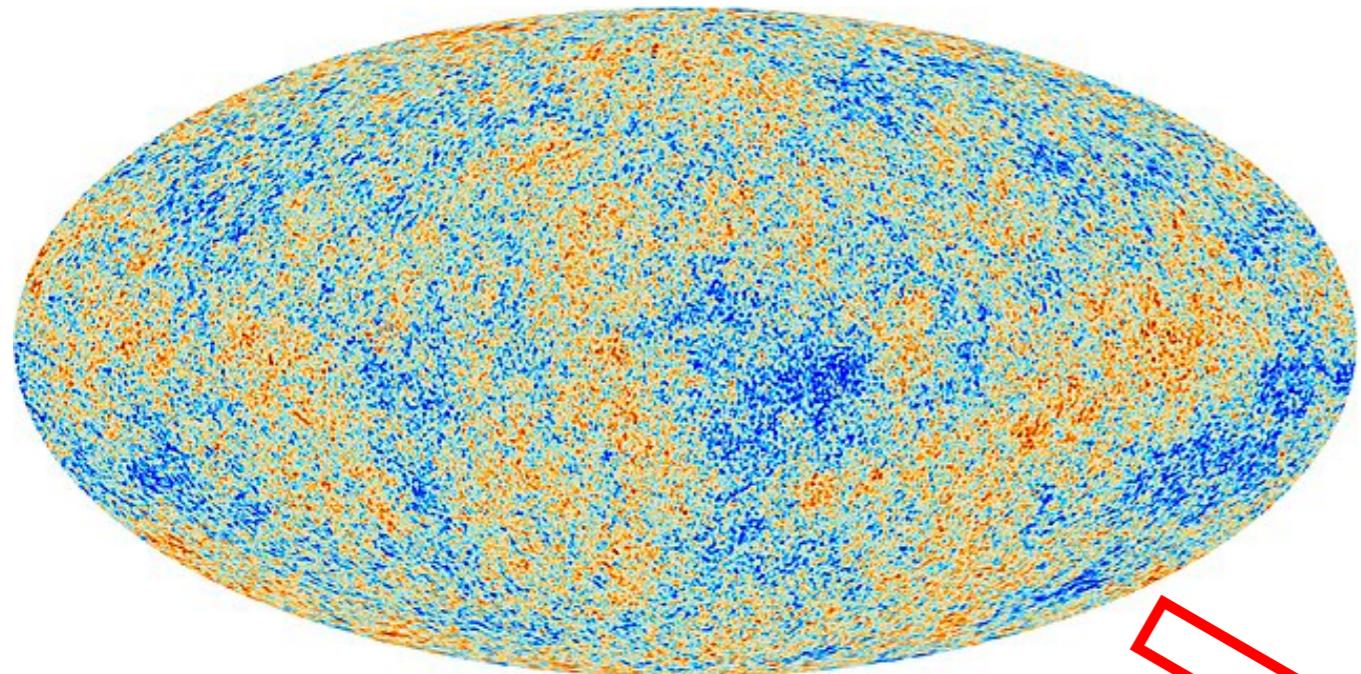


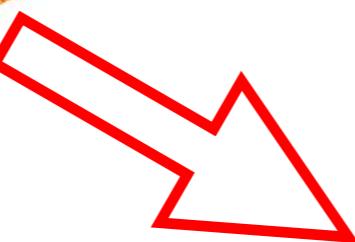
# Key Assumptions

- **Hot Big Bang & Cosmological principle**
  - Cosmic expansion, Hubble's law, homogenous and isotropic at 0th order
- **Cosmic Inflation**
  - Origin of the density fluctuations, Nearly Gaussian random fields, scale invariant power spectrum
- **Cold Dark Matter**
  - Hierarchical gravitational merging
- **Cosmological constant dark energy**
  - Late-time acceleration of space time, end of hierarchy

