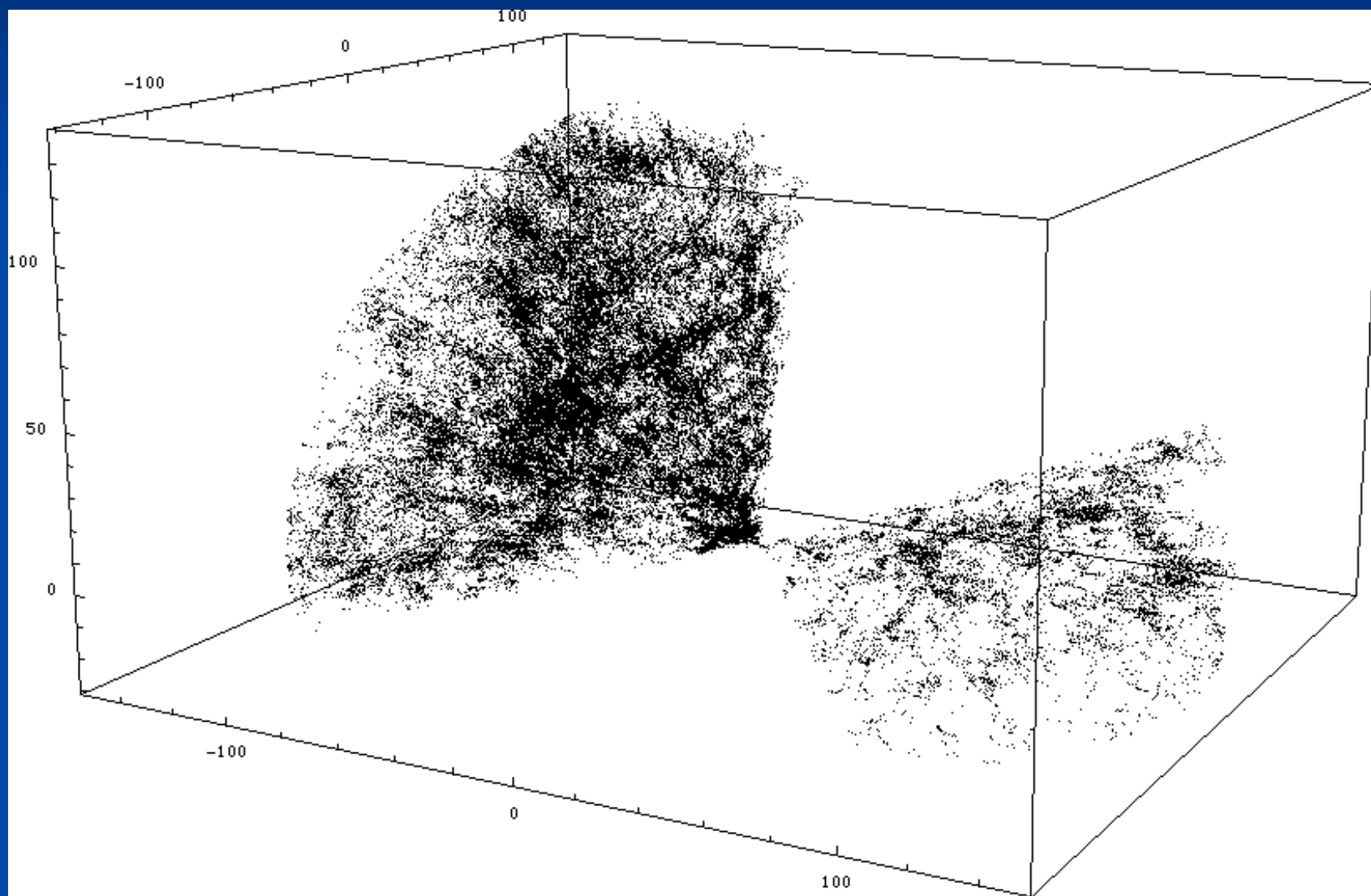


**City-City Correlations
as an
Introduction to Galaxy-Galaxy
Correlations**

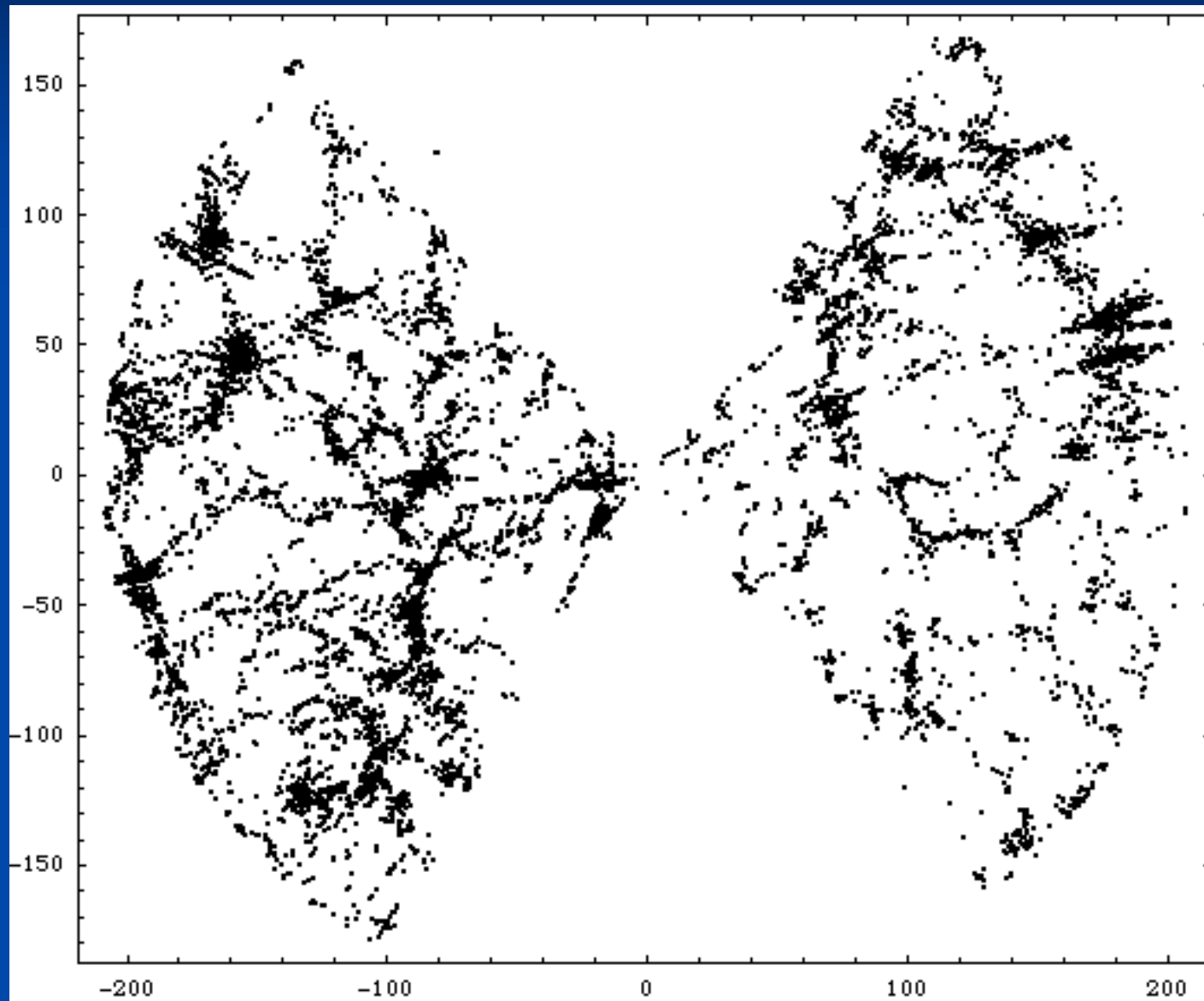
Daniel M. Smith, Jr.
South Carolina State University
Orangeburg, SC

