Cosmological Parameter Estimation from Large Scale Structure Topology

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agenda

- current dark energy probes
- genus and topology
- linear theory and genus measurements
- cosmological parameter fitting
- summary

current dark energy probes

- supernovae search
- CMB anisotropy
- weak lensing
- baryon acoustic oscillation (BAO)

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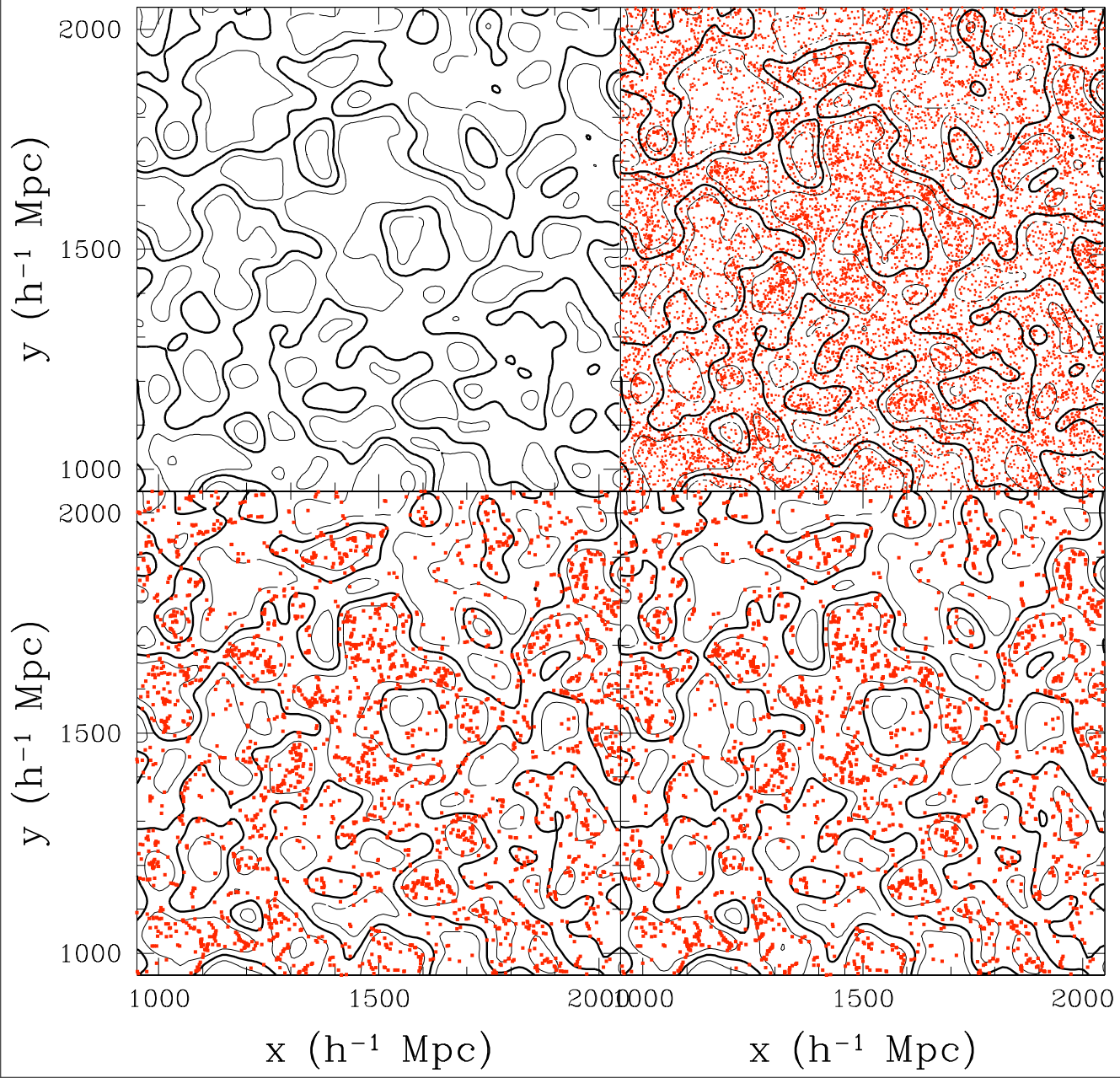
- large scale structure topology

what is genus?

