

# Galaxy populations in rich and poor environments:

There are more galaxies where there are less galaxies



"Haven" by Vladimir Kush

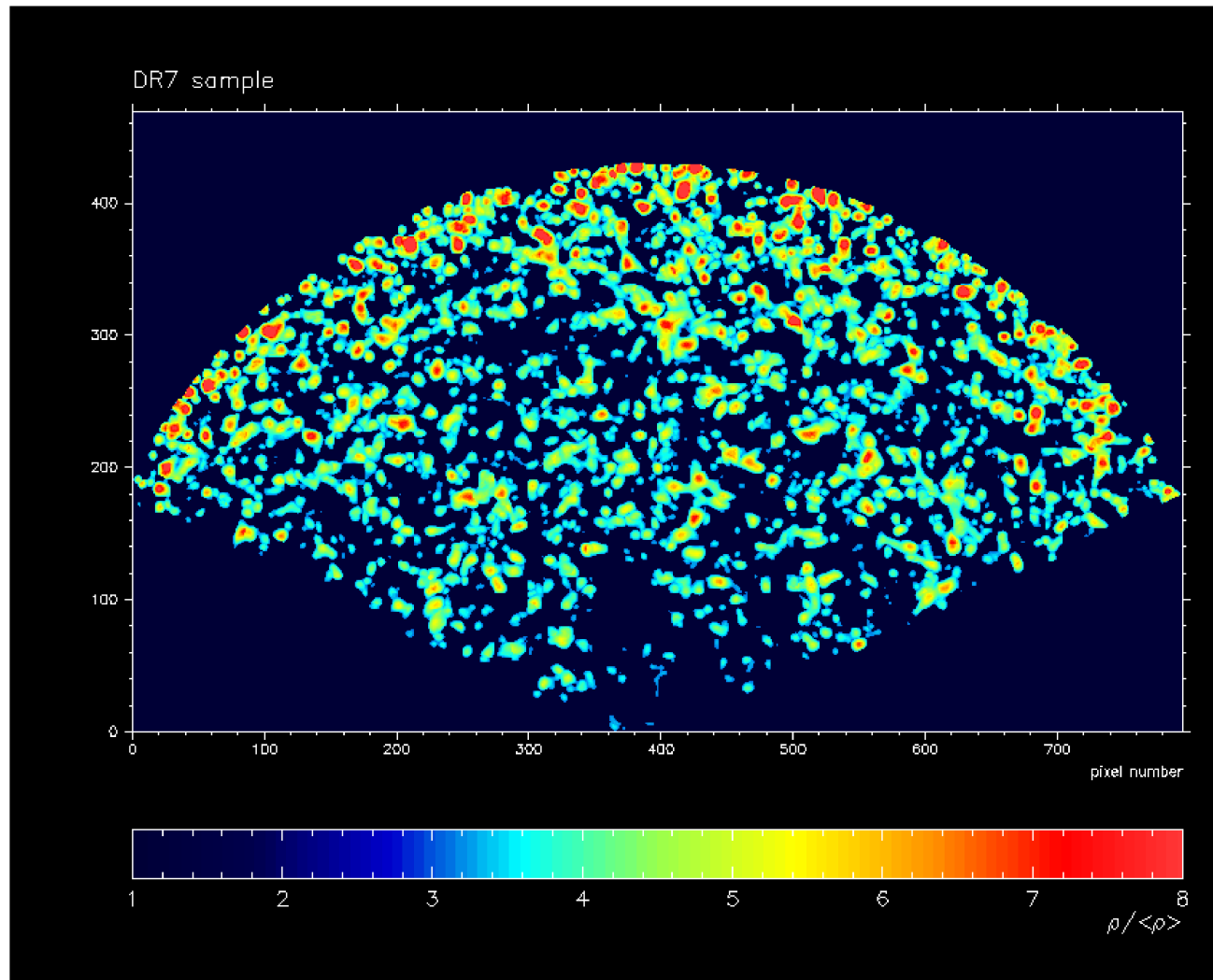
Heidi Lietzen

Astronomer's day 2012

# SDSS DR8 galaxies

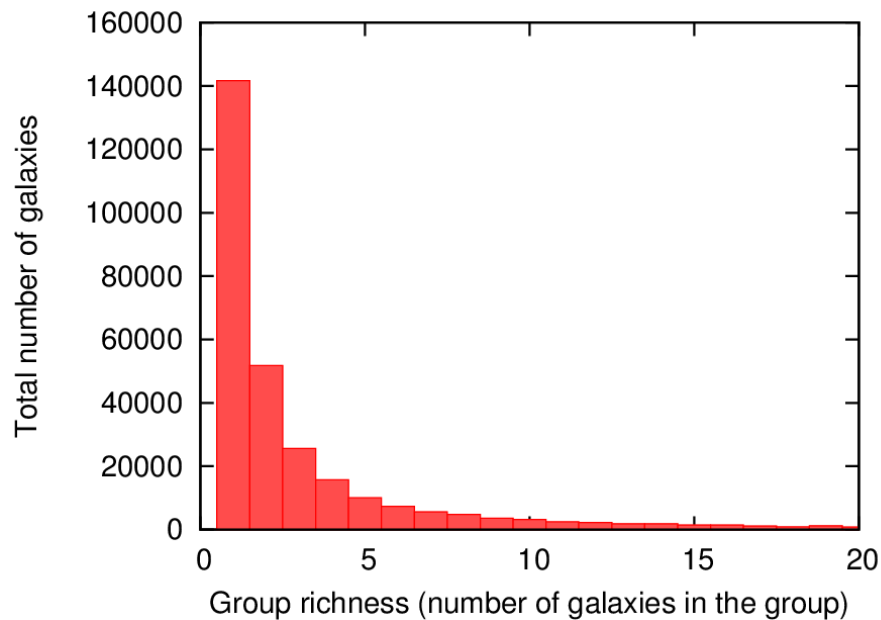
- Magnitude limited sample
- 576 493 galaxies, 77 858 groups
- The most reliable data:  $120 < D < 340$  Mpc ( $0.04 < z < 0.116$ )
  - 306 397 galaxies, 45 922 groups
- Information on galaxies:
  - Morphology, spectral properties, luminosities
  - Group richness & luminosity
  - Large-scale environmental density