AAPT, July 2006

SDDS Galaxies for $z < 0.05$



SDSS Slice, $z < 0.05$



Correlation Functions from SDSS Galaxy Data

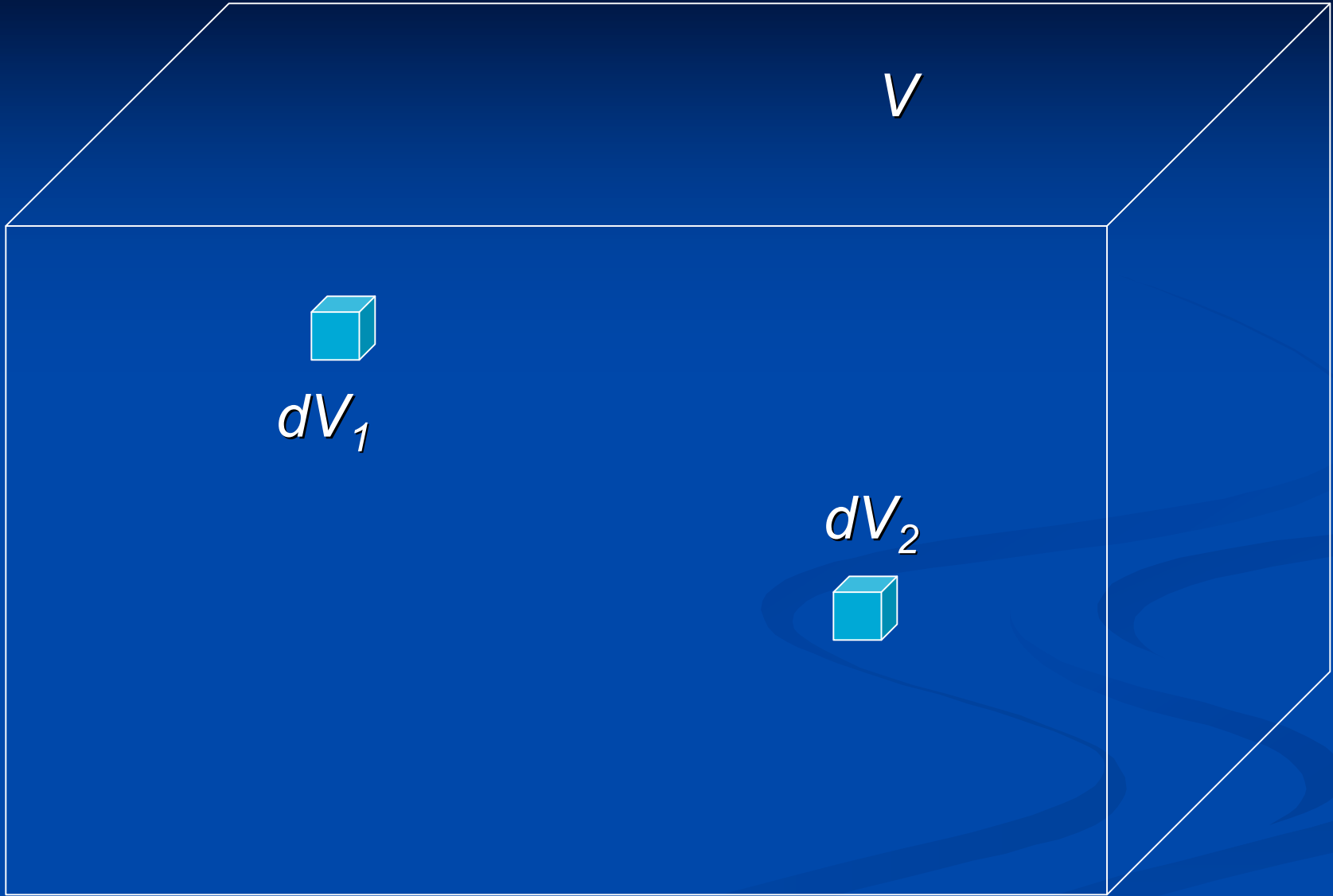
Importance:

- ❑ Study differences between early-type and late-type galaxies in Large Scale Structure
- ❑ Enables separation of peculiar velocities of galaxies from the Hubble flow
- ❑ Determination of percentage of dark matter

Two-point, Galaxy-Galaxy Correlation Function

Probability of finding a galaxy in each of the *randomly* placed volume elements dV_1 and dV_2 in a uniform distribution of galaxies is

$$dP_1 dP_2 = \frac{dV_1}{V} \frac{dV_2}{V}$$



Calculating the 2-point Correlation Function

In the presence of gravity, the probability of finding a galaxy in each of the volume elements dV_1 and dV_2 separated by a distance r is

$$dP_1 dP_2 = \frac{dV_1}{V} \frac{dV_2}{V} (1 + \xi(r))$$

$\xi(r)$ is the two-point correlation function.

