January 24, 2004

PHYS 5970 sec. 001  (Cosmology)
Assignment #2
Due 1:30pm Wednesday January 28, 2004

Read: Sections 17.1 through 17.3 of Rindler.

Work: Exercises 16.11, 17.1 and the following,

Show by direct substitution that the spatial part of the FRW \( k = -1 \) model
\[
\frac{dr^2}{1 + \eta^2} + \eta^2 (d\theta^2 + \sin^2 \theta d\phi^2),
\]
has the same metrical structure as a 3-dimensional mass-shell in Minkowski space.

Minkowski space is the 4-dimensional space of special relativity and its metric is
\[
(ds)^2 = -(dw)^2 + (dx)^2 + (dy)^2 + (dz)^2. \tag{1}
\]
A mass shell in this space is defined by the 3-dimensional surface for which
\[
-w^2 + x^2 + y^2 + z^2 = 1. \tag{2}
\]
A metric on this 3-dimensional space is given by (1) by simply restricting the points \((w, x, y, z)\) to satisfy (2). Only 3 coordinates (e.g., \(x, y, z\)) are needed to label all points in this shell and when spherical polar coordinates \((\eta, \theta, \phi)\) are substituted for the rectangular Cartesian coordinates the spatial part of the \( k = -1 \) FRW metric results.