Extra-Galactic Astronomy I (Cosmology)

Assignment 1

Total marks: 30

(will be scaled to 10% of final total)

All questions are compulsory. Please hand in your answer sheets no later than **5pm Friday 20 January 2017**.)

1 FLRW times and distances

1.1 Matter and radiation *(11 marks = 3+3+3+2)*

Consider a spatially flat cosmology with non-relativistic matter and radiation, i.e., $\Omega_{m0} + \Omega_{R0} = 1$, $\Omega_{\Lambda 0} = 0 = \Omega_{k0}$. Find analytical expressions for the following quantities:

1. $\chi_{\text{source}}(z)$ [comoving distance to a source at redshift z]

2. χ_{P} [particle horizon evaluated at the present epoch]

3. $H_0 t_0$ [present age of the Universe, in units of the inverse Hubble constant]

4. q_0 [deceleration parameter at present epoch]

1.2 Matter or radiation *(8 marks = 4+4)*

Take appropriate limits above and calculate $\chi_{\text{source}}(z)$, χ_{P}, $H_0 t_0$ and q_0 for a spatially flat cosmology that is

1. dominated by matter (Einstein-deSitter universe).

2. dominated by radiation.

1.3 Open or closed *(11 marks = 3+3+3+2)*

Repeat 1.1 above for a universe with non-relativistic matter and spatial curvature, i.e., $\Omega_{m0} + \Omega_{k0} = 1$, $\Omega_{\Lambda 0} = 0 = \Omega_{R0}$, considering both $\Omega_{k0} > 0$ (open) and $\Omega_{k0} < 0$ (closed) models.