4300430: Introdução à Cosmologia Física

Problem Set 4

(Due October 01, 2024)

1) Distance-Redshift relation: (worth 10.0 points)

In this problem, you will compute distances as a function of redshift **numerically**. For the comoving radial distance $D(z)$ you will need to compute numerically the integral

$$D(z) = \int_0^z \frac{dz}{H(z)} \quad (1)$$

$$H(z) = H_0\sqrt{\Omega_k(1+z)^2 + \Omega_{\rm m}(1+z)^3 + \Omega_{\rm r}(1+z)^4 + \Omega_{\rm DE}(1+z)^{3(1+w)}} \quad (2)$$

$$\Omega_k = 1 - (\Omega_{\rm m} + \Omega_{\rm r} + \Omega_{\rm DE}) \quad (3)$$

From $D(z)$ you can obtain other distance definitions. I **highly** suggest you write a program in C/C++ or Fortran or Python so you can easily combine with other cosmological codes later. You can then find a free numerical integrator (e.g. Simpson, Romberg, etc) to incorporate to your program. Plot the 3 distances (radial, angular-diameter and luminosity) as a function of redshift z for the fiducial case and cosmology variations indicated in problem set 3).