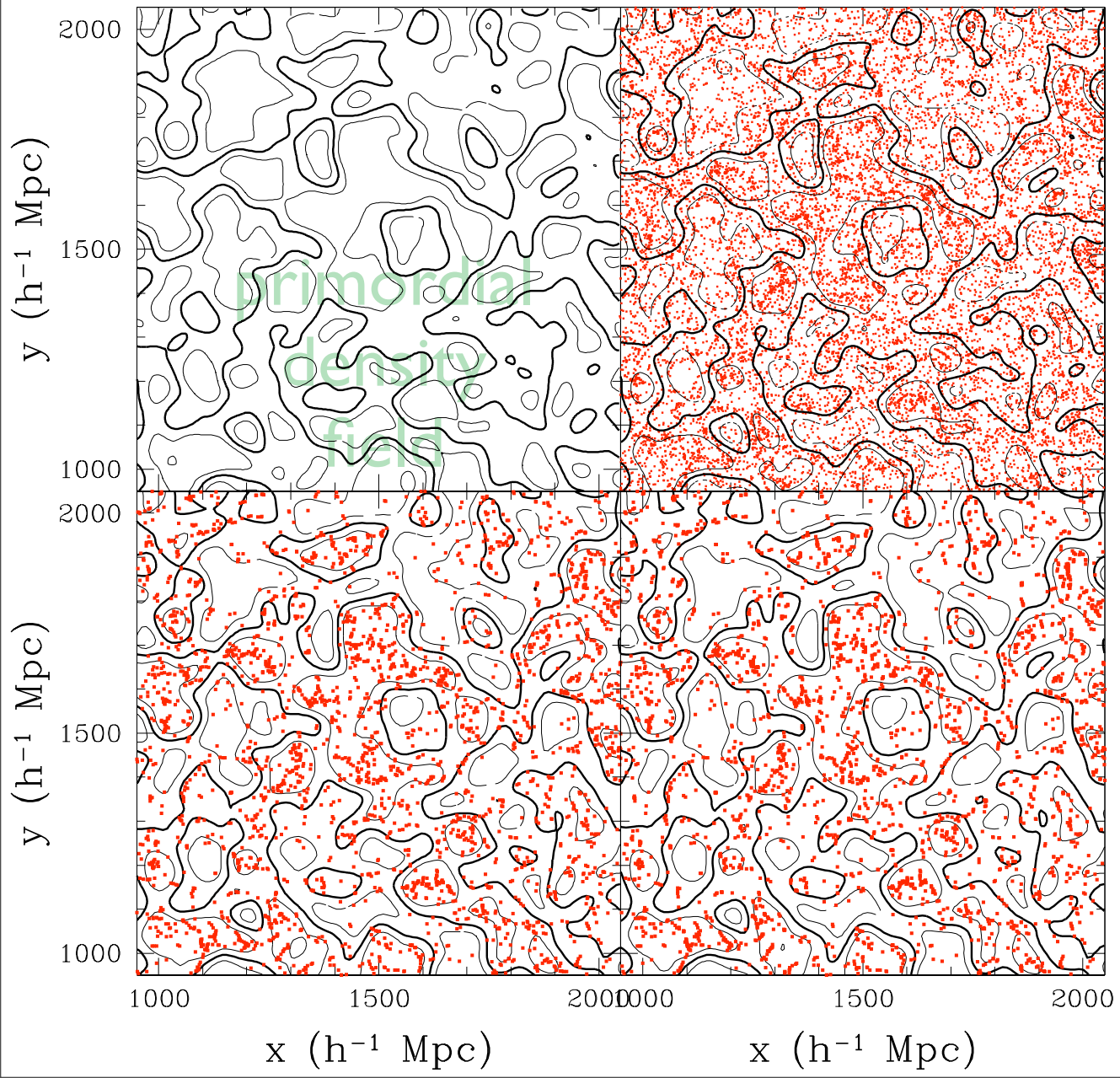
- a measure of topology
- G=number of holes in contour surfaces-number of isolated regions
- Gauss-Bonnet theorem: $G = -\frac{1}{4\pi}\int_S \kappa \, dA$
-  G=-1,   G=0