Planck CMB map, credit: ESA

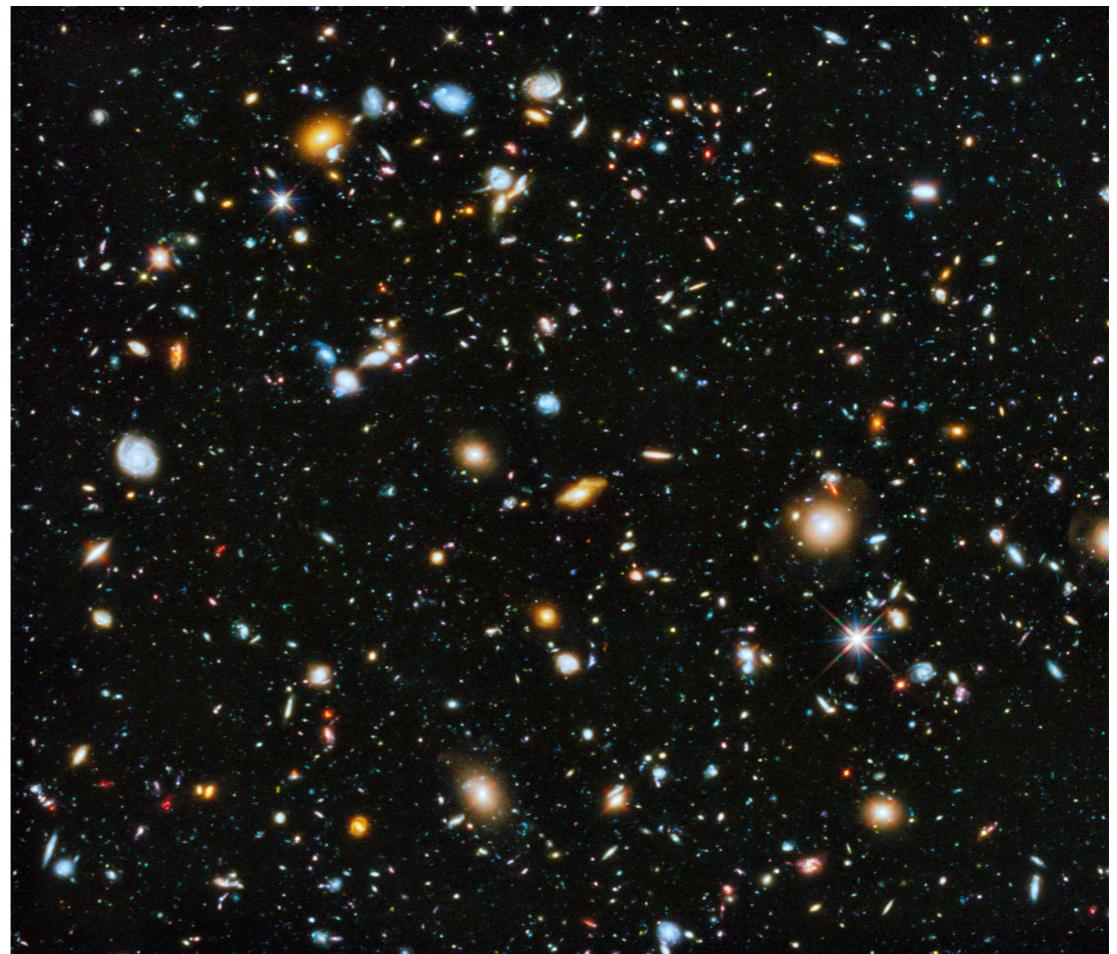


