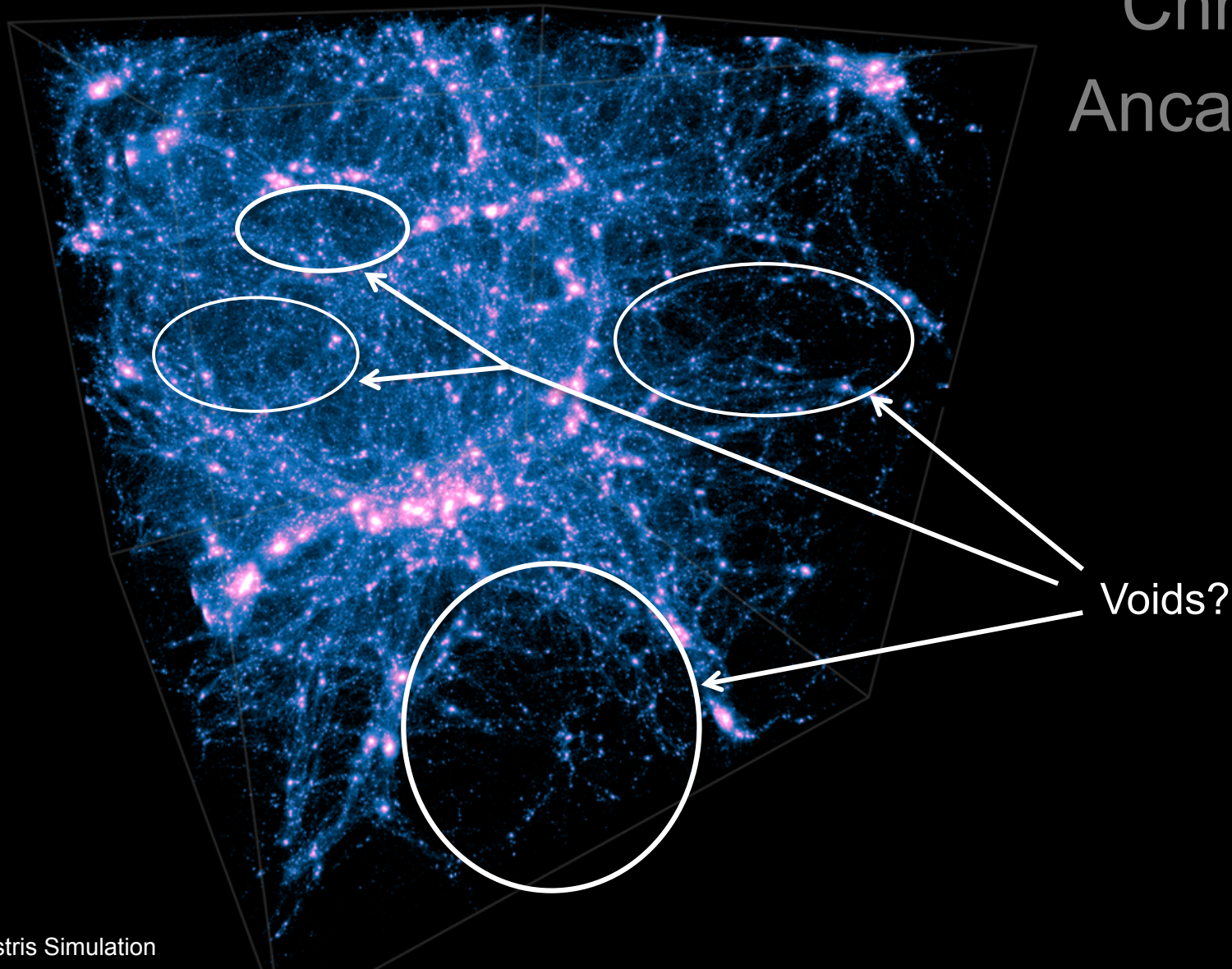
