

Spacetime and Gravity: Assignment 5

In what follows, unless otherwise stated, we will use units such that the speed of light, $c=1$.

1

Consider ordinary two dimensional flat spacetime in Cartesian coordinates with line element:

$$ds^2 = -dt^2 + dx^2. \quad (1)$$

Now consider a non inertial coordinate system (t', x') given by:

$$t' = t, \quad x' = x - vt - \frac{1}{2}at^2. \quad (2)$$

- a) What is the metric in these coordinates?
- b) What is the inverse metric?
- c) What is the Christoffel Symbol, Γ_{tt}^x ?
- d) What is the geodesic equation for x' in the nonrelativistic limit where $t=s$?

2

Consider an ordinary flat three dimensional spacetime in polar coordinates (t, r, θ) .

Write out the metric in these coordinates.

The coordinates associated with an observer rotating at constant angular velocity ω are given by: (t', r', θ') and are related to the usual coordinates by:

$$t' = t, \quad r' = r, \quad \theta' = \theta + \omega t. \quad (3)$$

- a) What is the metric in these coordinates?
- b) What is its inverse?
- c) What is the christoffel symbol Γ_{tt}^r ?
- d) What is the radial component of the geodesic equation?
- e) Thus, taking the “classical” limit where $s=t$, calculate the force felt by an observer moving in circular motion with constant angular velocity. What is this force normally called?