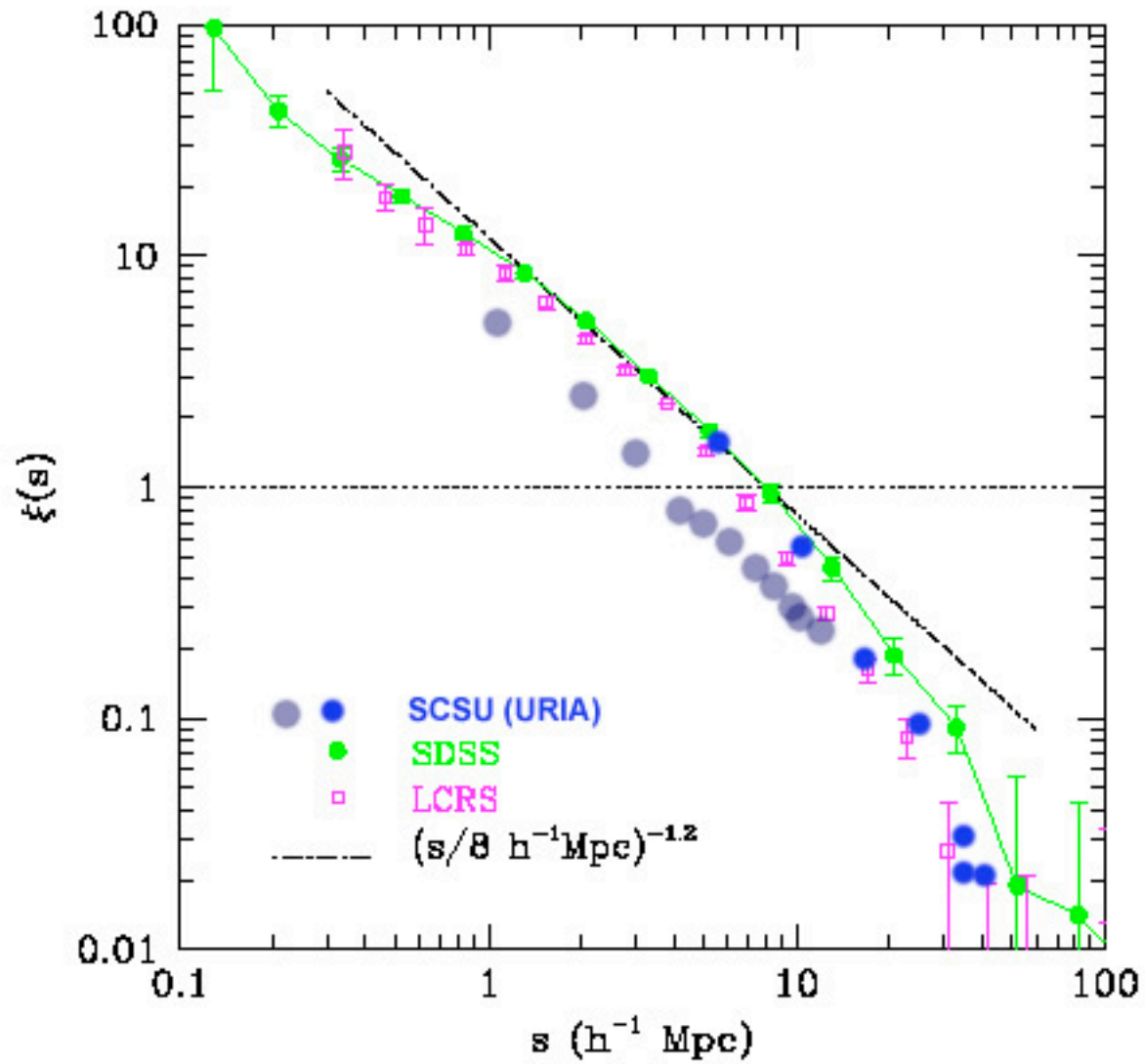
$$\xi(r) = \frac{\langle DD(r) \rangle}{\langle RR(r) \rangle} - 1$$

$\langle DD(r) \rangle$ = number of galaxy-galaxy pairs at separation r

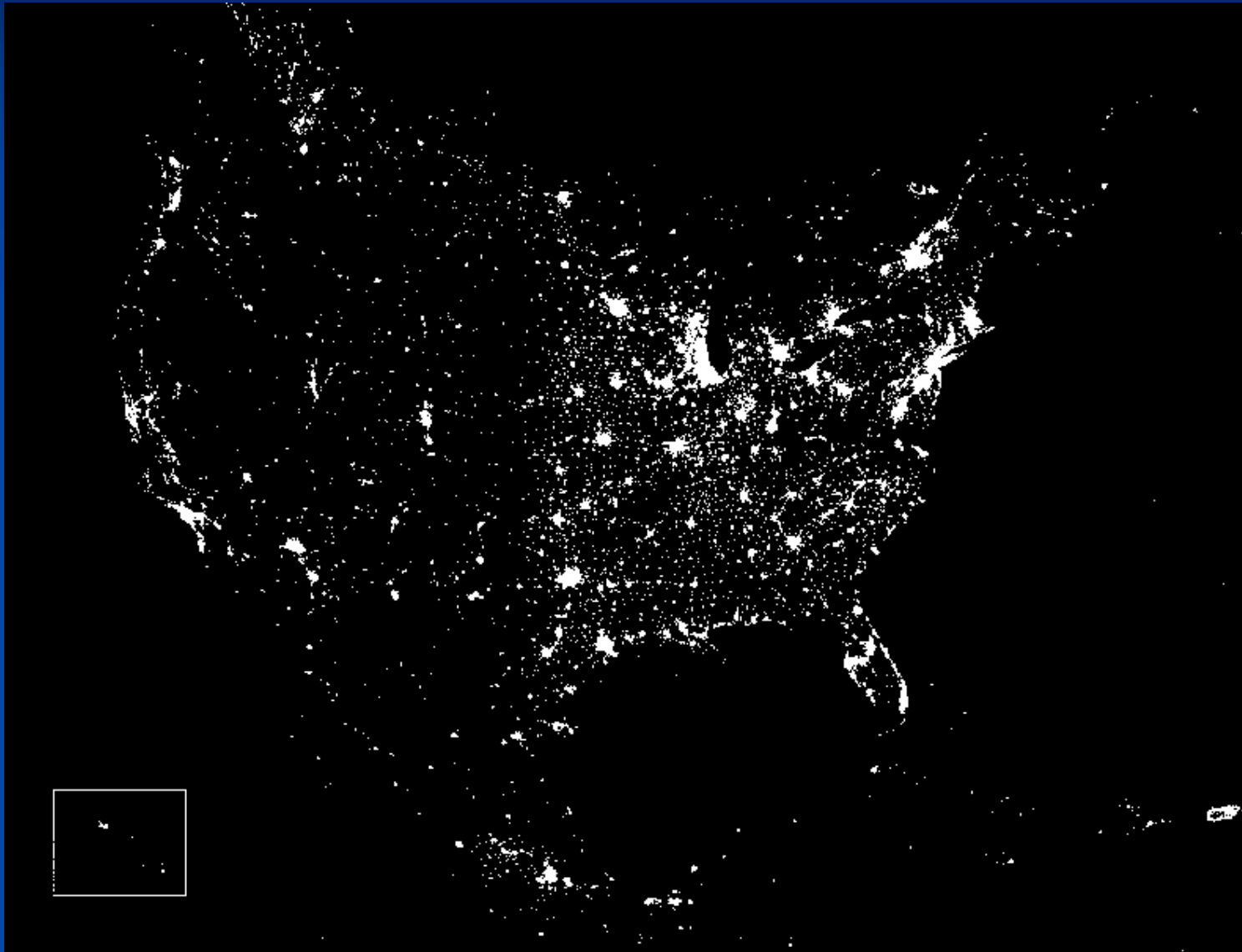
$\langle RR(r) \rangle$ = number of pairs at separation r for a random distribution of galaxies

Comparison of student calculations and published calculations:

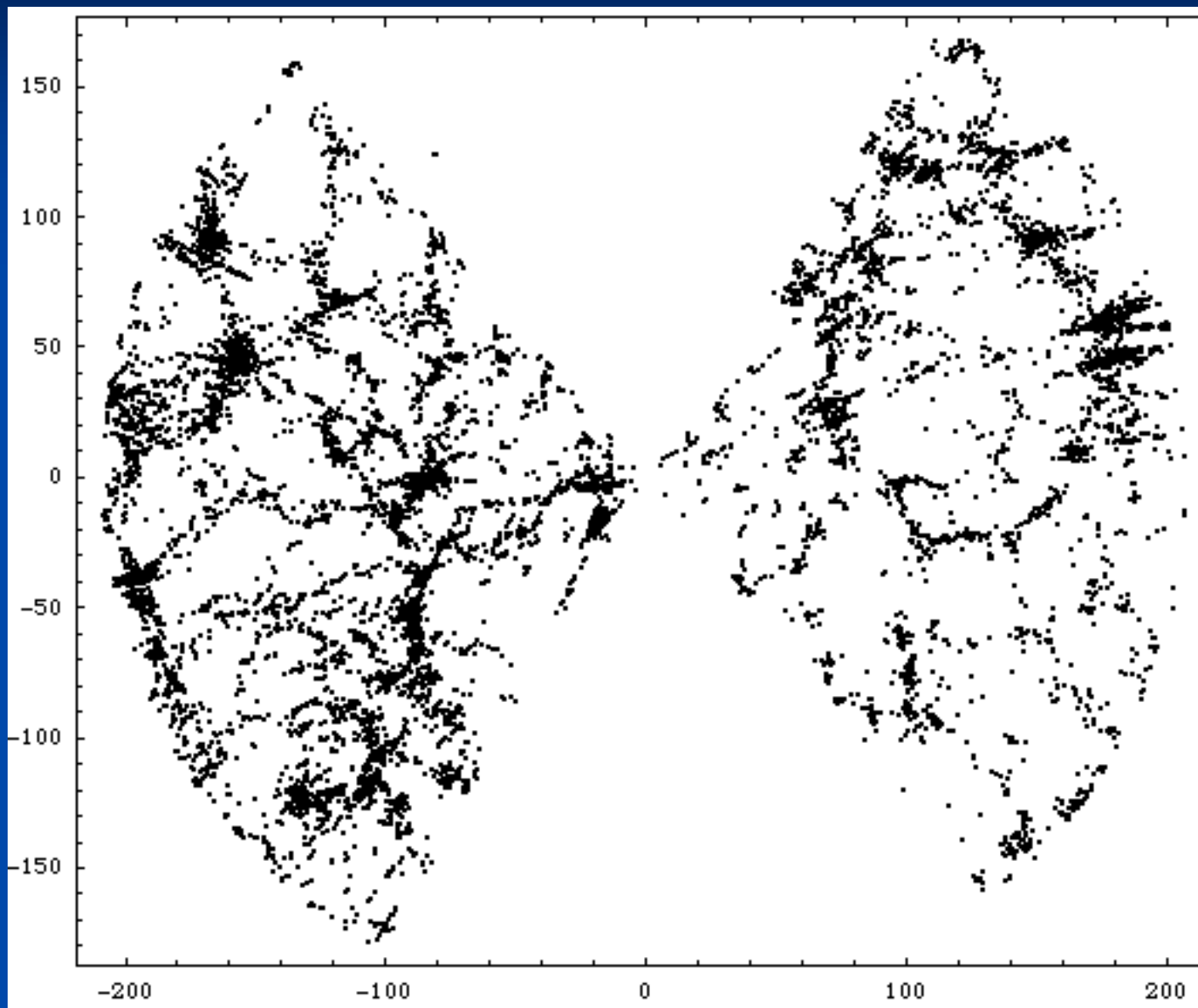
Analysis



North American Lights



SDSS Galaxies

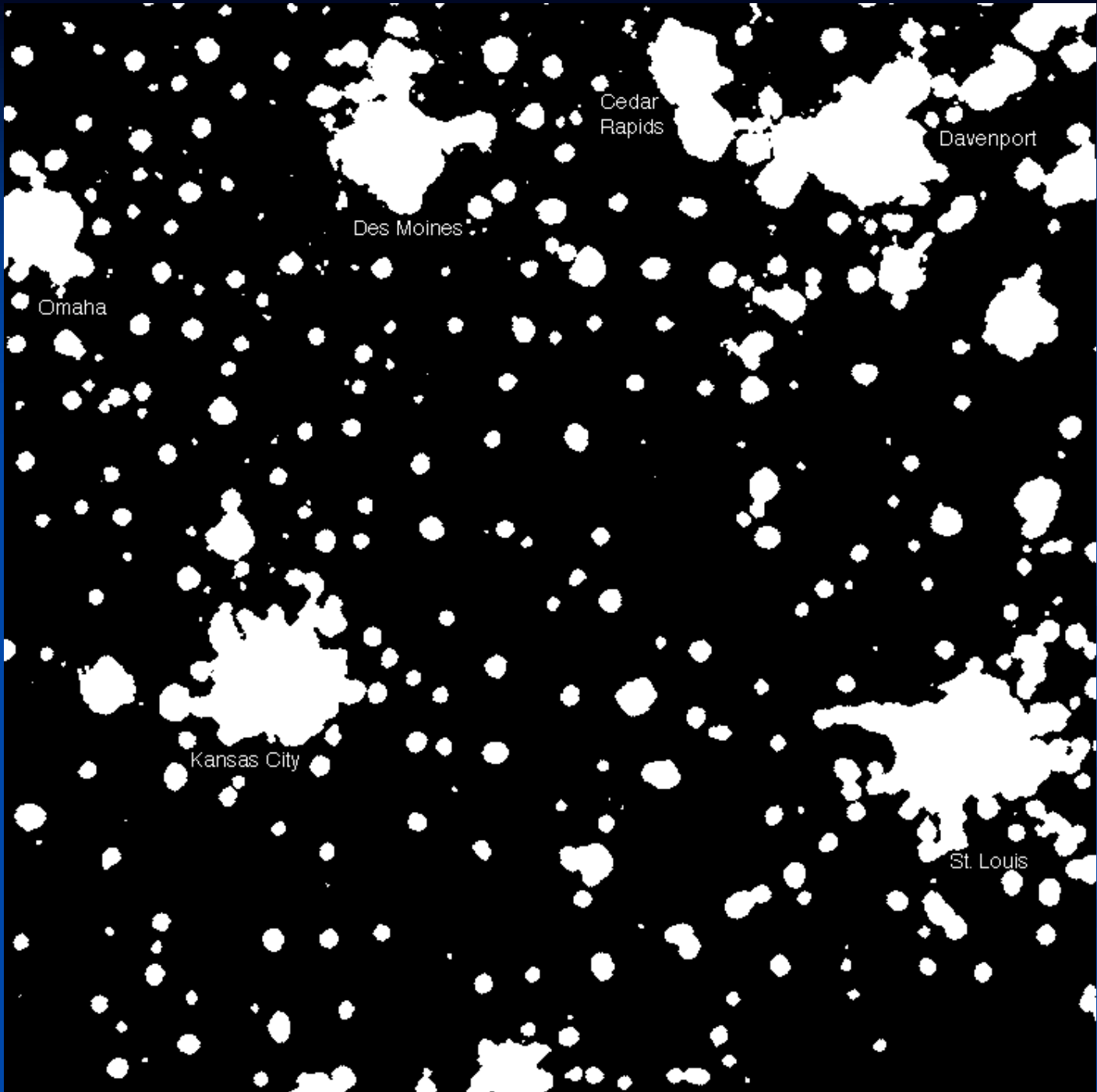


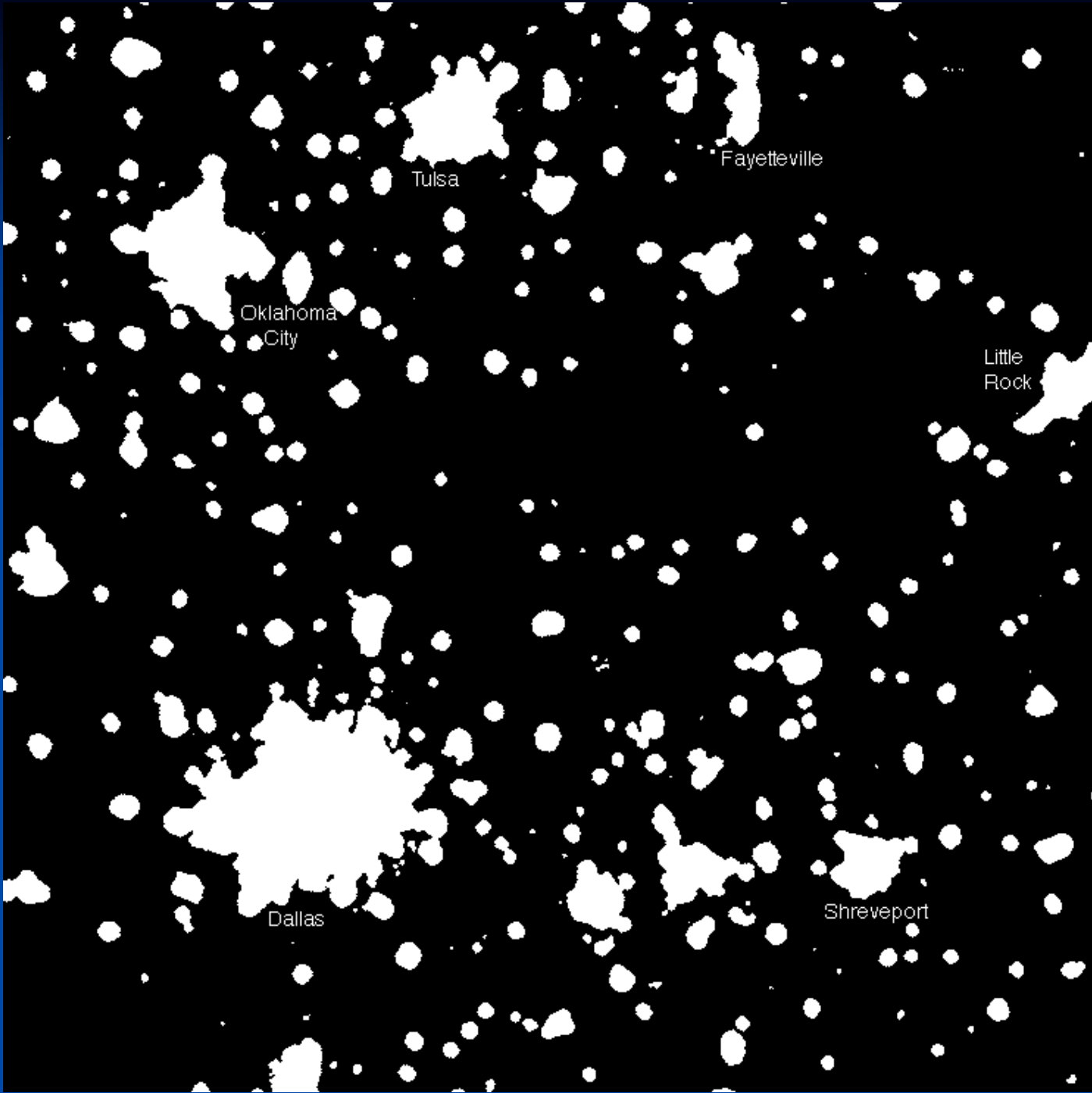
Do City Clusters Resemble Galaxy Clusters?