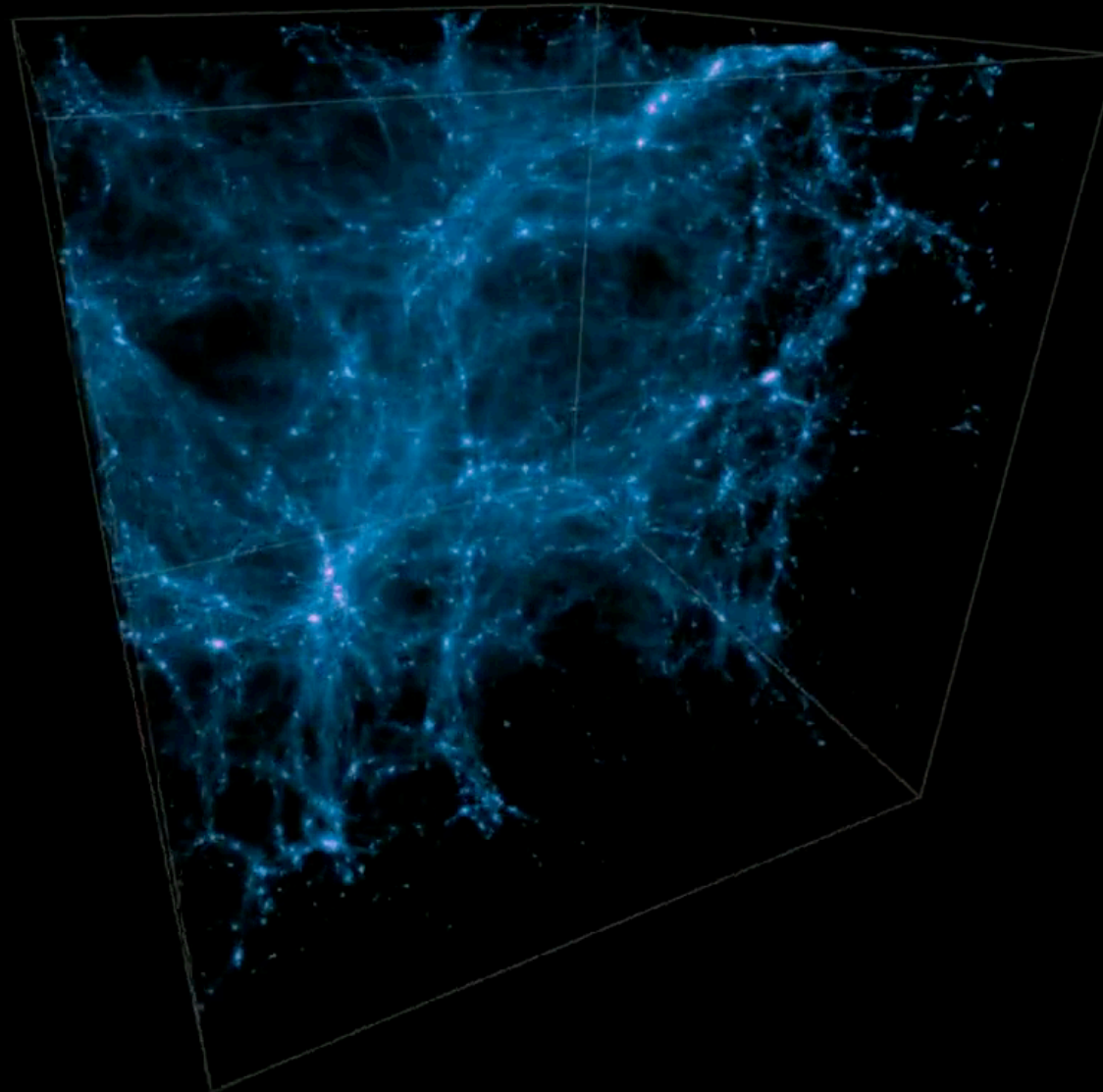