LSS topology in the linear regime



- large scale structure topology does not vary in the linear regime
- in the linear regime, we see the topology of primordial density field

LSS topology in the linear regime



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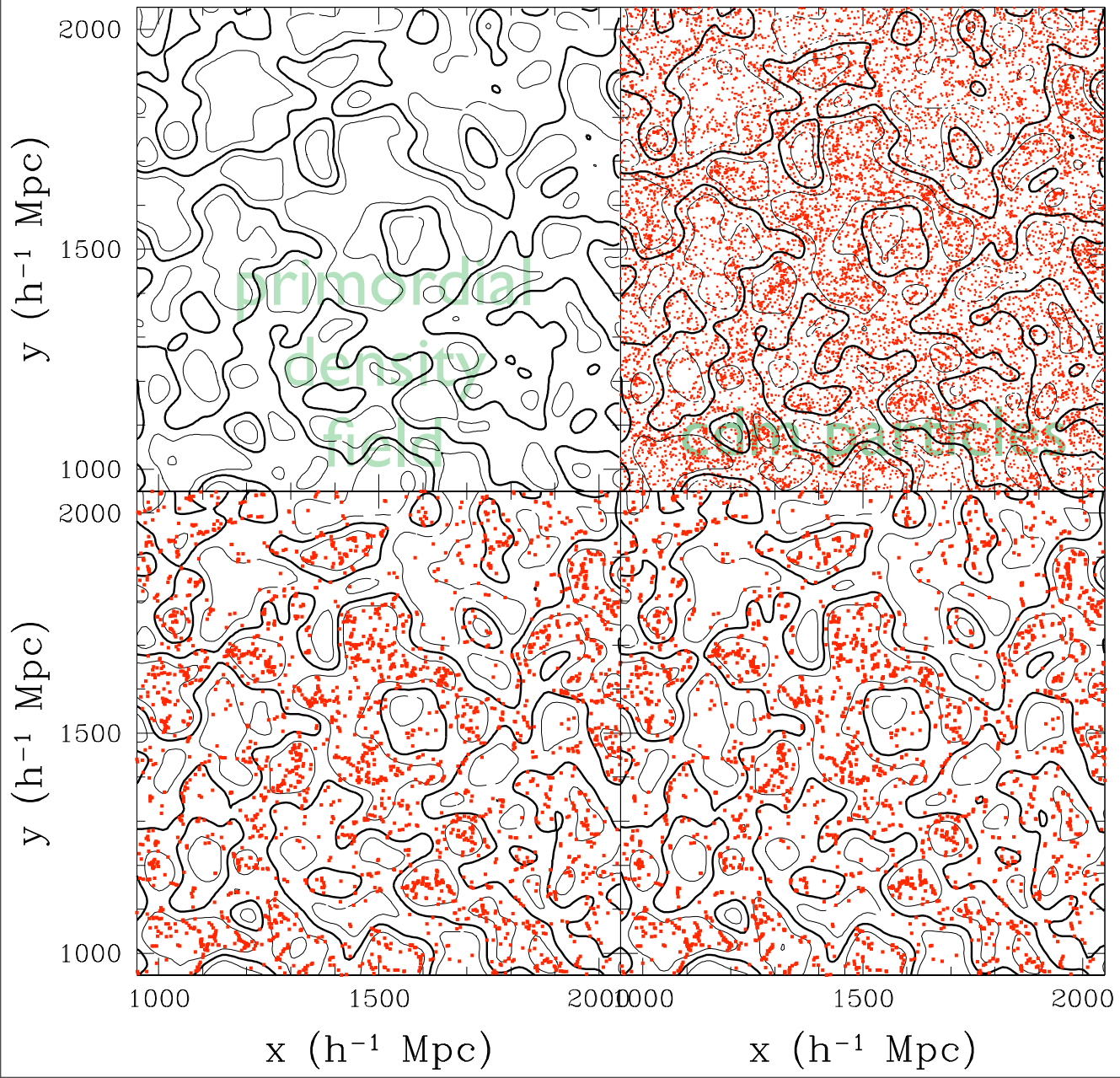