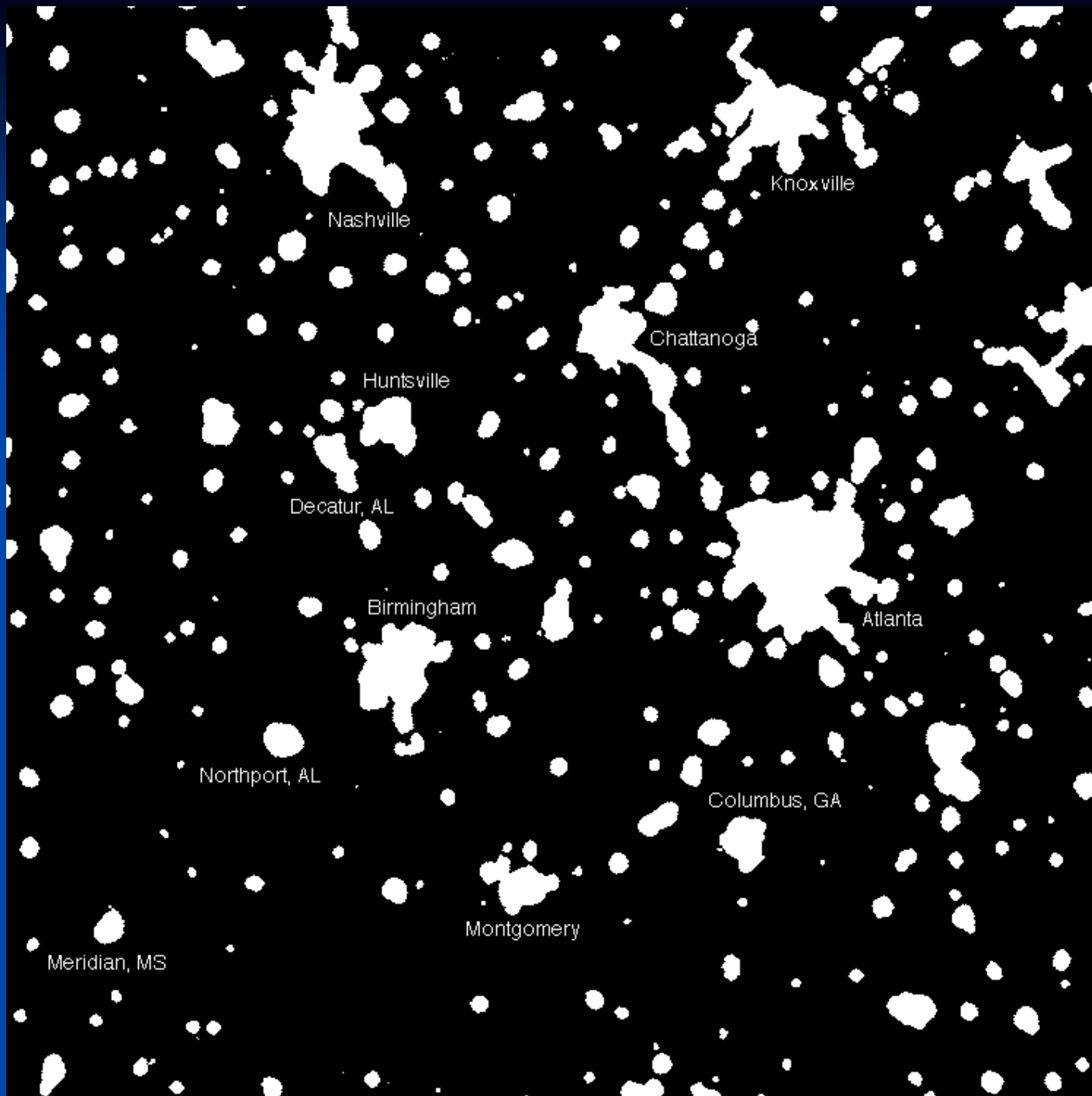
- ❑ Let 1 pixel of city light be equivalent to 1 galaxy
- ❑ Choose a group of clustered cities
- ❑ Calculate the correlation function for the cluster