# Large-scale density: Luminosity-density field

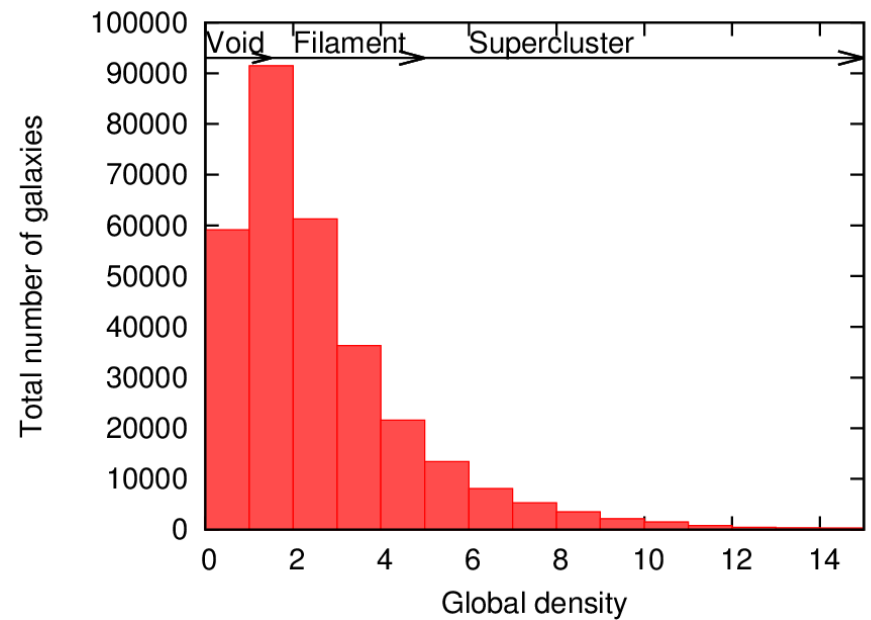


# There are more galaxies where there are less galaxies

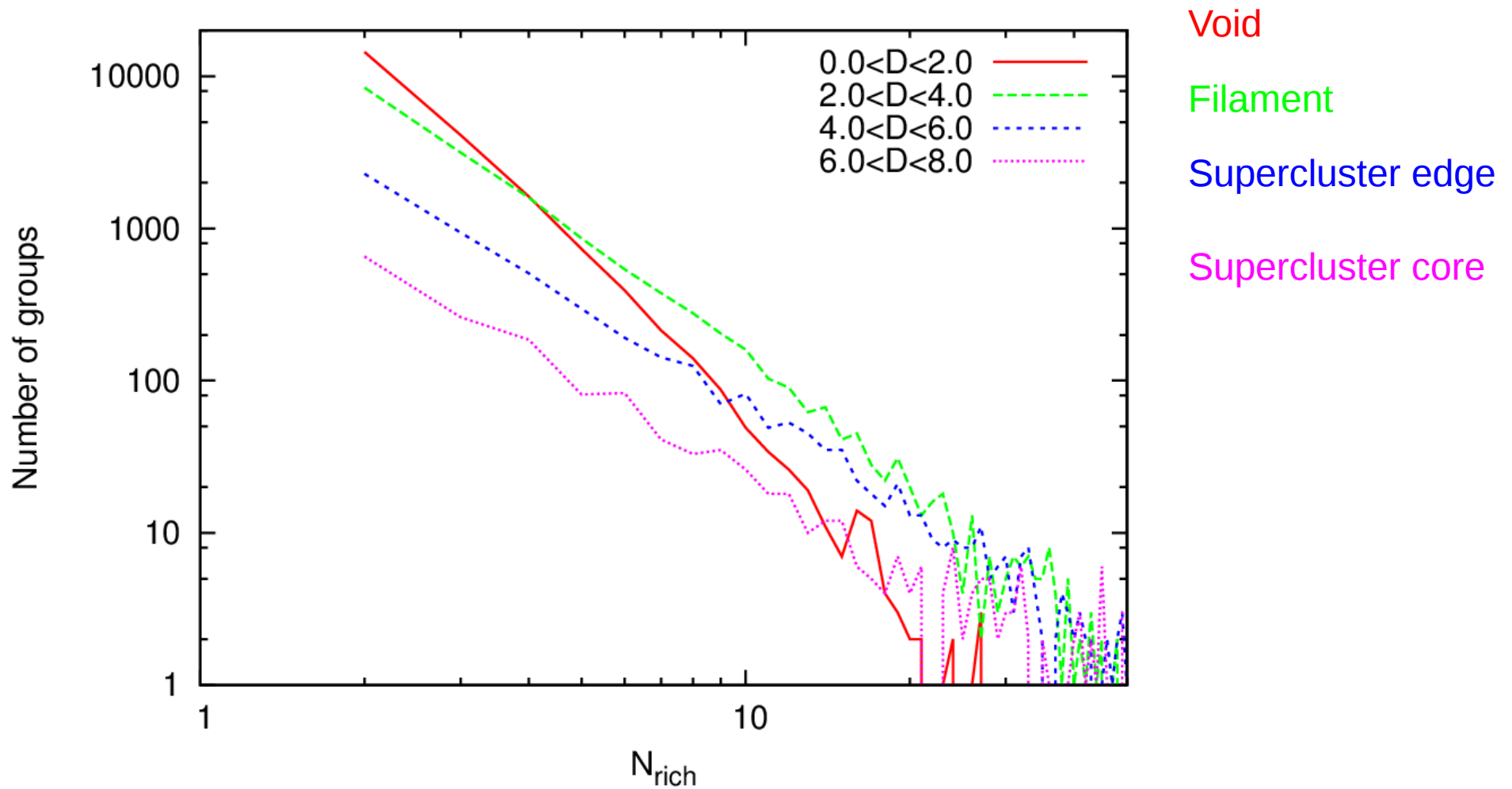
Group scale:



Large scale:



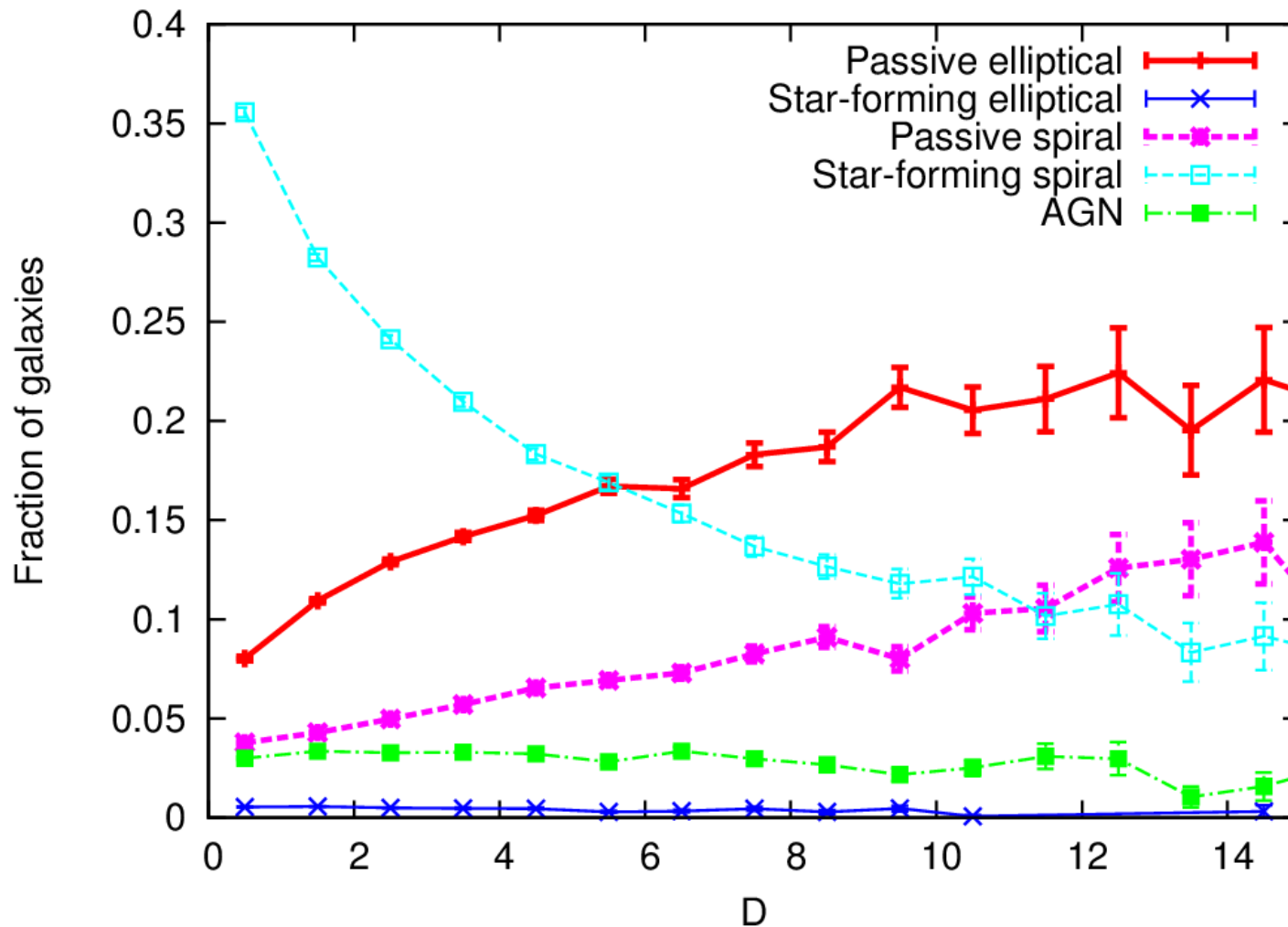
# There are more galaxies where there are less galaxies



# Galaxies in dense environments

- More often ellipticals (morphology-density relation)
- Redder
- Lower star-formation rate
- More luminous
- AGN more often radio-loud

