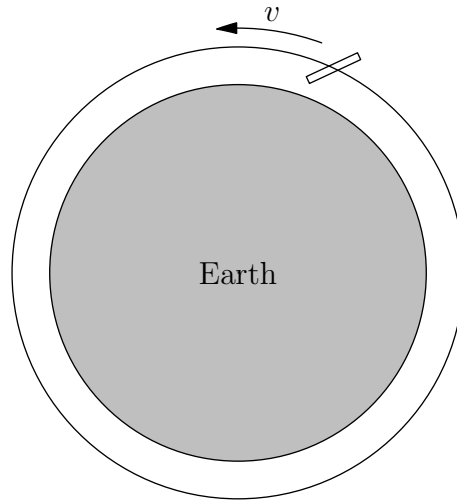# M05M.3 - Satellite Orientation

Problem

The orientation of a satellite in low-Earth orbit can be stabilized with gravity gradients. Let the satellite be a long cylinder of length L and radius a ($a \ll L$). The distribution of the mass m is uniform within the cylinder. The satellite is in a circular orbit around Earth with a period T_{or}. Express your answers to parts b), c) and d) in terms of T_{or}, L and a.

a)   What is the stable equilibrium orientation, for which the satellite appears to be at rest in a coordinate system rotating with the same angular velocity as the orbital motion?

b)   What is the period T_π of small oscillations about equilibrium in the orbital plane?

c)   What is the period T_σ of small oscillations about equilibrium perpendicular to the orbital plane?

d)   The satellite is given a small angular speed ω around its long axis. To first order in ω, find the new stable-equilibrium orientation of the satellite, where the direction of the long axis appears to be fixed in the rotating coordinate system.