

Exercise	1	2	3	Total
100%	3	3	6	12
Points				

## Extragalactic Astronomy and Cosmology

Homework 1 - Lecture 2 & 3 - distances, equivalent principle, Hubble relation

**Due date: September 12**

### 1 Parallax

The parallax angle of  $\alpha$  Centauri is  $0.75''$

Find the distance to  $\alpha$  Centauri in units of  
(a) parsecs; (b) light-years; (c) AU; (d) m

### 2 Cross section

Assume a Universe with an average galaxy density of  $\rho = 0.9 \text{ Mpc}^{-3}$ . Each galaxy has an average diameter of 30 kpc. How far could you see on average in any direction before your line of sight would hit a galaxy? Assume an Euclidian space and an infinitely large, infinitely old Universe.

### 3 Tired light

Alternatively to our explanation of an expanding Universe there was the explanation of the Hubble relation called the “tired light hypothesis”<sup>1</sup>. The tired light hypothesis states that the Universe is not expanding, but that photons simply lose energy as they move through space, with the energy loss per unit distance being given by

$$\frac{dE}{dr} = -CE \quad (1)$$

where  $C$  is a constant. Show that this hypothesis gives a distance-redshift relation that is linear in the limit  $z \ll 1$ . What must the value of  $C$  be in order to yield a Hubble constant of  $H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ? You might find it useful to read Section 2.3 of Ryden..

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<sup>1</sup>Actually, there are still people who believe in this hypothesis