# Distribution in different large-scale environments



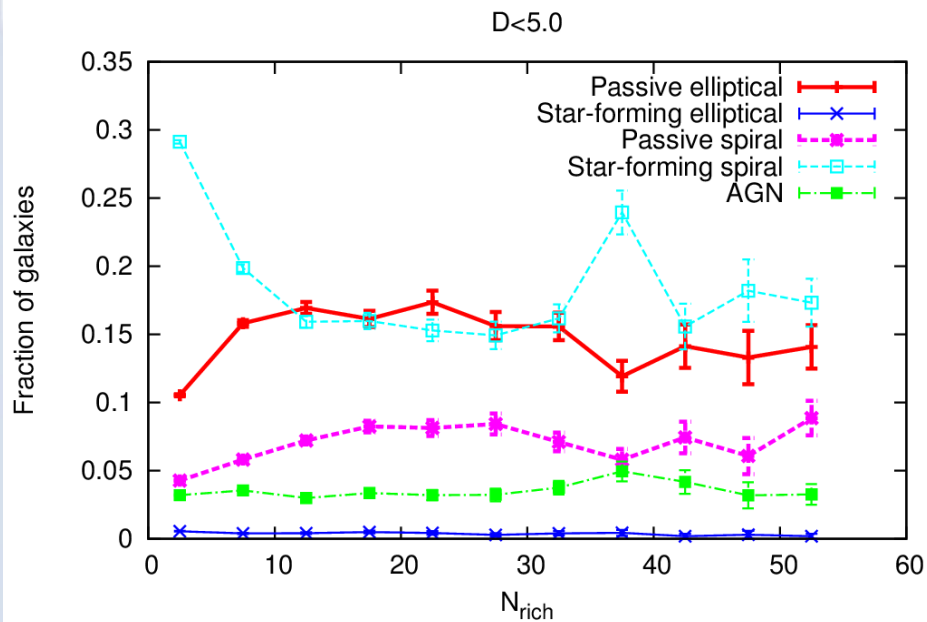
# Results on the large scale

- Density grows → Fraction of star-forming spirals goes down, fraction of passive galaxies up
  - Environment somehow quenches star formation
- Fraction of AGN is almost the same in all environments
  - They are not where the star-formation ends

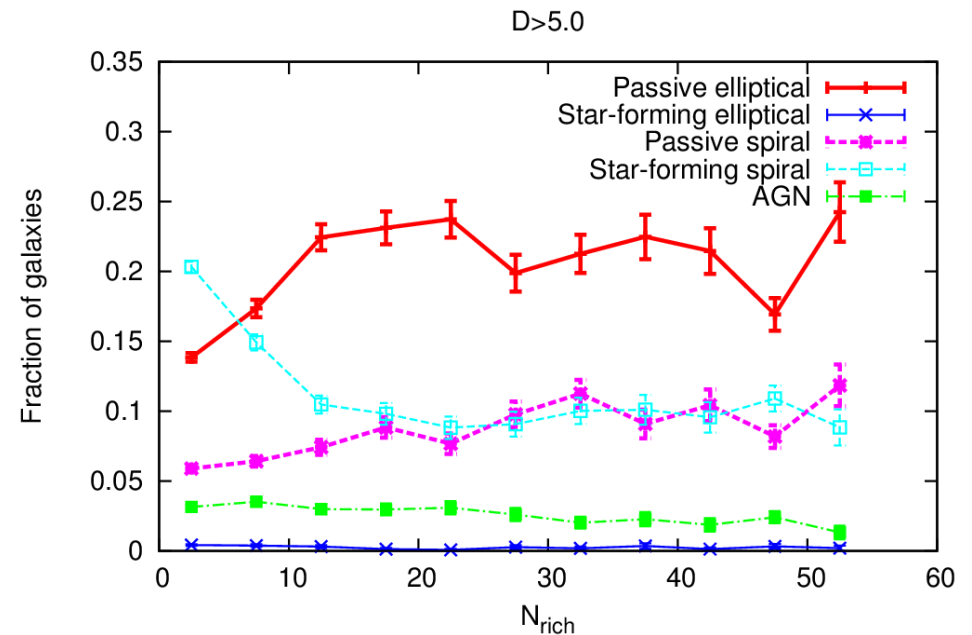


# Distribution in groups

In voids or filaments  
( $D < 5.0$ ):



In superclusters  
( $D > 5.0$ ):

