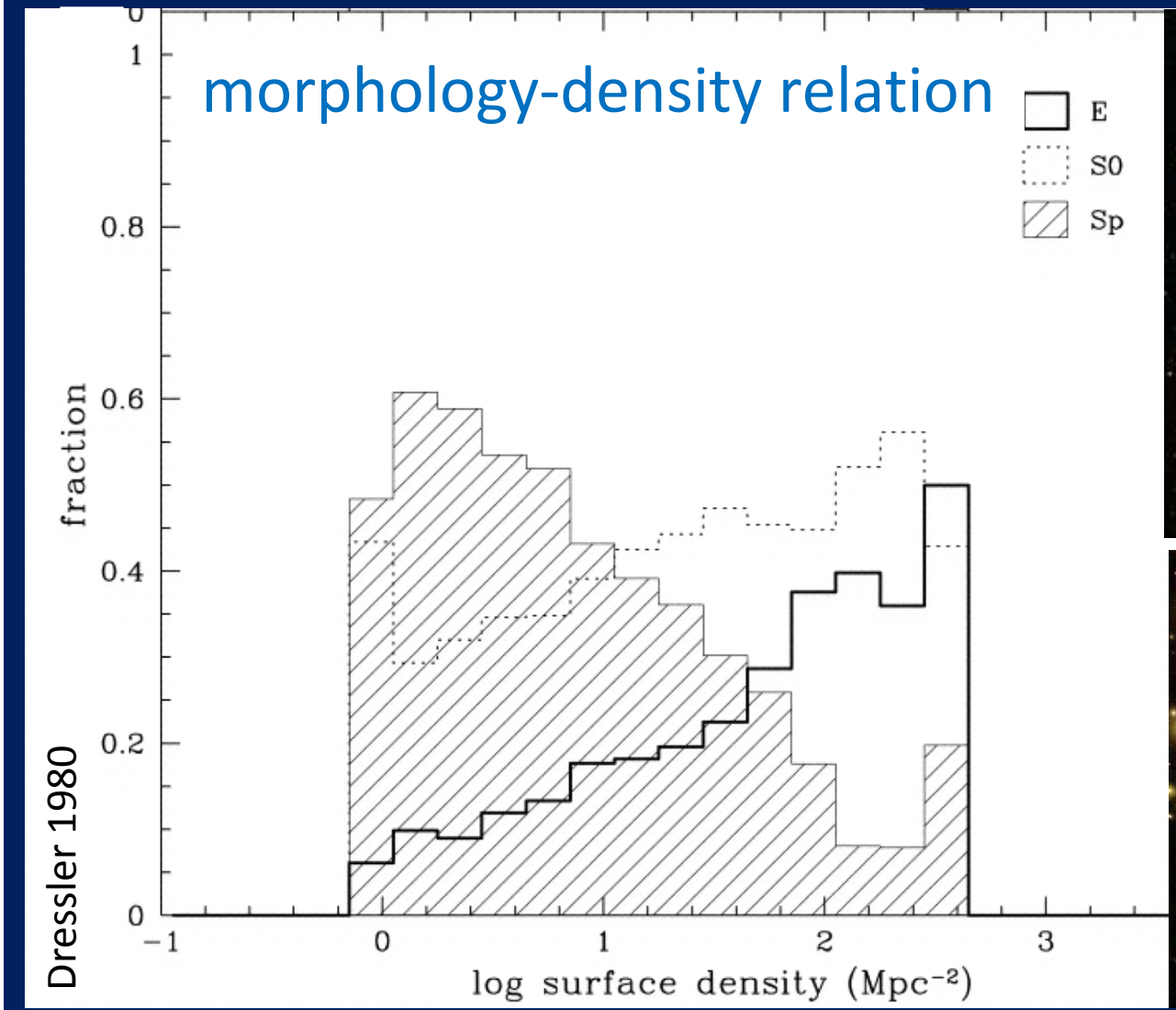
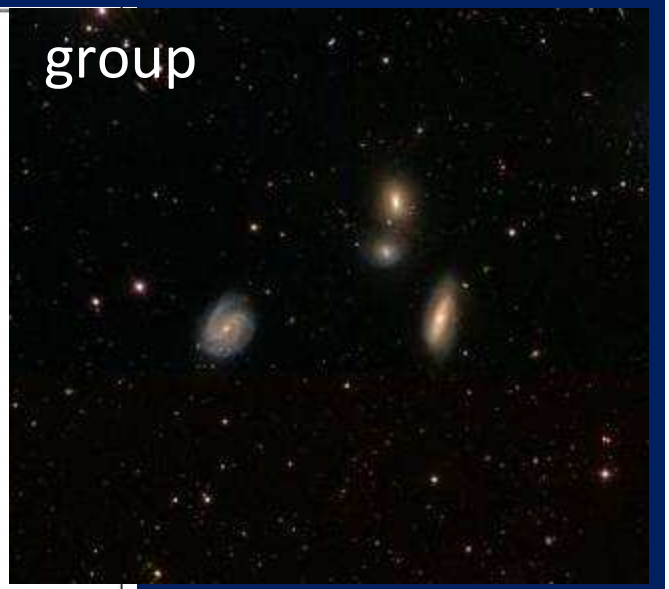

