Astronomy 128: Galaxies and Galactic Structure

Week 11, Thursday, April 6

Topic: Large-scale Structure

This week we'll step beyond clusters of galaxies, and look at their clustering on even larger scales. We'll see that the distribution is not random, but that clusters themselves are clustered into walls and voids, in a sponge-like structure. Observationally, it appears that we finally reach the scale of broad homogeneity on scales somewhere around several hundred Mpc. We'll look at how to quantify clustering, and our theoretical understanding of how these structures formed and evolved, and are continuing to evolve today.

Break: Victoria

Reading: Chapter 7 of Sparke & Gallagher, through Section 7.3. Read Section 7.4 if you like; it has some interesting material. I'll also photocopy for you the draft Ch. 7 from the new Sparke & Gallagher. You don't have to read it for this week, but you might find it handy to keep for reference if you come back to this material on cosmology; it is much expanded and updated, since it includes the contribution of the cosmological constant Λ, something that is sorely lacking from the cosmology in the edition we're using.

Problems:

NOTE: We'll continue our requirement from last week of giving a few sentences of explanation/context for each problem we do from Sparke & Gallagher. If you have time, I'd appreciate knowing what you think of this; either stop by to let me know, or drop me an e-mail.

1. Come to class with at least one *written* question on the reading.
2. (a) SG 7.1.

   (b) SG say that the density of galaxies in a galaxy cluster is only 10–100 times larger than the overall average space density of galaxies. What is this comparison for *stars* in a *galaxy*? Find the average space density of stars in the Local Group (explain any assumptions/approximations you use), and compare it to the space density of stars within the Milky Way.

3. Estimate the maximum distance at which one can use the surface brightness fluctuation method to find the distance of an elliptical galaxy. Give an answer both for observations made with a ground-based telescope (without adaptive optics), and the Hubble Space Telescope.

4. SG 7.2.

5. SG 7.3.

6. In Figure 7.5, why do you think the authors surveyed a region with such an elongated shape ($4° \times 49'$)?

7. Explain Eq. 7.1, the defining equation for the two-point correlation function $\xi(r)$, in words. That is, why does it take the form shown?

8. SG 7.6.

9. SG 7.10. The recent observations of the CMB by the WMAP satellite show clearly that $\Omega_0 = 1$, as assumed in this problem. Even if we did not know the value of the cosmological constant (Ω_Λ), what other astrophysical observation tells us that the age of the universe can't be the value you derive in this problem?

10. SG 7.13. Don't use dice for this! It's about three lines of IDL code. (Really, you can do the calculations and plotting in three lines, though overplotting the fit and printing the coefficients may increase that to five or six.) You'll want to take a look at `randomn,` `randomu`, and `polyfit`. Use the latter to fit a straight line to your data and see what H_0 they would give. Note that SG use $\sigma = 350$ km s^{-1} in their newer edition, so use that instead of the $\sigma = 600$ km s^{-1} given in our book.