } \tilde{L} = L_x + iL_y$$

$$\dot{\tilde{L}} = -i\omega_p \tilde{L} \qquad \tilde{L} = \tilde{L}_0 e^{-i\omega_p t} \qquad \dot{L}_z = 0 \qquad L_z = L_z^0$$

Next week we will solve the general case where I and ω are not parallel.

- The same physics is involved in precession of a magnetic moment $\mu = IA$ by $\vec{\tau} = \vec{\mu} \times \vec{B}_0$

1) Calculate the gyromagnetic ratio $\gamma = \mu/L$ for a point mass m or charge q orbiting in a circle
2) Calculate the Larmor precession frequency $\omega_L = \gamma B$ of a neutron, where $\gamma = g_n\, e/2m$.
3) In the rotating frame the non-inertial time derivative acts as a pseudomagnetic field. Add an oscillating B_1 (static in the rotating frame) and calculate Rabi flopping $\omega_R = \gamma B_{tot}$.