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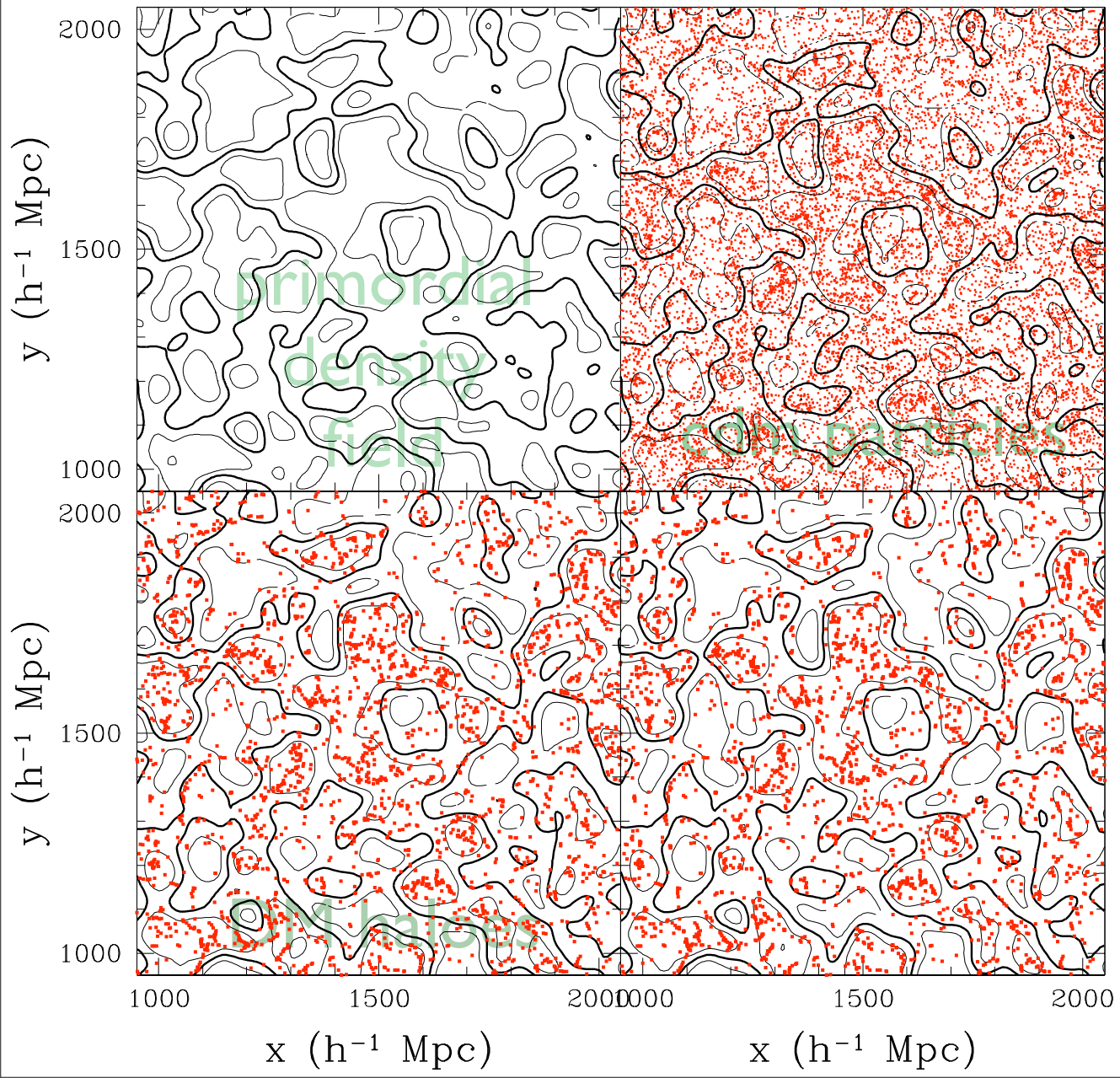