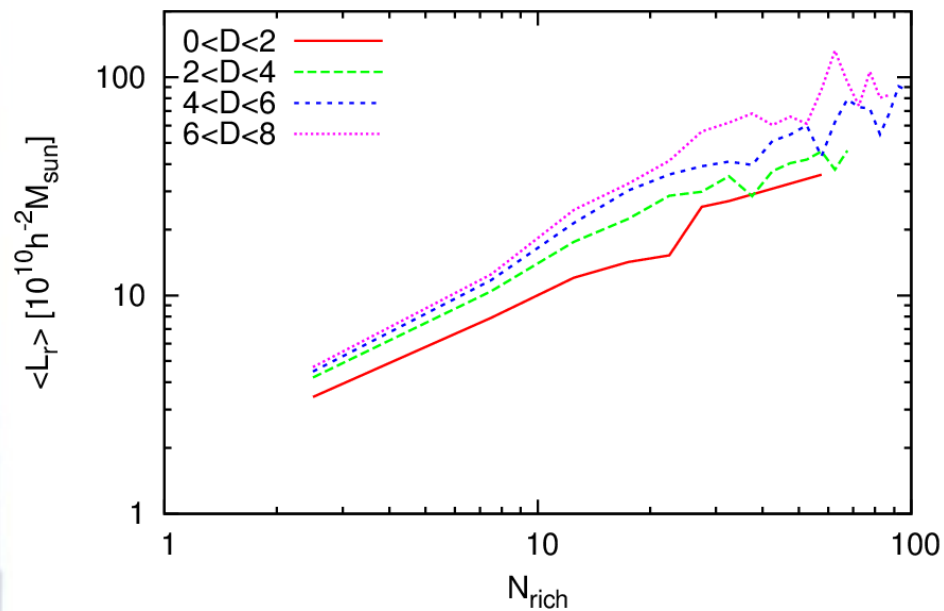


# Results on groups

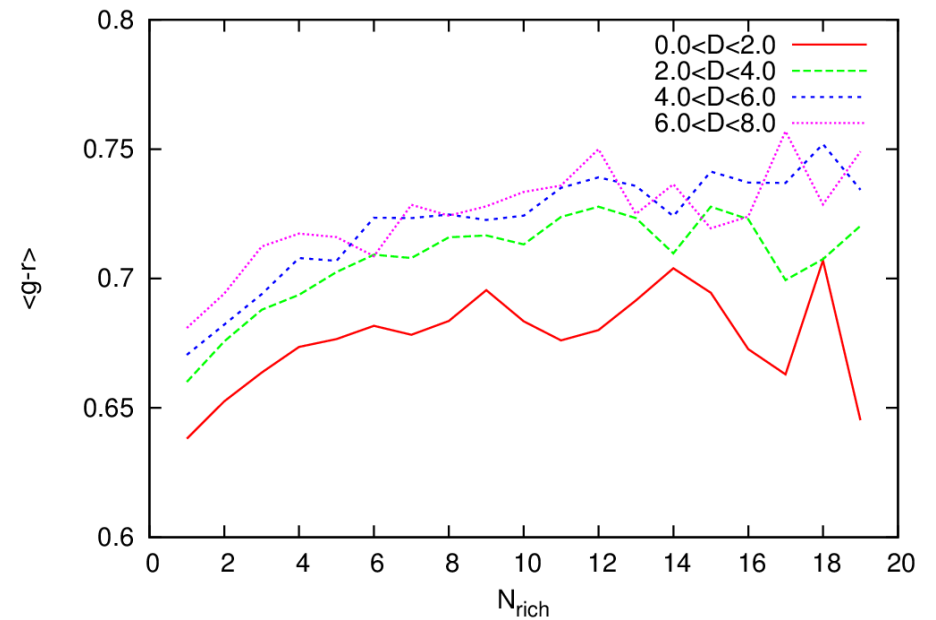
- Fraction of passive galaxies rises when group richness grows, but only up to  $\sim 10$  galaxies
  - Evolution happens in the smallest groups
- Fractions of different types in superclusters are different from lower densities
  - High large-scale density enhances evolution