Three City-Cluster Samples









Nashville

Knoxville

Chattanooga

Huntsville

Decatur, AL

Birmingham

Atlanta

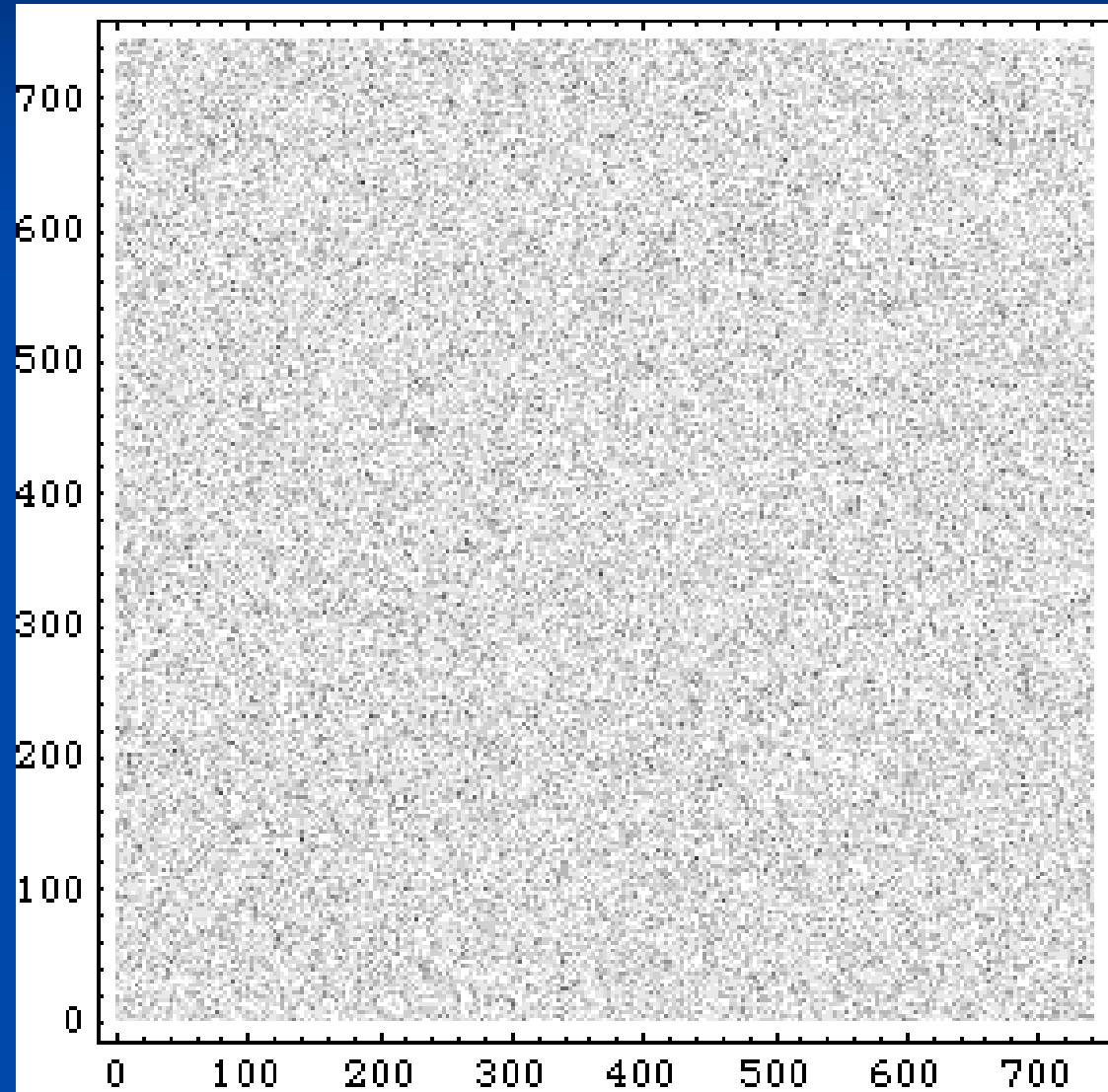
Northport, AL

Columbus, GA

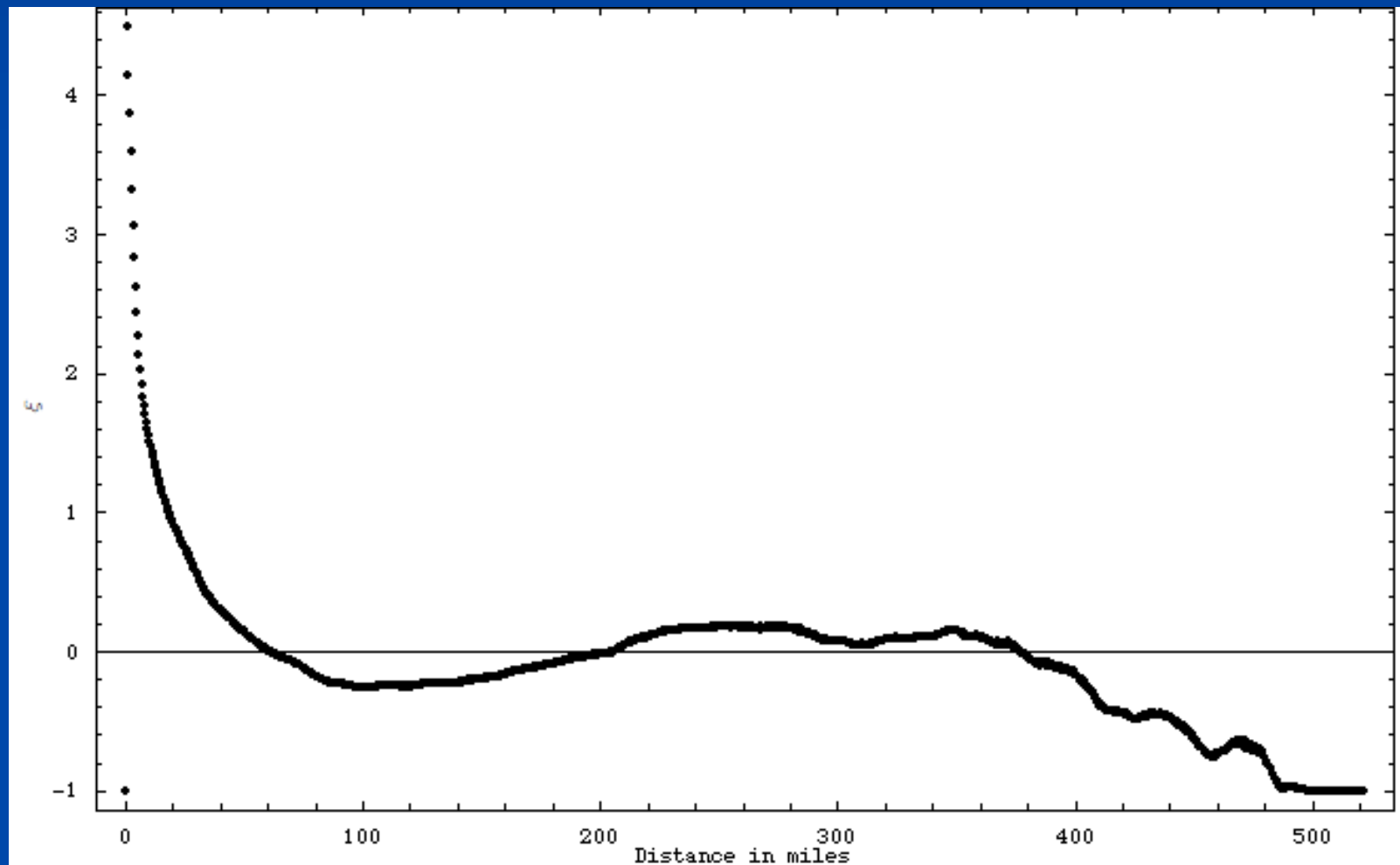
Montgomery

Meridian, MS

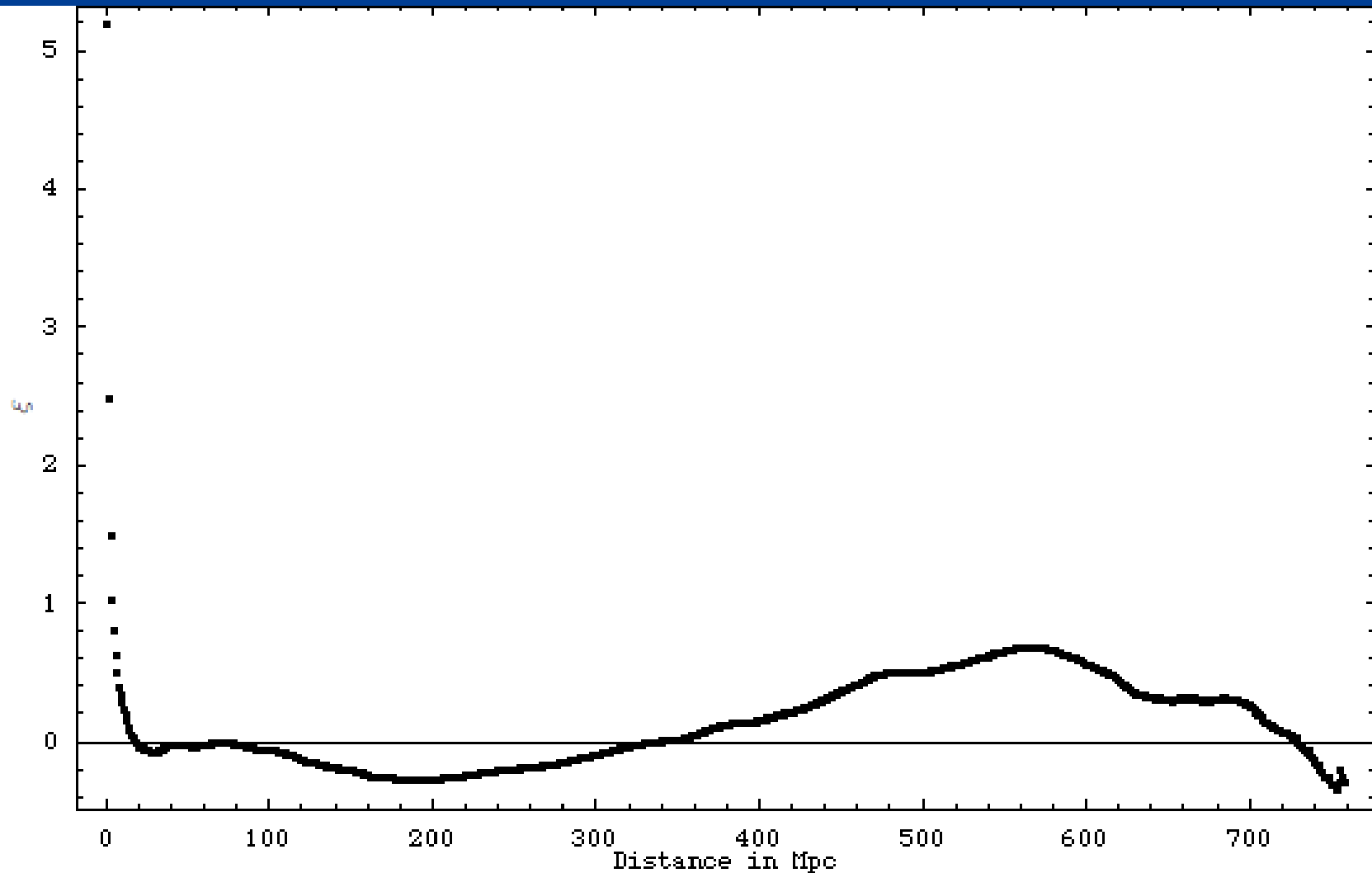
Randomly Placed City Lights



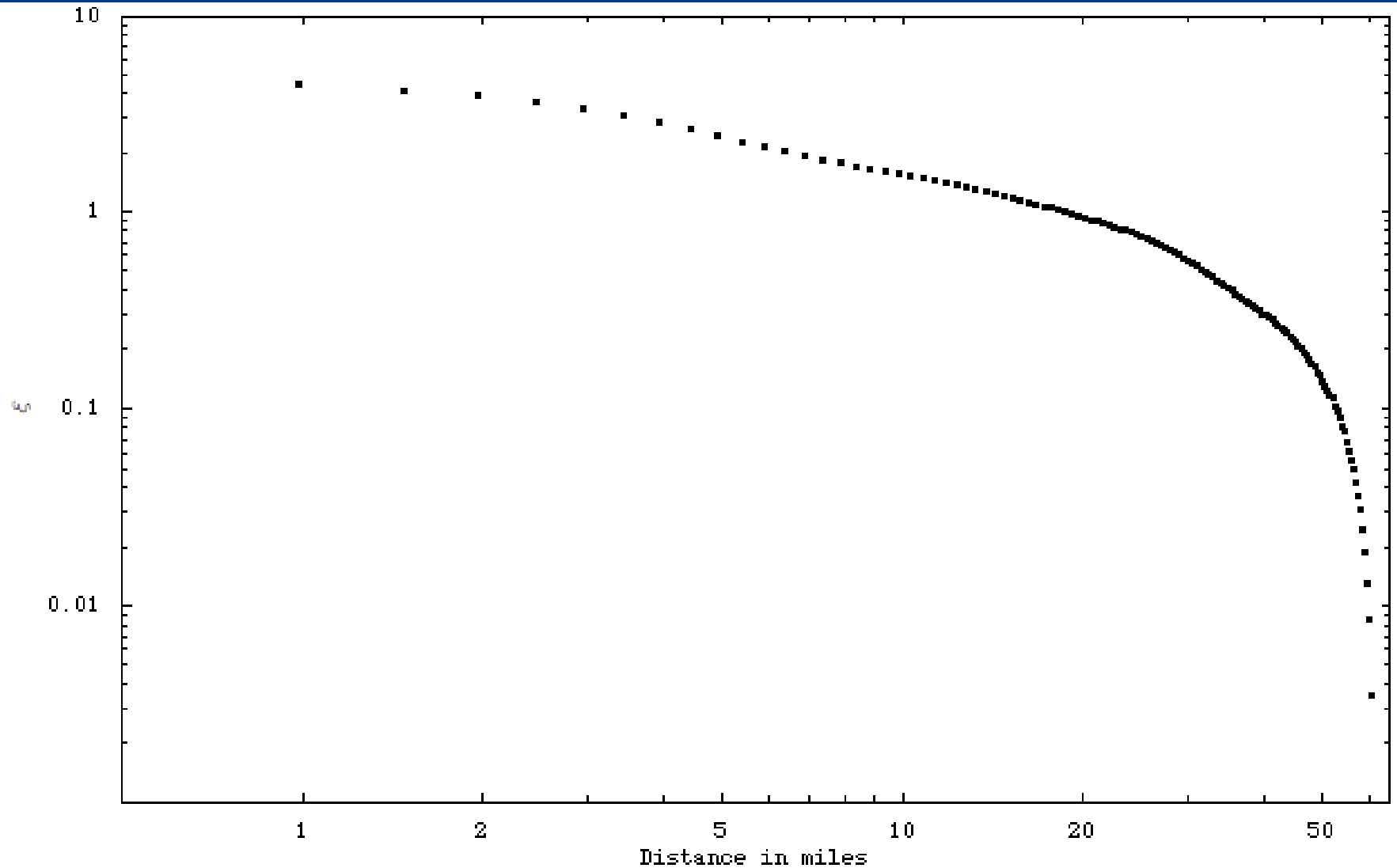