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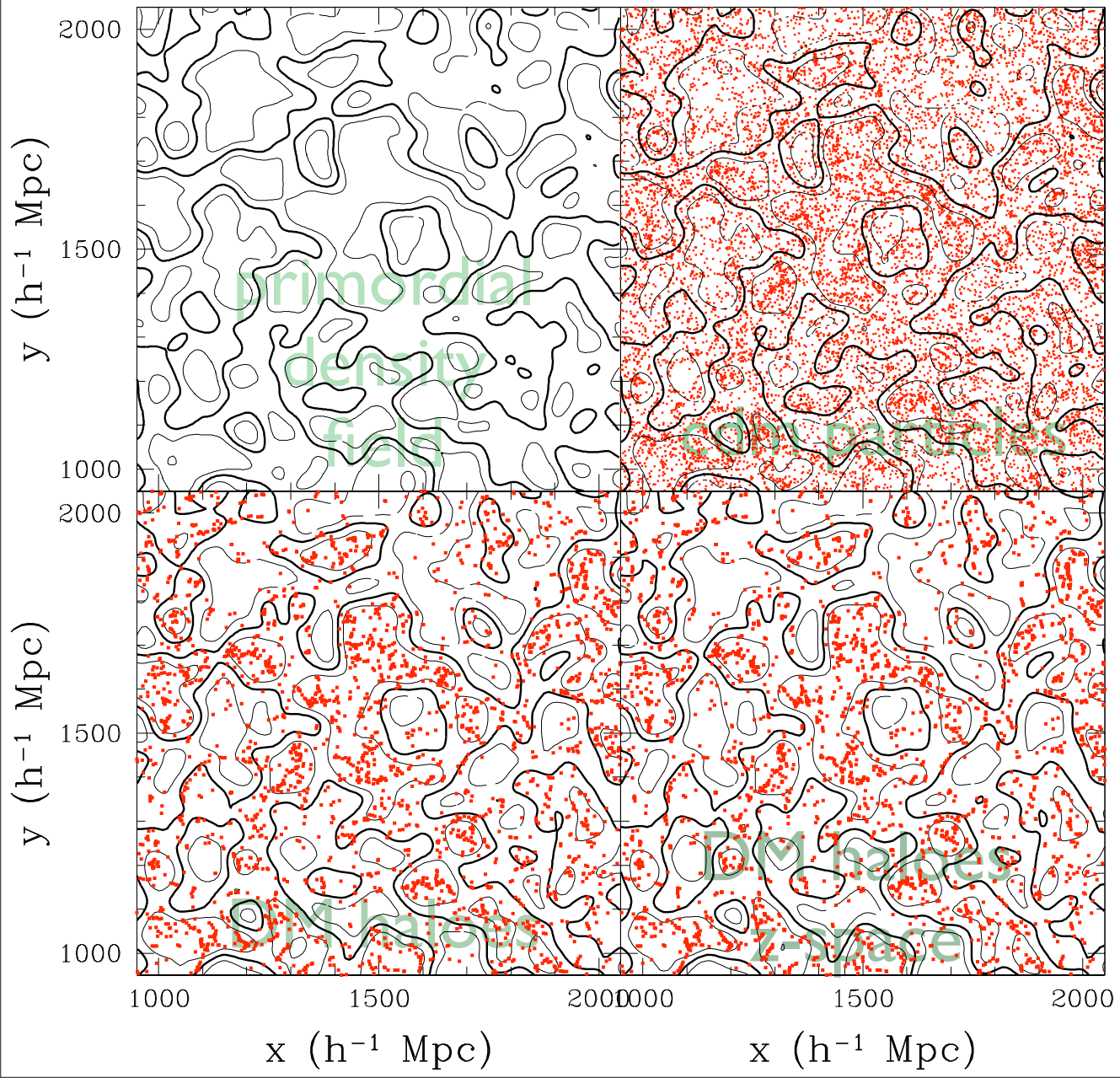

