For a single plate about its center:

\[ I_z = S \int_0^{L/2} \int_0^{L/2} \frac{9m}{2} (x^2 + y^2) \, dx \, dy \]

\[ = 4 \frac{S}{L^2} \frac{L^2}{2} \frac{9m}{2} \int_0^{L/2} x^2 \, dx \int_0^{L/2} y^2 \, dy \]

\[ = 4 \frac{9m}{2} \frac{L^2}{4} \left[ \frac{x^3}{3} \right]_0^{L/2} \left[ \frac{y^3}{3} \right]_0^{L/2} \]

\[ = 4 \frac{9m}{2} \frac{L^2}{4} \left( \frac{L^2}{4} \right)^2 \left( \frac{L^2}{4} \right)^2 \]

\[ = 4 \frac{9m}{2} \frac{L^4}{4} \frac{1}{3} \frac{1}{16} \]

\[ I_z = \frac{1}{6} m L^2 \]

\[ I_x = I_y = \frac{1}{12} m L^2 \]

By the parallel axis theorem, about point \( A \):

\[ I_x = \frac{1}{12} m L^2 \]

\[ I_y = \frac{1}{12} m L^2 + \frac{1}{4} m d^2 \]

\[ I_z = \frac{1}{6} m L^2 + \frac{1}{4} m d^2 \]

Since the plates are equidistant from \( A \) we have for both:

\[ I_1 = \frac{1}{3} m L^2 + \frac{1}{2} m d^2 \]

\[ I_2 = \frac{1}{6} m L^2 + \frac{1}{2} m d^2 \]

\[ I_3 = \frac{1}{6} m L^2 \]

b. \( L = I_1 w_1 \hat{z}^\uparrow + I_2 w_2 \hat{y}^\uparrow + I_3 w_3 \hat{x}^\uparrow \)

\[ \frac{\vec{L}}{dt} = \frac{d}{dt} \vec{I}_a \vec{b} + \vec{w} \times \vec{L} \]

\[ \vec{E} = I_1 w_1 \hat{z}^\uparrow + I_2 w_2 \hat{y}^\uparrow + I_3 w_3 \hat{x}^\uparrow \]

\[ + I_2 w_2 w_3 \hat{z}^\uparrow - I_1 w_1 w_3 \hat{y}^\uparrow - I_3 w_2 w_3 \hat{z}^\uparrow + I_1 w_1 w_2 \hat{x}^\uparrow \]

\[ + I_3 w_1 w_3 \hat{y}^\uparrow - I_2 w_1 w_2 \hat{x}^\uparrow \]
Or in component form:

\[ \tau_7 = I_1 w_1 + (I_2 - I_3) w_2 w_3 \]
\[ \tau_y = I_2 w_2 + (I_3 - I_1) w_1 w_3 \]
\[ \tau_x = I_3 w_3 + (I_1 - I_2) w_1 w_2 \]

If \( \tau_r = 0 \), initially only \( w_2 \) is nonzero.

Immediately after the asteroid hits, \( w_1 \) and \( w_3 \) are initially small but nonzero. Let:

\[ w_1 = w_{10} e^{s^t} \quad (s \text{ complex}) \]
\[ w_3 = w_{30} e^{s^t} \]

In (2), \( w_1 w_3 \approx E^2 \) and can be neglected.

Thus, \( I_2 \dot{w}_2 = 0 \) and \( w_2 \) can be taken as constant.

\( I_1 \dot{w}_1 + (I_2 - I_3) w_2 w_3 = 0 \) \( (1) \)

\( I_3 \dot{w}_3 + (I_1 - I_2) w_1 w_2 = 0 \) \( (3) \)

\[ w_3 = \frac{1}{s I_3} \left( \frac{I_2 - I_1}{I_1} \right) w_2 w_1 \]

\[ s I_1 w_1 + (I_2 - I_3) w_2, \quad s \frac{1}{I_3} \left( \frac{I_2 - I_1}{I_1} \right) w_2 w_1 = 0 \]

\[ s^2 I_1 I_3 + w_2^2 \left( \frac{I_2 - I_3}{I_1} \right) \left( \frac{I_2 - I_1}{I_1} \right) = 0 \]
\[ s^2 = -\frac{w_2^2 (I_2 - I_3)(I_2 - I_1)}{I_1 I_3} \]

Since \( I_1 > I_2 > I_3 \), \( s^2 > 0 \)

Thus, \( w_1 \) and \( w_3 \) represent a superposition of exponentially growing and exponentially decaying solutions.

The growing solution dominates and the motion is perturbed strongly.

\[ \tau = \frac{1}{3} \dot{w}_2 \sqrt{\frac{I_1 I_3}{(I_2 - I_3)(I_2 - I_1)}} \]

Solving for \( w_2 \):

In the rotating frame:

\[ \ddot{\mathbf{r}} = -G \frac{m^2}{(d+L)^2} \quad (\text{Force on the center of one panel is due to only the other panel by symmetry, also approx. constant}) \]

\[ \ddot{\mathbf{a}}_{\text{lab}} = \ddot{\mathbf{a}}_{10d} + \dot{\omega}_2 \times \mathbf{v} \]

\[ -\frac{g}{d} = -G \frac{m}{(d+L)^2} - w_2 \dot{w}_2 \frac{1}{2} (d+L) \]

\[ \frac{g}{3(d+L)} - 2G \frac{(d+L)^3}{(d+L)^3} = w_2^2 \]

\[ w_2 = \sqrt{\frac{g}{3(d+L)} - 2G \frac{m}{(d+L)^3}} \]