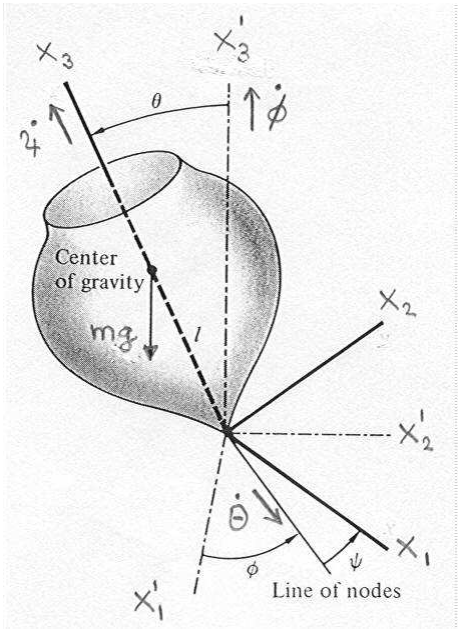
Heavy symmetric top: rotation, precession, and nutation [msl49]

Representation of
inertial cordinate system (x_1', x_2', x_3')
and body coordinate system (x_1, x_2, x_3).

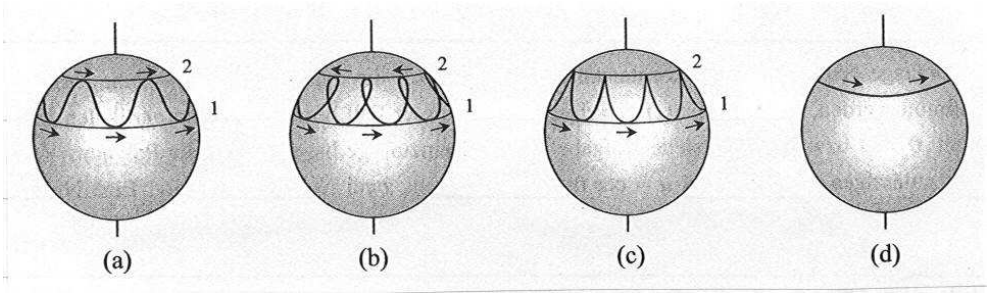


Rotation $\dot{\psi}$ about body 3-axis.
Precession $\dot{\phi}$ about inertial 3-axis.
Nutation $\dot{\theta}$ about line of nodes.

[Goldstein 1981]

Types of precession:

(a) Monotonic precession: $\dot{\phi}$ does not change sign.
(b) Looping precession: $\dot{\phi}$ changes sign.
(c) Cusp-like precession: $\dot{\phi} = \dot{\theta} = 0$ at $\theta = \theta_2$.
(d) Steady precession: $\theta = \text{const}$.



[Goldstein1981]