TFY4345 Classical Mechanics. Department of Physics, NTNU.

ASSIGNMENT 12

Question 1

Show that

$$[p_i, L_j] = \varepsilon_{ijk} p_k$$

and that

$$[x_i, L_j] = \varepsilon_{ijk} x_k$$

Here, $[\cdots]$ denotes a Poisson bracket, whereas p_i , L_i and x_i is cartesian component nr *i* of the momentum p, the angular momentum L, and the position vector r, respectively.

Question 2

a) Find the velocity components of \boldsymbol{u} in the inertial system S in terms of the components of $\boldsymbol{u'}$ in the system S'. The system S' has velocity $v \hat{z}$ relative to S. Assume that the particle is instantaneously at rest in S' (i.e., $\boldsymbol{u'} = 0$), and that its acceleration in this system is $\boldsymbol{a'}$. Show that the acceleration components $a_i = du_i/dt$ in S are

$$a_x = (1 - \beta^2) a'_x$$

$$a_y = (1 - \beta^2) a'_y$$

$$a_z = (1 - \beta^2)^{3/2} a'_z$$

b) A radioactive ⁵⁷Co sample is located on the circumference of a rotating disk The speed of the circumference is u. The emitted radiation is received by an observer in the centre of the rotating disk. Let ν^0 be the radiation frequency in the inertial system where the sample is at rest, and find the frequency ν of the observed radiation.



Figure 1: Rotating disk with radioactive sample.