Why do galaxies in clusters look different from other galaxies?

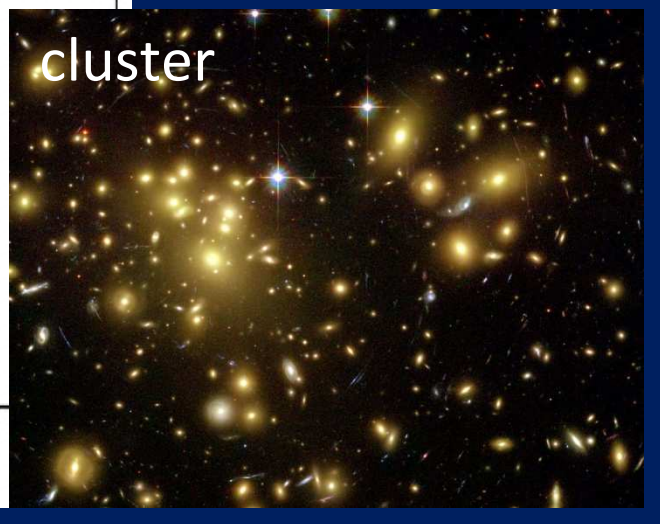
Goals for today

1) Relate galaxy color and morphology to galaxy environment (density of galaxies)
2) Explain why the morphology/color-density relations cannot be explained by a higher merger rate in clusters
3) Evaluate two alternative explanations: (a) pre-processing in groups, and (b) effects of hot gas

Clusters have more: elliptical/S0 galaxies, red galaxies (old/metal-rich)



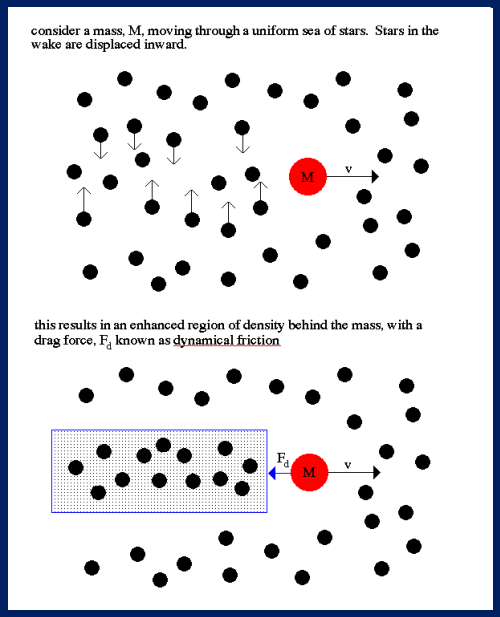


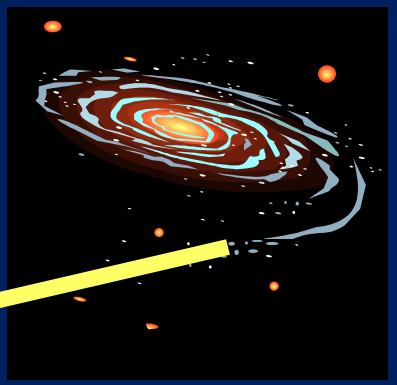


puzzle of morphology-density relation: mergers don't happen in clusters

at the high speeds typical of rich galaxy clusters, galaxies are unlikely to slow each other enough to become bound