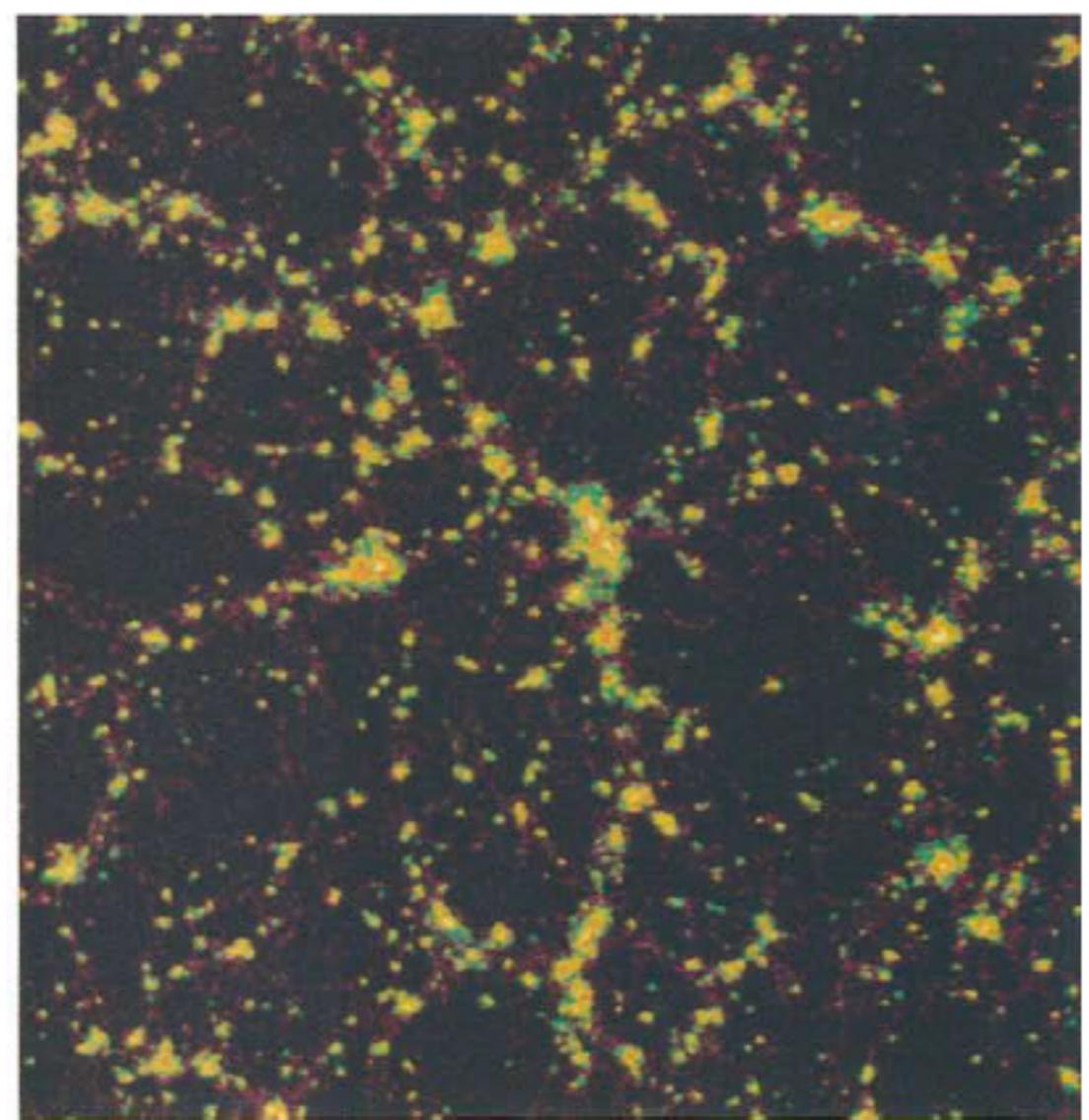
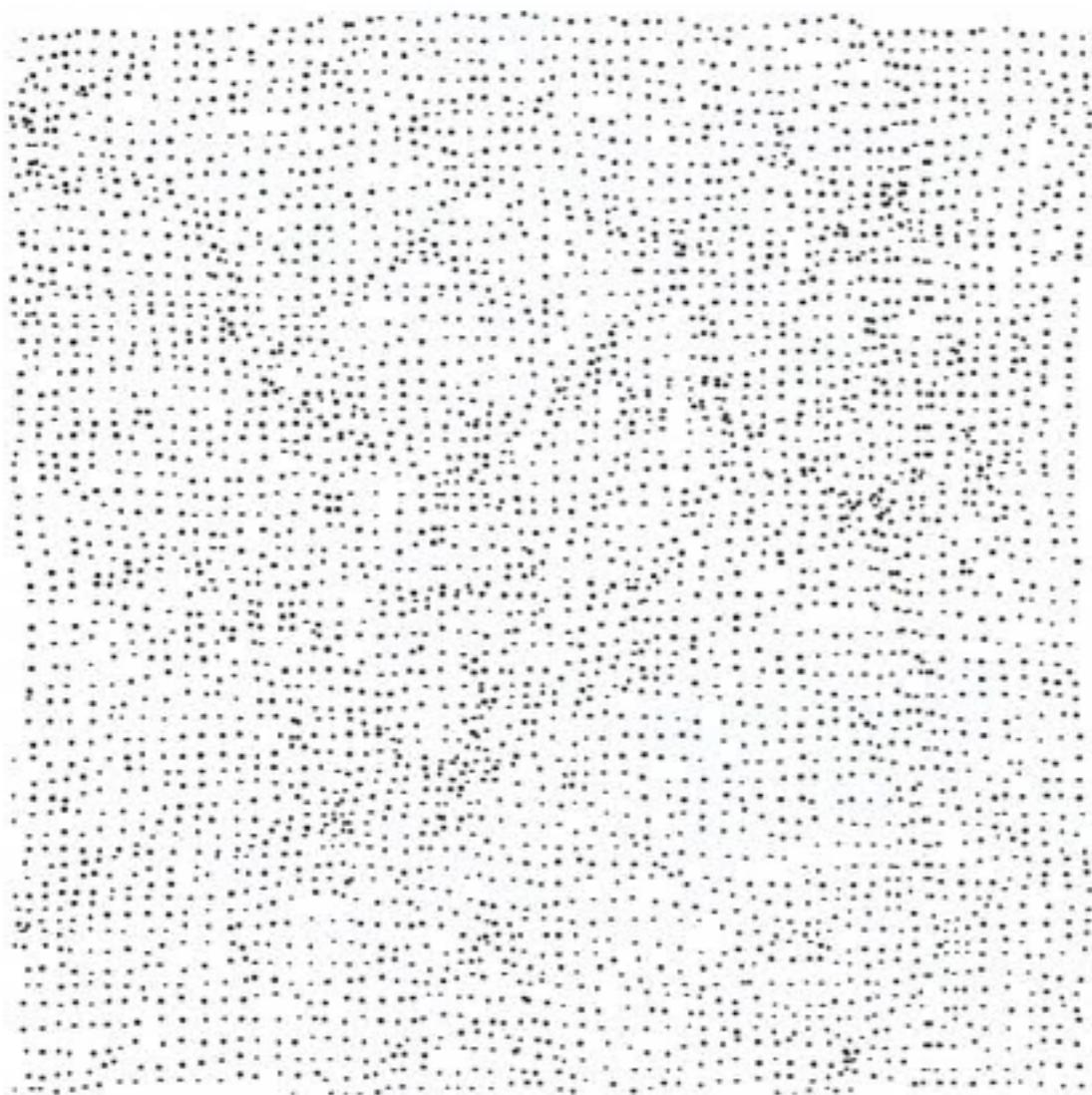
- Early universe
- Linear regime
- Nearly Gaussian