Correlation Function for Omaha, Des Moines, Cedar Rapids, K. C., St. Louis Cluster



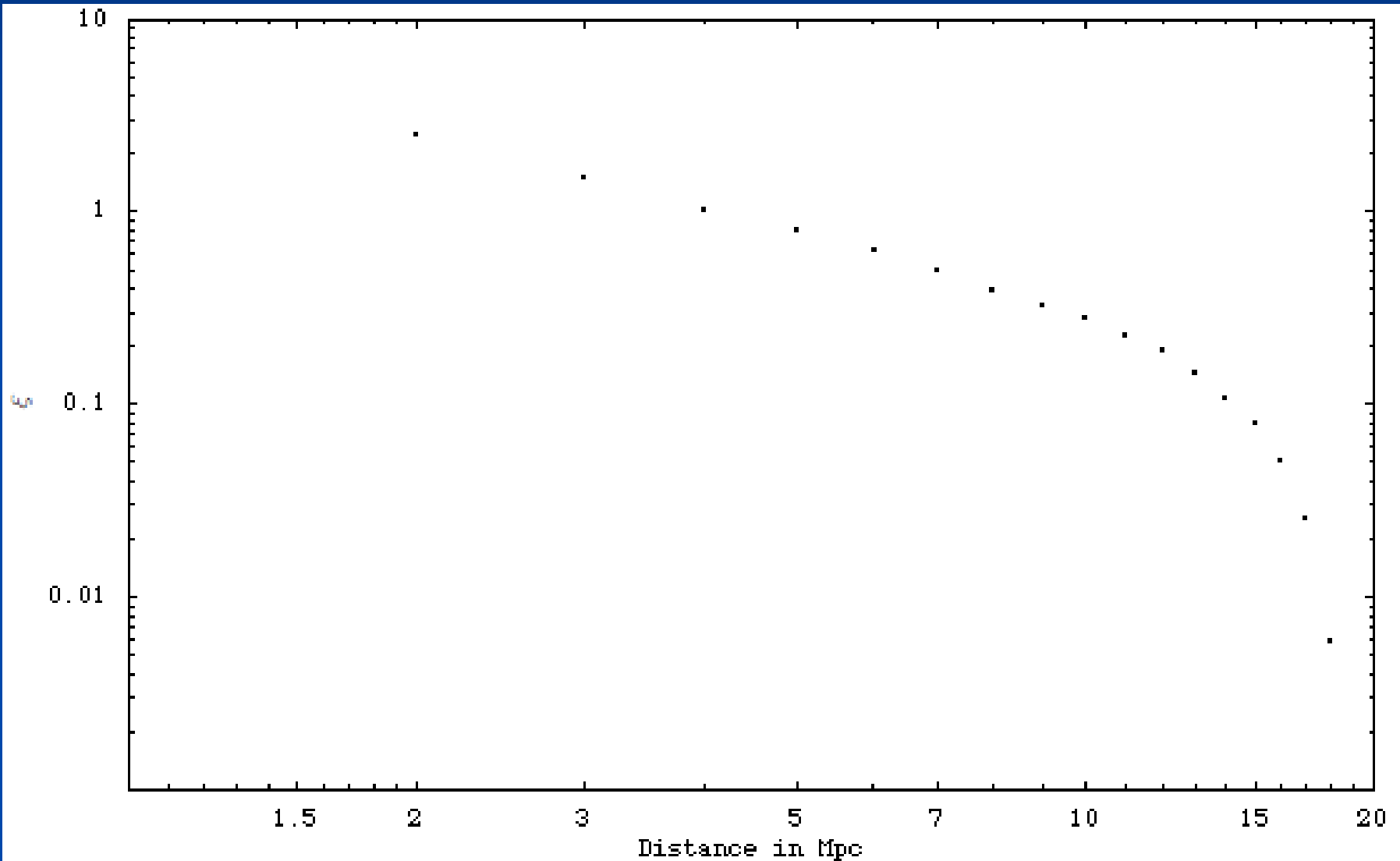
Correlation Function for 57,378 SDSS Galaxies



City-City Correlation Function



Galaxy-Galaxy Correlation Function



Summary of Measurements

	City-City	Galaxy-Galaxy
Diameter from Corr. Fn.	40 mi.	10 Mpc cluster size
Distance between from Corr. Fn.	200 mi.	350 Mpc between clusters
Average computed distance between	228 mi.	N/A

Conclusions

- ❑ Distribution of “North America at Night” cities is suggestive of large scale galaxy distribution.
- ❑ Calculations demonstrate that the city-city and galaxy-galaxy correlation functions have very similar forms.
- ❑ The city-city correlation function could be a useful way to introduce to students the galaxy-galaxy correlation function important for cosmology.