http://abyss.uoregon.edu/~js/lectures/cannibalism/cannibalism_7.html

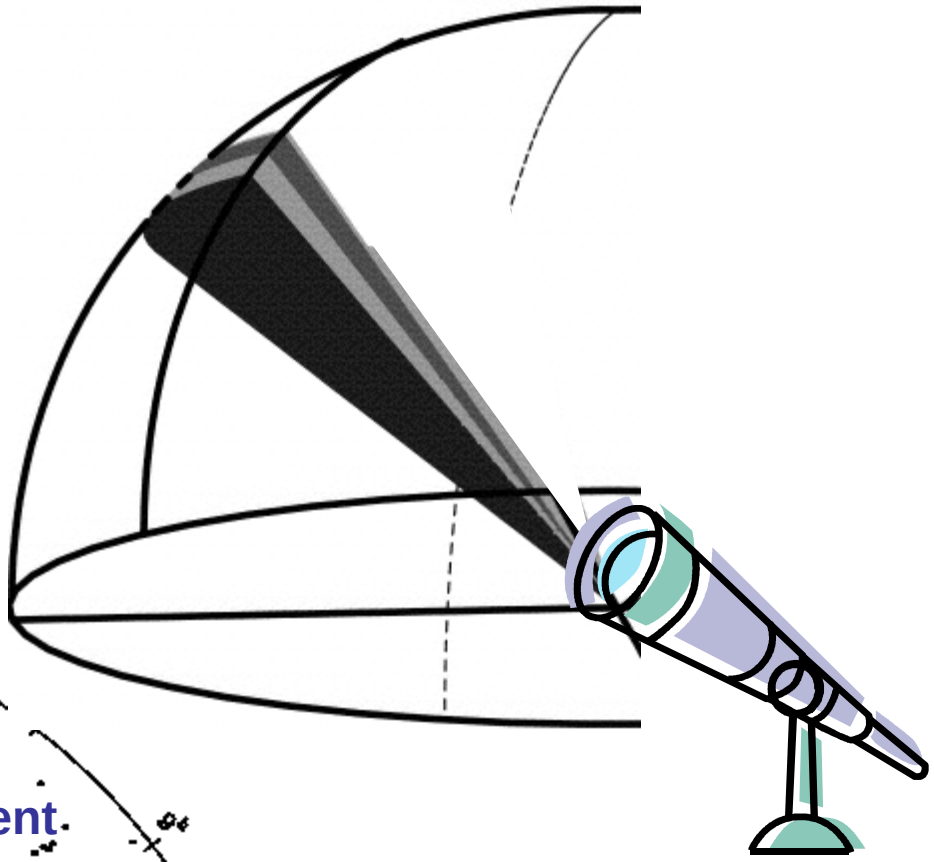


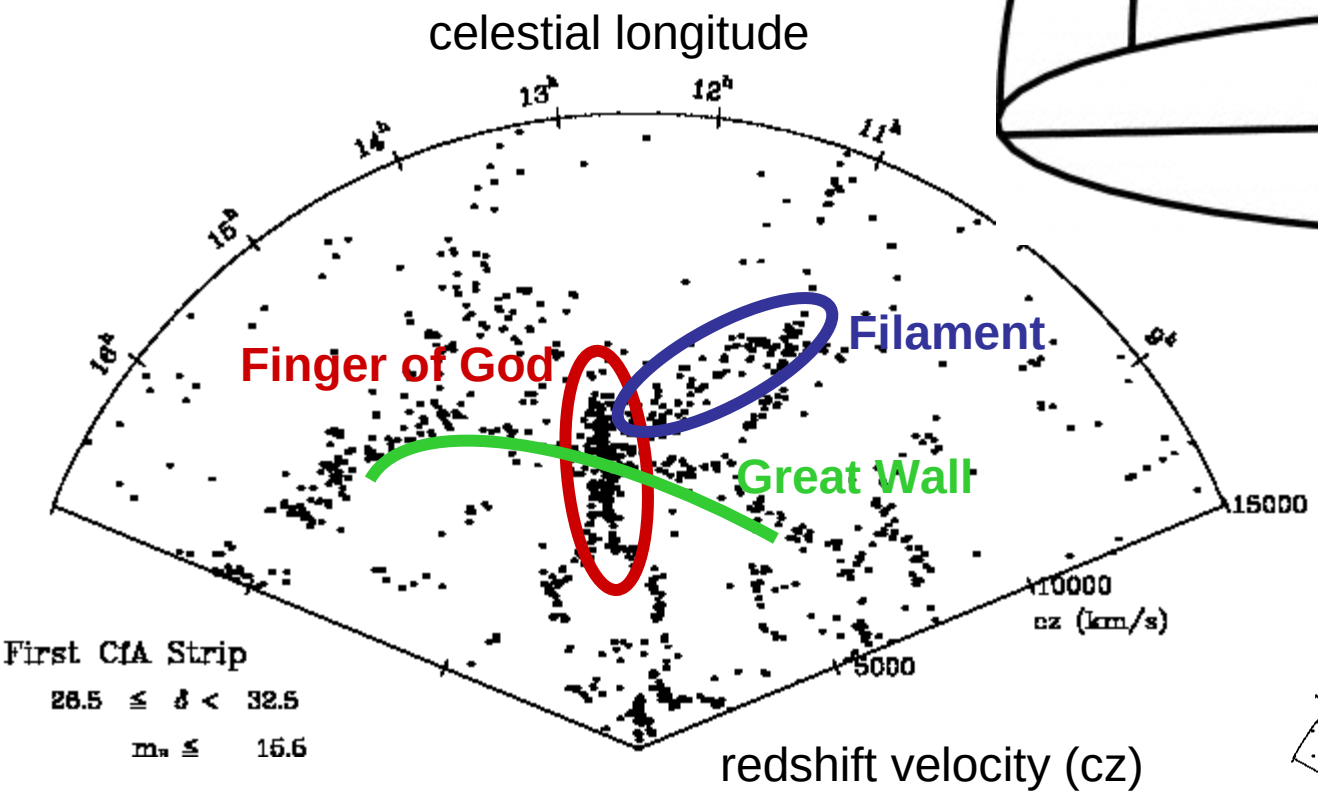


just get galaxy "harassment" from flyby encounters

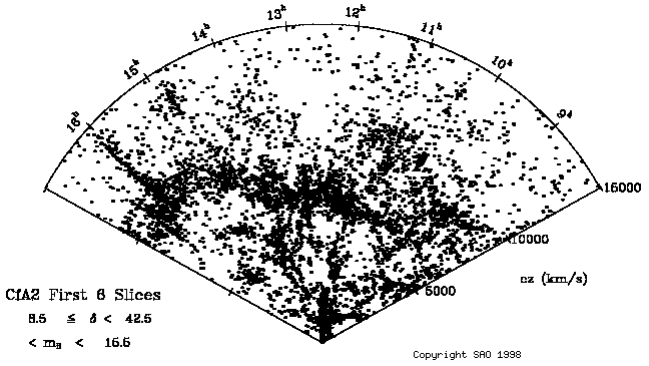
(except behemoth at cluster center)