Building the Most Robust Cosmic Void Catalog

Chris Castillo
Anca Constantin



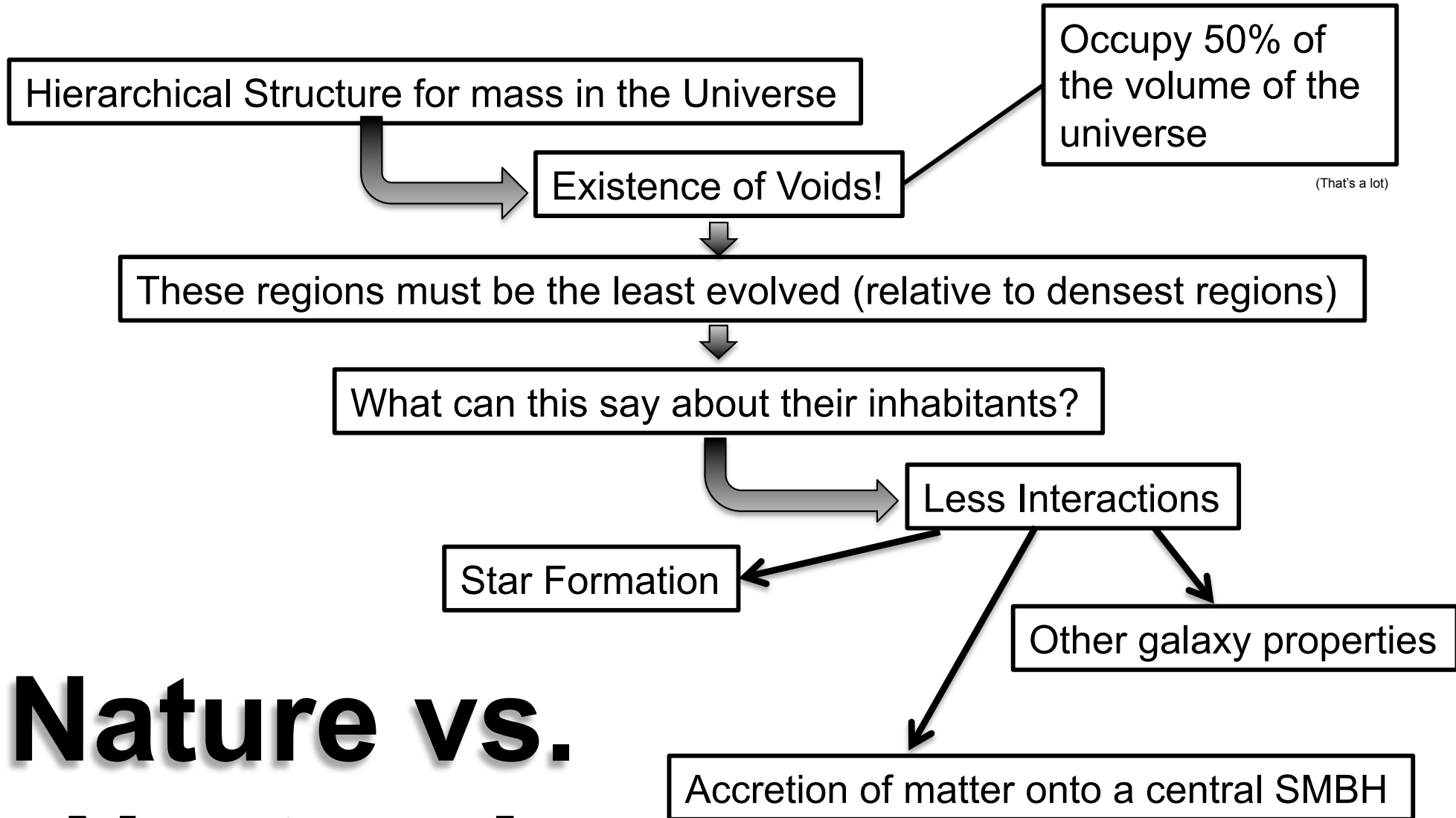
Dark Matter



redshift : 5.47
Time since the Big Bang: 1.1 billion years

stellar mass : 0.5

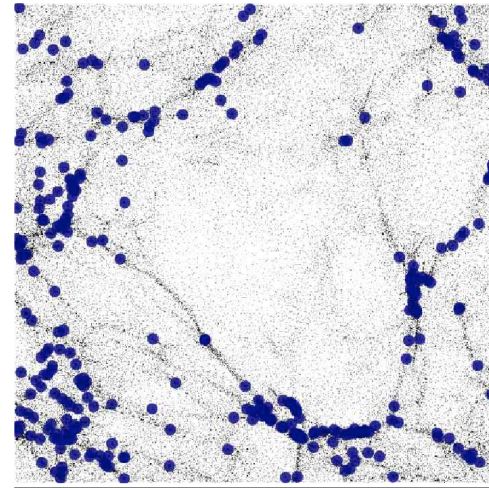
Why Voids?