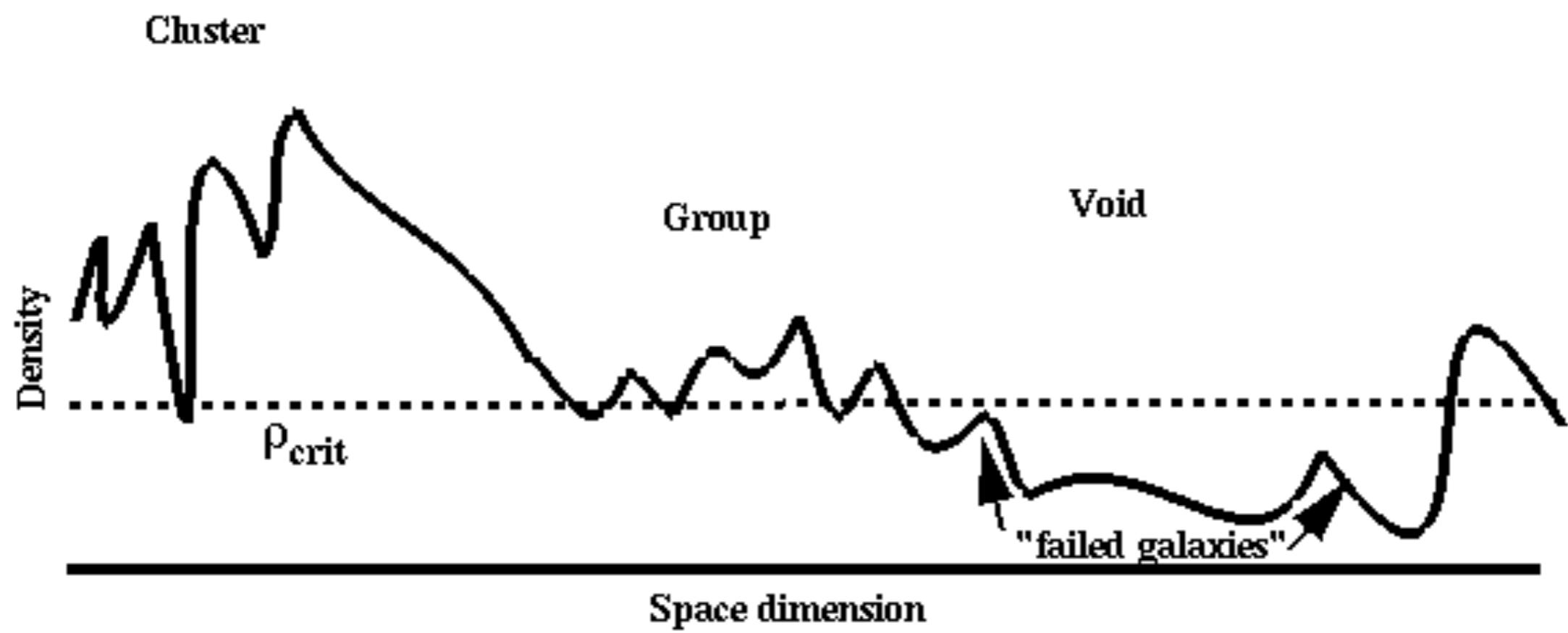


Hubble deep field, credit: ESA/Hubble

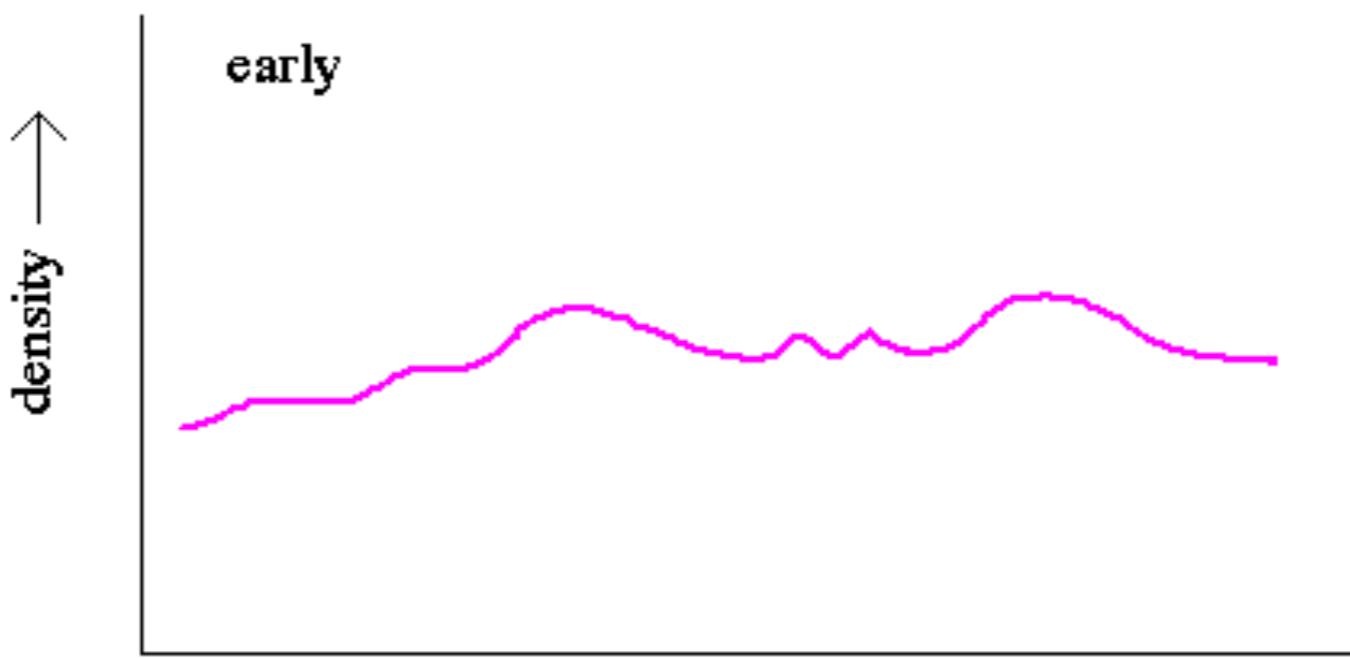
- Late universe
- Nonlinear regime
- Highly non-Gaussian



