

HOMEWORK #2 (Due 5:00 pm April 9th)

Problem 1: Geometry of Curved Space – Metric

In ordinary three dimensional space, we can write the distance between two nearby points (R, θ, Z) and $(R + dR, \theta + d\theta, Z + dZ)$ as $ds^2 = dR^2 + R^2 d\theta^2 + dZ^2$ using cylindrical coordinates. The equation $R^2 + Z^2 = R_c^2$ describes a sphere of radius R_c .

(a) Show that if the two points lie on this sphere, then the distance between them is

$$ds^2 = dR^2 \left(1 + \frac{R^2}{Z^2}\right) + R^2 d\theta^2 = R_c^2 \left[\frac{d\sigma^2}{1 - \sigma^2} + \sigma^2 d\theta^2\right] \quad (1)$$

where $\sigma = R/R_c$

(b) For what value of the curvature parameter κ does the Robertson-Walker metric, resemble the equation above? Do we call this a closed, open, or flat geometry?

Problem 2 (3 pts): **Non-Euclidean Geometry – Angular Diameters**
Do Ryden 3.2.

Problem 3 (3 pts): **Non-Euclidean Geometry – Measuring Curvature**
Do Ryden 3.3

Problem 4 (3 pts): **Critical Density**
Ryden 4.4