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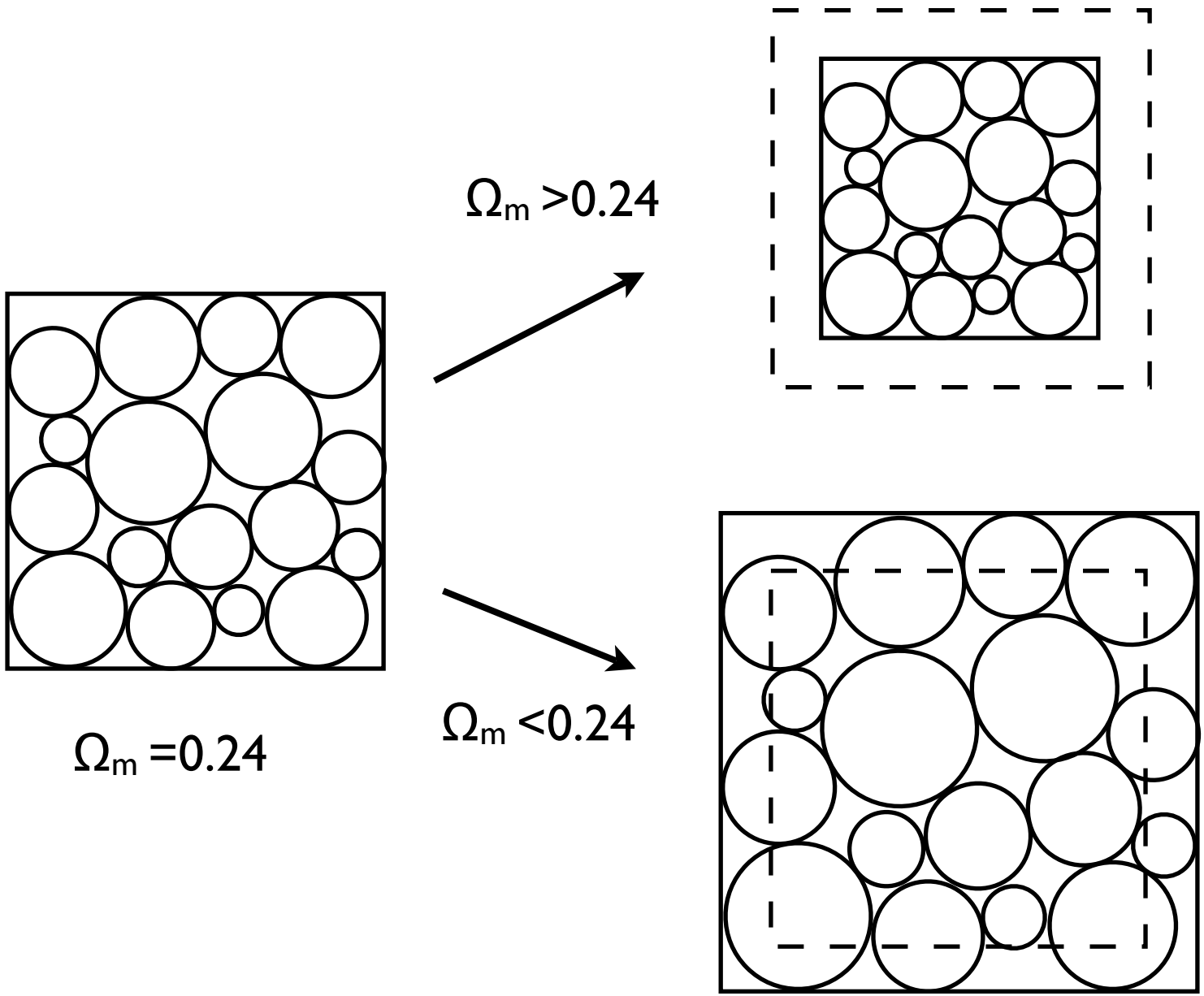
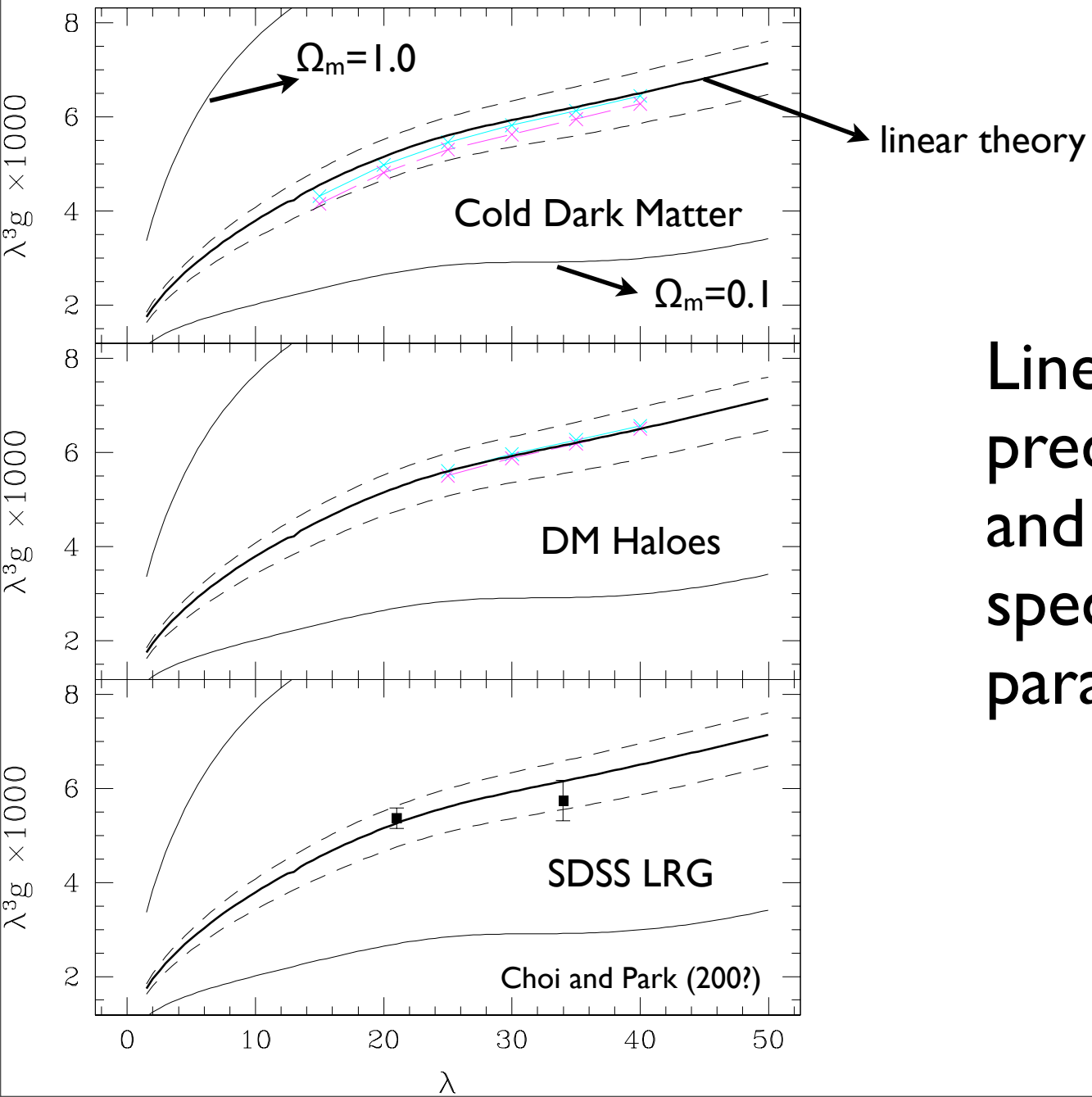
strategy:

- choose a reference cosmology
- convert the positions through a test cosmology
- calculate the genus (we do this for many cosmologies)
- when we get the same genus values at the same smoothing length, that tells us we have the correct cosmology

toy model

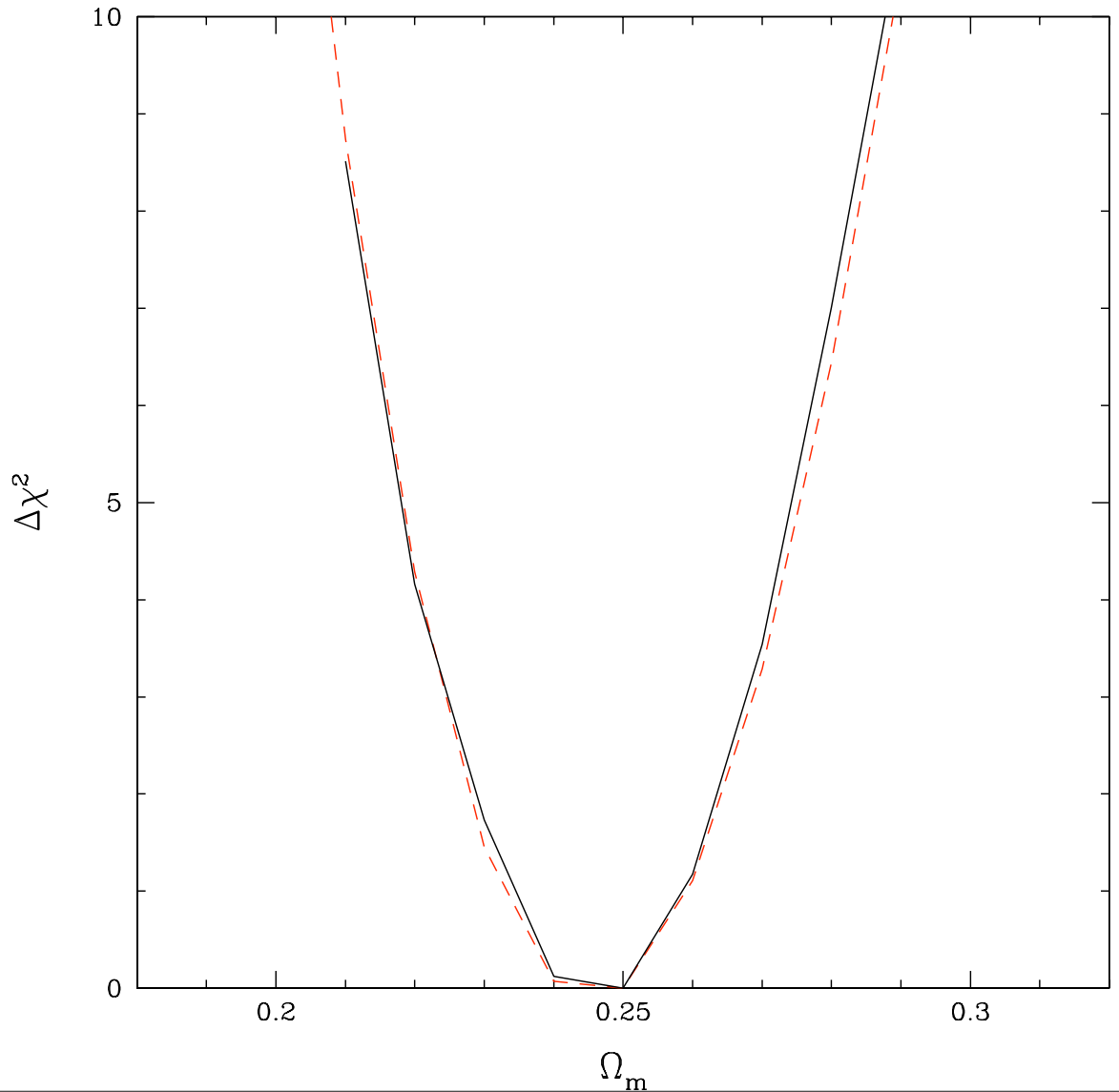


genus vs. smoothing length



Linear theory prediction: Eisenstein and Hu (1998)'s power spectrum with WMAP3 parameters

χ^2 for z=0 and z<<1



solid: z=0,

dashed: z<<1

- Ω_m can be constrained when z is very small
- best fit occurs at Ω_m =0.25 (flat universe)

summary

- using large scale structure topology is a new and efficient method to constrain cosmological parameters
- Ω_m can be constrained from low redshift data
- work in progress: dark energy and other parameters by combining low and high redshift data