

## 1 Problem 1: WMAP Data and Models

- (a) Goto <http://lambda.gsfc.nasa.gov/product/map/current>. Download the combined TT power spectrum and read the description.
- (b) Goto <http://www.cmbfast.org> download CMBFAST, read the documentation and compile. Run CMBFAST for  $\Omega_v = 0$  and  $\Omega_{\text{tot}} = \Omega_b + \Omega_c = 0.5, \dots, 1.5$  in steps of 0.1. These are open and closed models with no cosmological constant. For the other parameters, hold  $\Omega_b h^2 = 0.022$  and  $\Omega_c h^2 = 0.108$  (or  $\Omega_m h^2 = 0.13$ ) fixed by adjusting  $H_0$  appropriately. You may set the other parameters to their default values indicated in parentheses.
- (c) Plot your results for  $\ell(\ell+1)C_\ell/2\pi$  vs  $\log_{10} l$  of the various models vs the WMAP data; include the error bars from cosmic and noise variance. Which model agrees best? [Remember that you can adjust the normalization from the default that CMBFAST gives you.]
- (d) Extra credit: test out other parameters described in class and verify the qualitative behavior and/or plot out the relative likelihood of  $\Omega_{\text{tot}}$  models.