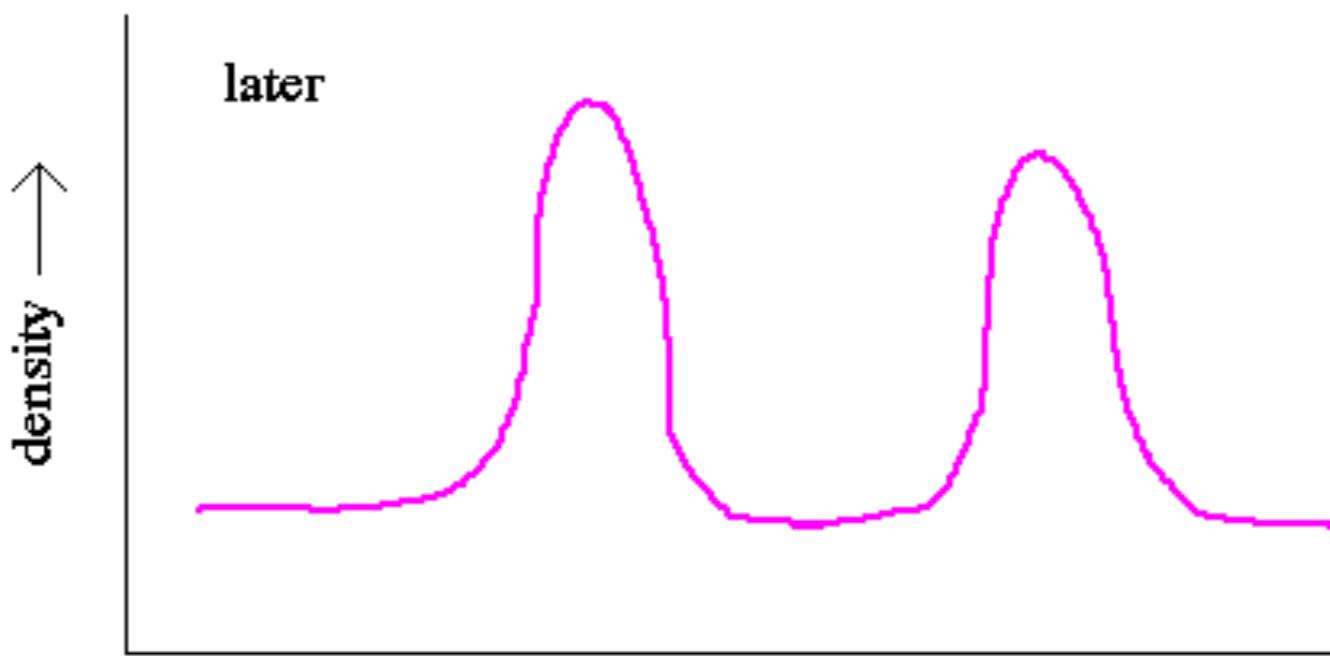




large scale fluctuations become gravitationally unstable and grow in amplitude



small scale fluctuations damp out with time



## Bottom-Up Structure Formation

in a bottom-up scenario, small, dwarf galaxy-sized lumps form first, then merger to make galaxies and clusters of galaxies