# Luminosities and colors

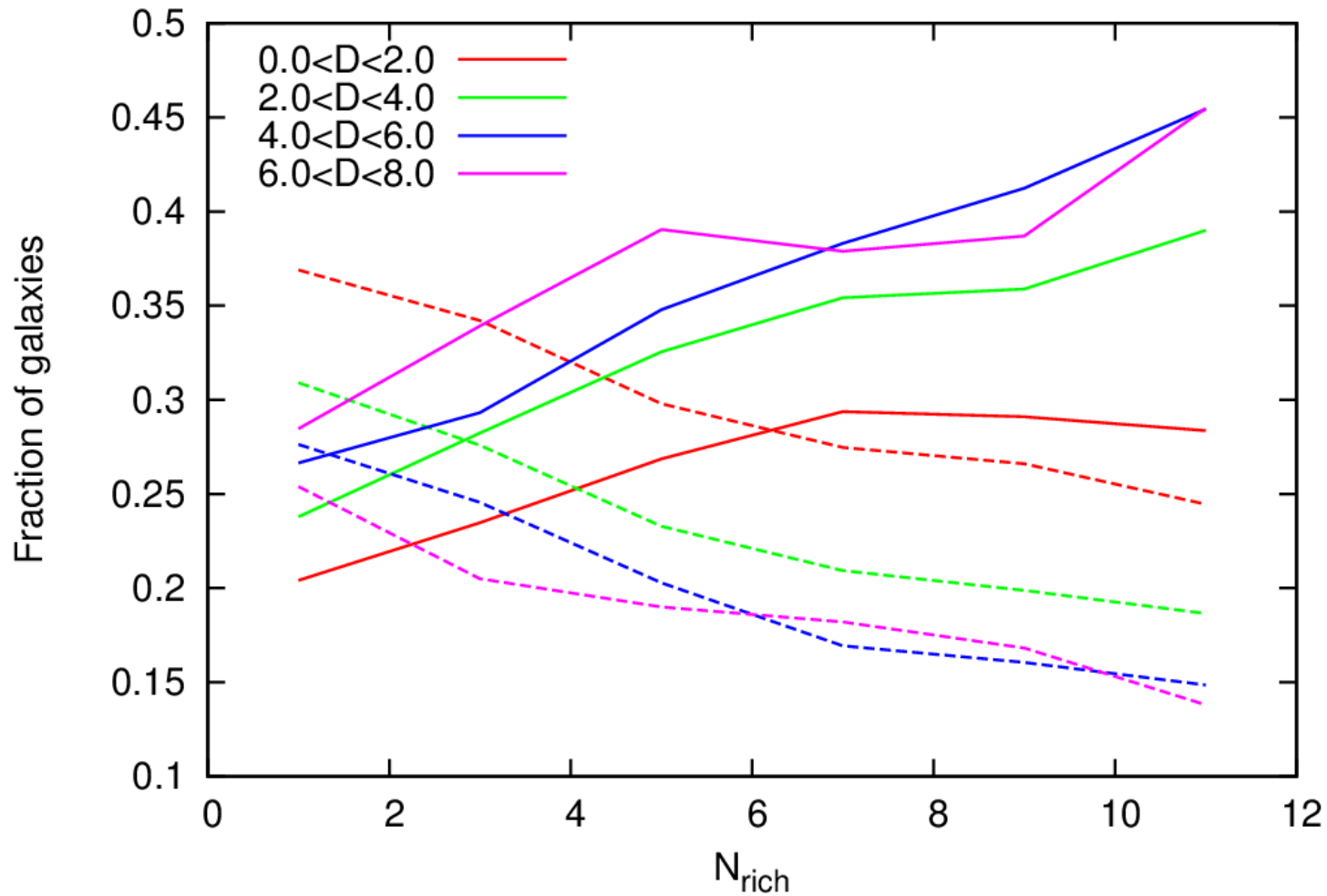
## Average group luminosity



## Average color of galaxies



# Fractions of passive and star-forming galaxies



Solid lines: passive galaxies, dashed lines: star-forming galaxies

# Results on star-forming and passive galaxies

- Crossing point moves to lower richness when large-scale density grows
  - Richer group is needed for galaxy evolution in low-density regions
  - Evolution enhanced in high densities and suppressed in low densities

# And what does all this mean?

- Large-scale ( $\sim 10$  Mpc) environment affects galaxy evolution
  - Baryonic and gravitational processes work on smaller scales
  - Simulations: evolution is more rapid in superclusters



"Arrow of Time" by Vladimir Kush