Quick Review: Walls, Filaments, and Fingers of God

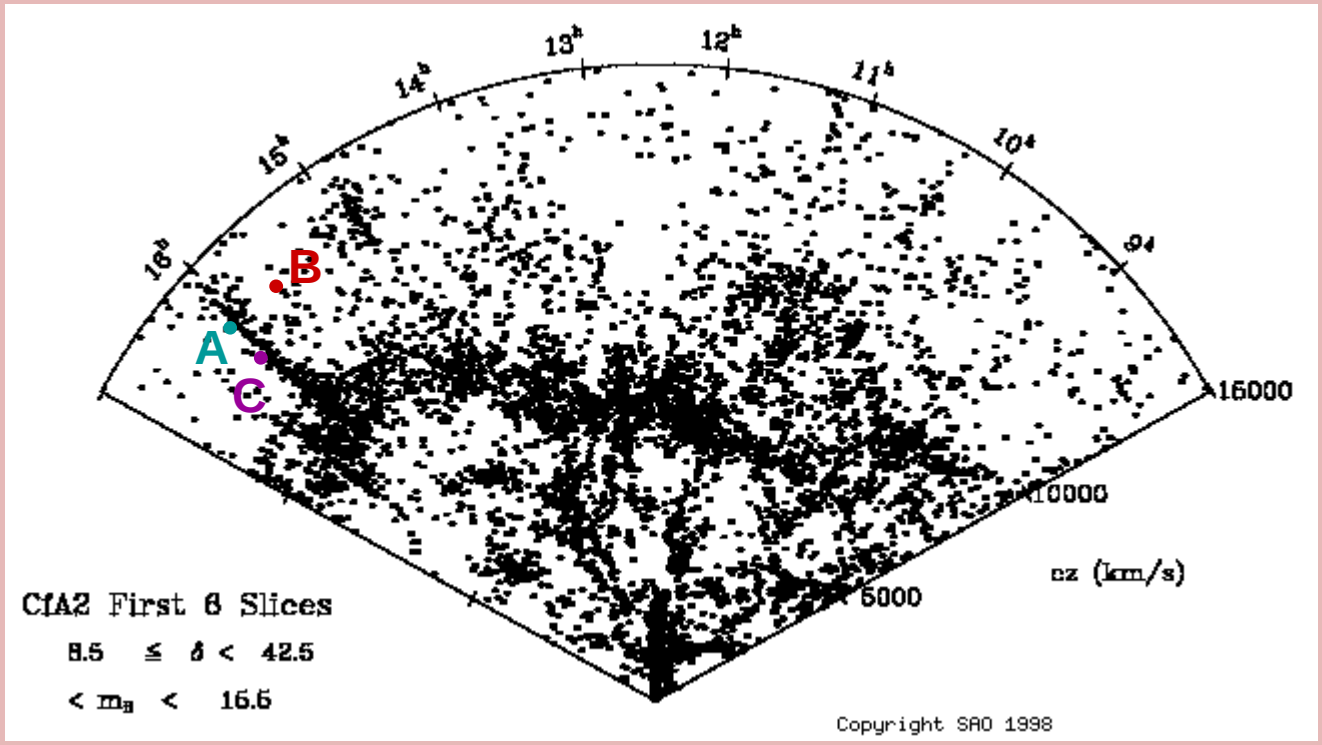




six slices stacked



Think-Pair-Share 1



i. Which galaxy is likely to be furthest away?
ii. Which galaxy is most likely to have a major merger that will create a dominant spheroid in the future?
iii. Which galaxy is most likely to be red?

D = both A and B E (back of paper) = both A and C

two possible solutions to the puzzle

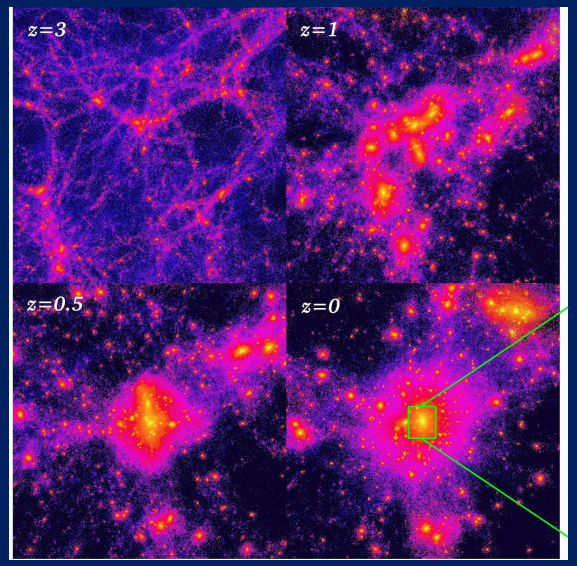
a) morphology-density relation may not reflect cluster processes, but events that occurred in groups destined to later merge into clusters

widely accepted for Es, can make big-bulged S0s

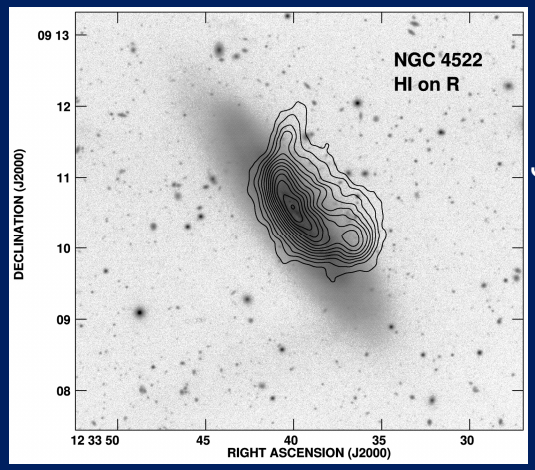
b) the hot gas in clusters may strip, strangle, starve, or otherwise “quench” star-forming galaxies

can make smaller-bulged S0s, probably not Es

pre-processing



B. Moore



Kenney et al 2004

stripping

Think-Pair-Share 2

Suppose you learn that the color-density relation is stronger than the morphology-density relation. Which is most likely to explain this result?

A) all cluster galaxies experience harassment in the cluster

B) all cluster galaxies experience merging in the cluster

C) all cluster galaxies experience pre-processing in groups

D) all cluster galaxies experience the effects of hot gas

Think-Pair-Share 3

What could explain why the morphology-density relation is weaker for S0 galaxies than for Es?

A) S0s are easily mistaken for Es when observed face-on

B) S0s form in many types of galaxy mergers while Es form only in gas-poor mergers

C) repeated harassment destroys S0s but not Es in clusters

D) “quenching” in clusters is only a weak effect