

PH523 Assignment No. 1

Due date: September 15, 2003

1. Show that the relativistic motion of a particle in an attractive inverse square law of force is a precessing ellipse. Compute the precession of the perihelion of Mercury resulting from this effect. [Answer: 7'' per century. This is much smaller than the actual precession of 40'' per century. The latter value is obtained by using general relativity.]
2. A generalized potential suitable for use in a covariant Lagrangian for a single particle is

$$\mathcal{U} = -A_{\lambda\nu}(x_\mu)u^\lambda u^\nu ,$$

where $A_{\lambda\nu}$ stands for a symmetric world tensor of the second rank and u^ν are the components of the world velocity. If the Lagrangian is

$$\mathcal{L} = \frac{1}{2} m u_\nu u^\nu - \mathcal{U}$$

obtain the Euler - Lagrange equations of motion. What is the Minkowski force? Give the components of the force as observed in some Lorentz frame.