The symmetric top

Both an exercise in the Lagrangian formalism, as well as in rigid body motion – moments of inertia, body system, It also serves as a good example in analyzing differential equations without having to solve them.



1 Problem

The analysis of the spinning top is thoroughly presented in Goldstein ??. In the end of the day, only simple differential equations are solved, and no complicated one. The crux is to analyze the problem systematically in different parameter regimes. This is very common in physics, and thereby this assignment is a good exercise in that sense. Of course, if you are ambitious (not expected) you can complement your analysis with a numerical study to compare/confirm the analytical derivations in Goldstein.

Assignment 2

For you actual task. Begin by stating the problem, introduce the relevant variables and derive the Lagrangian and the Hamiltonian. For the further analysis, derive the equations-of-motion. Describe the quantitative different motion of Figure 5.9 in Goldstein, and the meaning of "rotation", precession and nutation. By analyzing different settings, explain how do these types of motion of the top couple via gravity? What is meant by a fast top? What can we say about I_1 , I_2 and I_3 and the shape of the top? Finally, explain shortly the ideas behind a gyroscope.

References

[1] Goldstein, chapter 5.7.