

## 1 Problem 1: Conformal Time and Horizons

- Assume the universe today is flat with both matter ( $\Omega_m$ ) and a cosmological constant ( $\Omega_\Lambda$ ). (a) Compute the conformal age or horizon of the universe and plot your result for  $H_0\eta_0$  as a function of  $\Omega_m$ . [numerically integrate for a few values and sketch the behavior] (b) What is the current horizon size for a universe with  $\Omega_m = 1/3$  and  $h = 1/\sqrt{2}$ ? (c) What is the mass contained within the current horizon in solar masses. If all objects were  $10^{13}h^{-1} M_\odot$  in mass, how many are in the observable universe.
- Evaluate the conformal age as a function of the scale factor in the above cosmology. What happens when  $a \rightarrow \infty$ . Comment on the implications for establishing causal contact between observers currently separated by much more than a Hubble length.