**Nature vs.
Nurture!**

Finding Voids and their Inhabitants

- Variety of methods used for finding voids
- How matter, dark and luminous, are distributed in the universe



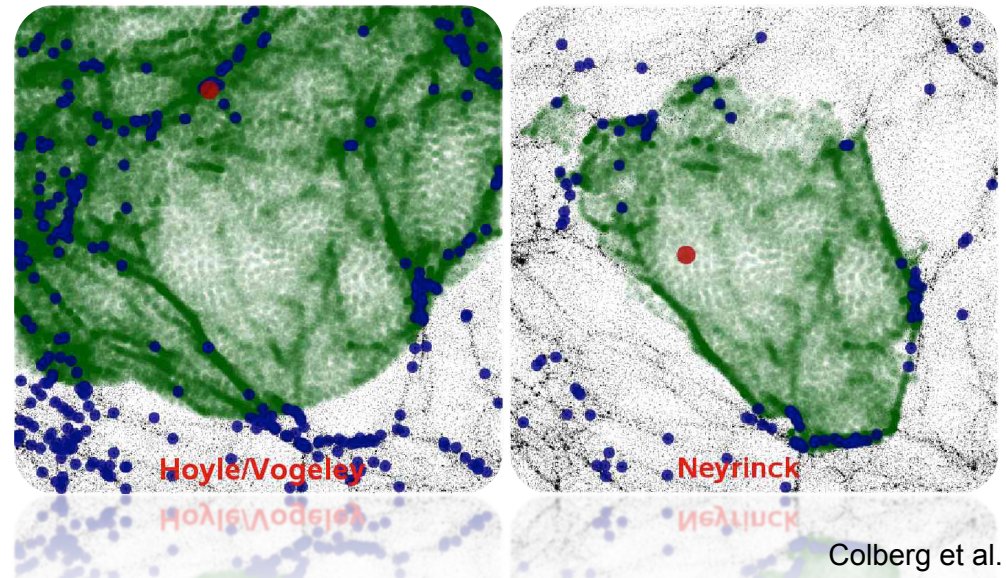
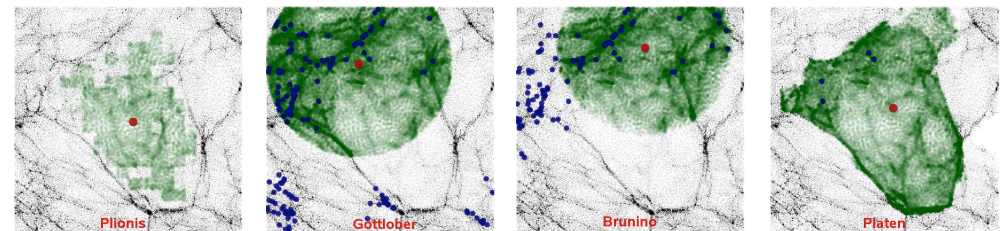
Initial distribution
 Blue - Galaxies
 Grey - Dark matter

Green – Void Region
 Blue – Void Galaxies
 Red – Center of Void

Observations

Simulations

Author	Base
Brunino	Halo
Colberg	Dark matter density field
Fairall	Galaxies
Foster/Nelson	Galaxies
Gottlöber	Halo/Galaxies
Hahn/Porciani	Dark matter density field
Hoyle/Vogele	Galaxies
Müller	Halo/Galaxies
Neyrinck	Dark matter density field
Pearce	Dark matter
Platen/Weygaert	Dark matter density field
Plionis/Basilakos	Dark matter density field
Shandarin/Feldman	Dark matter density field



