# MOMENT OF INERTIA

$\rho$ DEFINED IN BODY FIXED REF FRAME

$$J_I = \int_B S(\rho)^T S(\rho)\, dm$$

EQUIVALENT TO $\quad S(\rho)^T S(\rho) = (\rho^T \rho) I_{3\times 3} - \rho \rho^T = tr[\rho \rho^T] I_{3\times 3} - \rho \rho^T$

$$J_I = \int_B [(\rho^T \rho) I_{3\times 3} - \rho \rho^T]\, dm$$
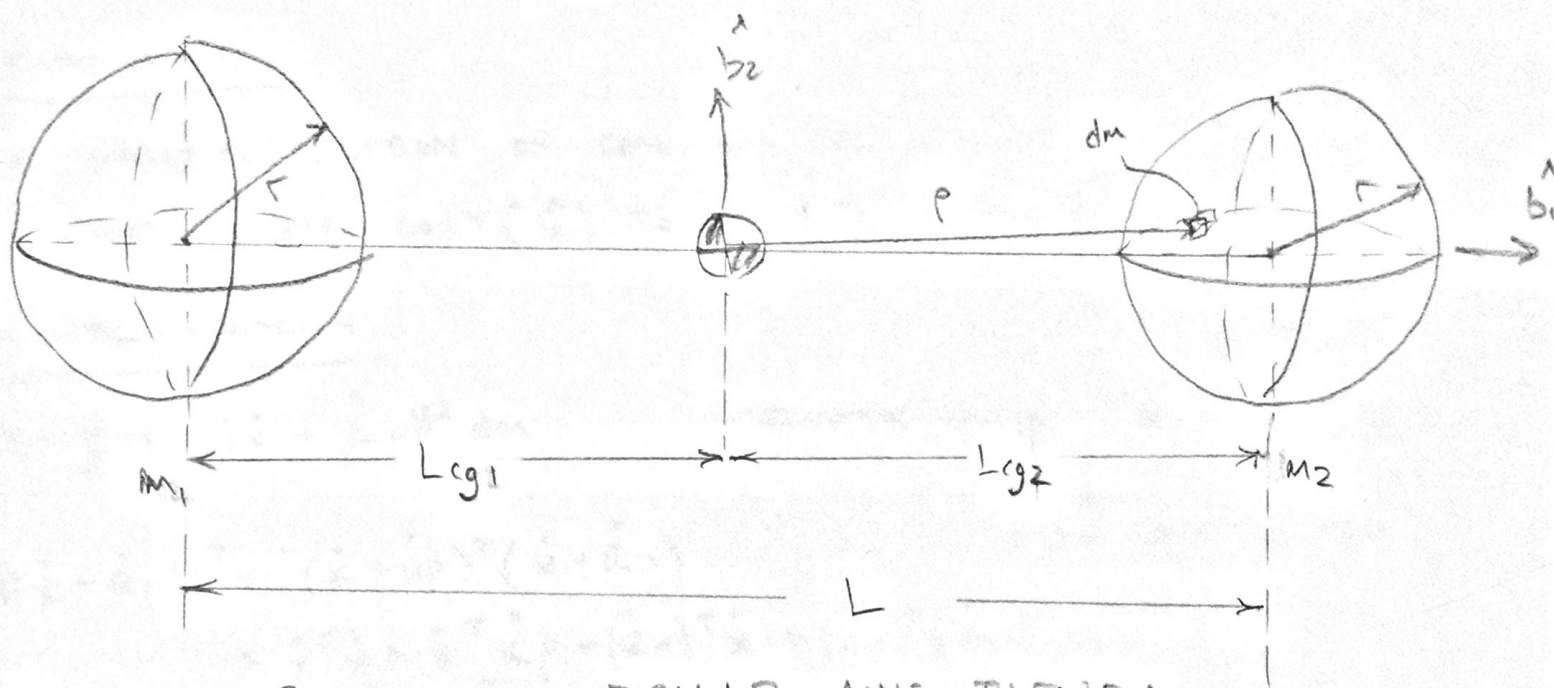


$$I_S = \frac{2}{5} M r^2$$

$$I_{11} = \frac{2}{5} M_1 r^2 + \frac{2}{5} M_2 r^2$$

$$I_{22} = \frac{2}{5} M_1 r^2 + M_1 L_{cg1}^2 + \frac{2}{5} M_2 r^2 + M_2 L_{cg2}^2$$

$$I_{33} = I_{22}$$

$$\boxed{L_{cg1} = \frac{M_2}{M_1 + M_2} L = L_{cg1} \hat{b}_1}$$