Two Most Recent Void Finder Studies

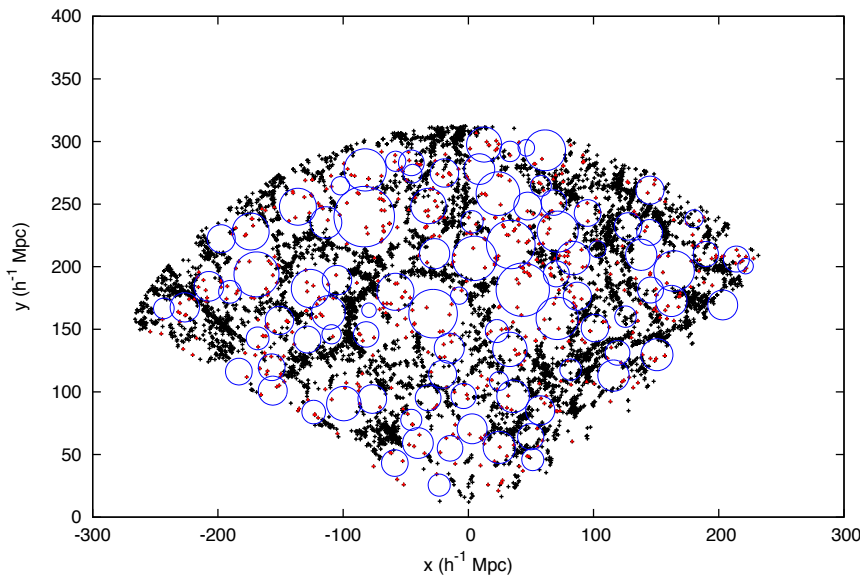
SDSS

Pan et al. (2012)

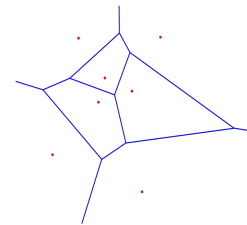
- Simplest shape: spherical
- Third nearest neighbor
- Grow spheres
- Form hierarchy from overlapping spheres
- All galaxies inside these spheres are void galaxies

Nadathur & Hotchkiss (2014)

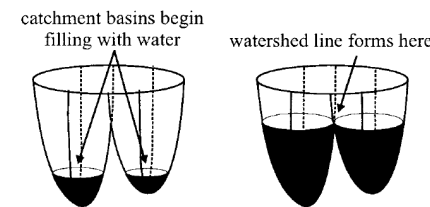
- No assumption of void shape
- ZOBOV
 - Form Voronoi tessellation, take inverse to get density
 - Use watershed to form 'zones'
- Code publicly available
 - Modify parameters
 - Build our own samples



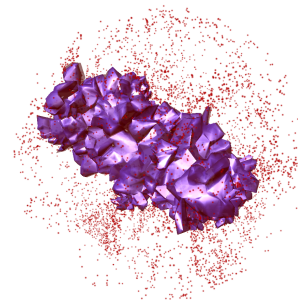
10 h⁻¹ Mpc thick slab of parent sample



Voronoi Tessellation



Watershed

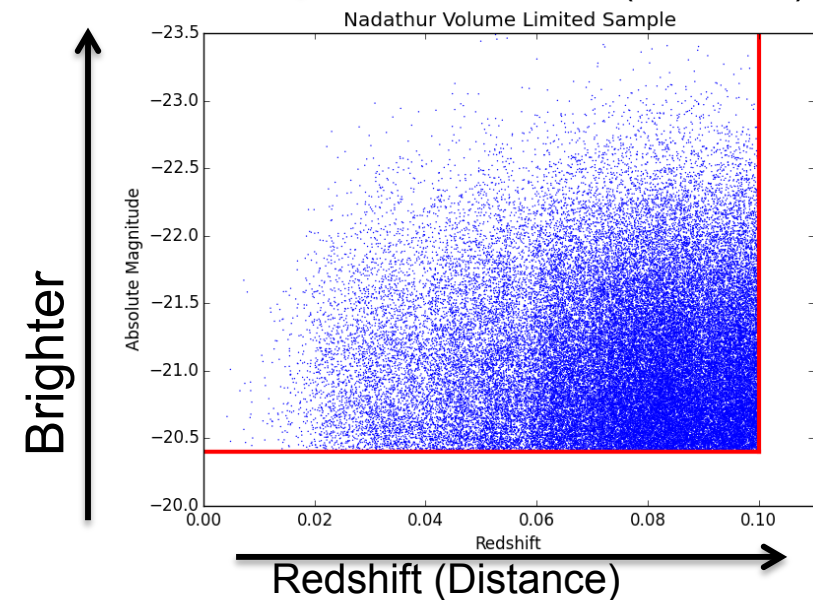
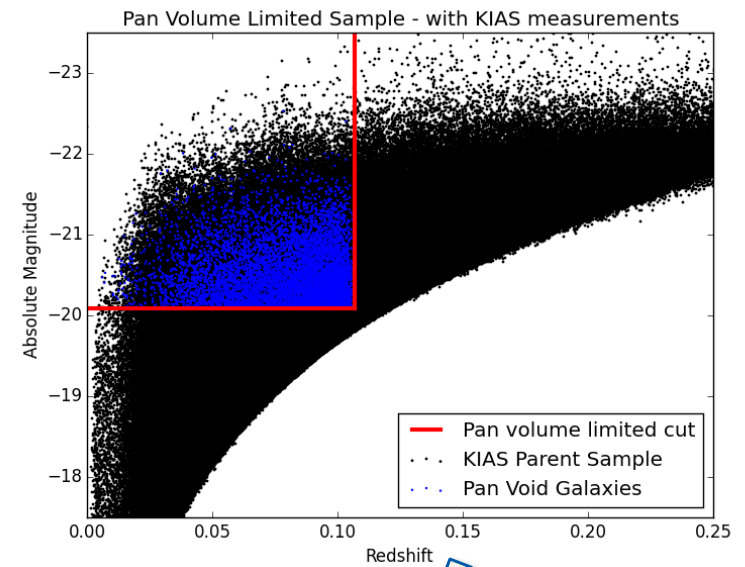
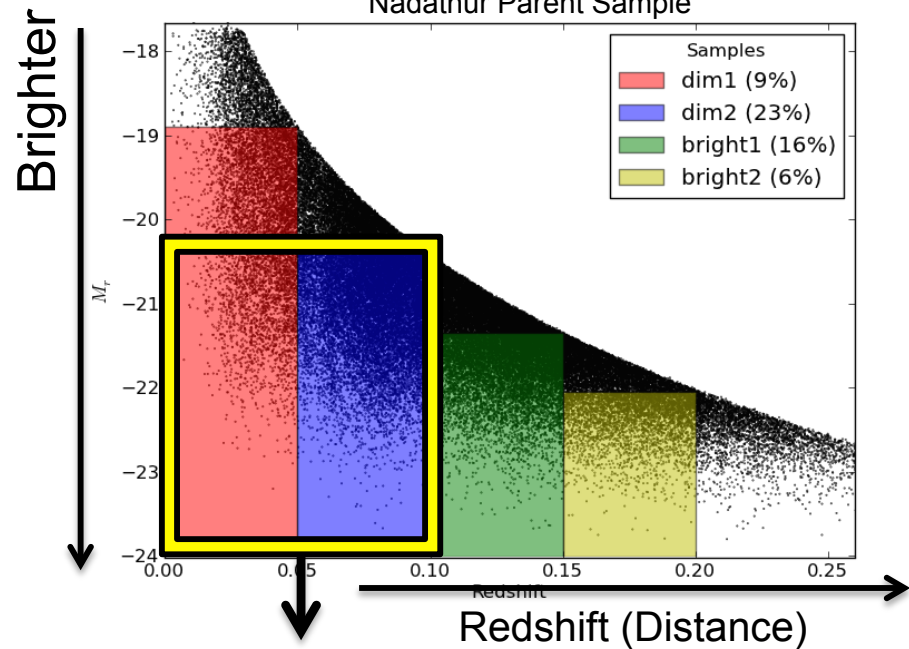


Zones!

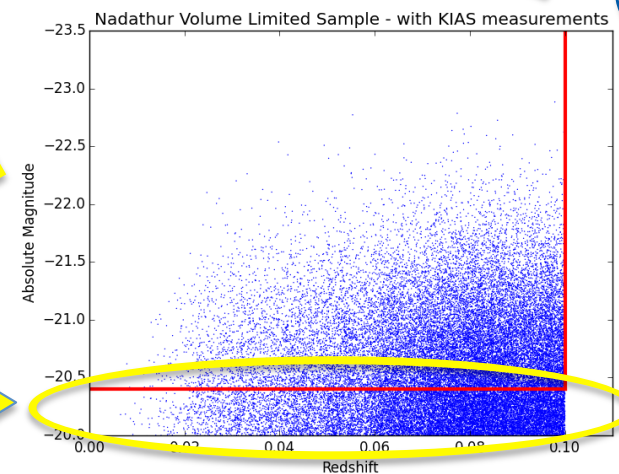
Brightness and z Distribution: Comparing Apples with Apples

Calculated Intrinsic Brightness (2011 cosmology)

Intrinsic Brightness from KIAS (2004 cosmology)

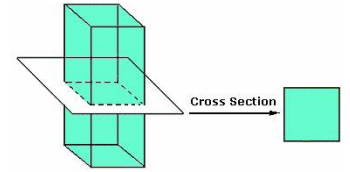


Using KIAS

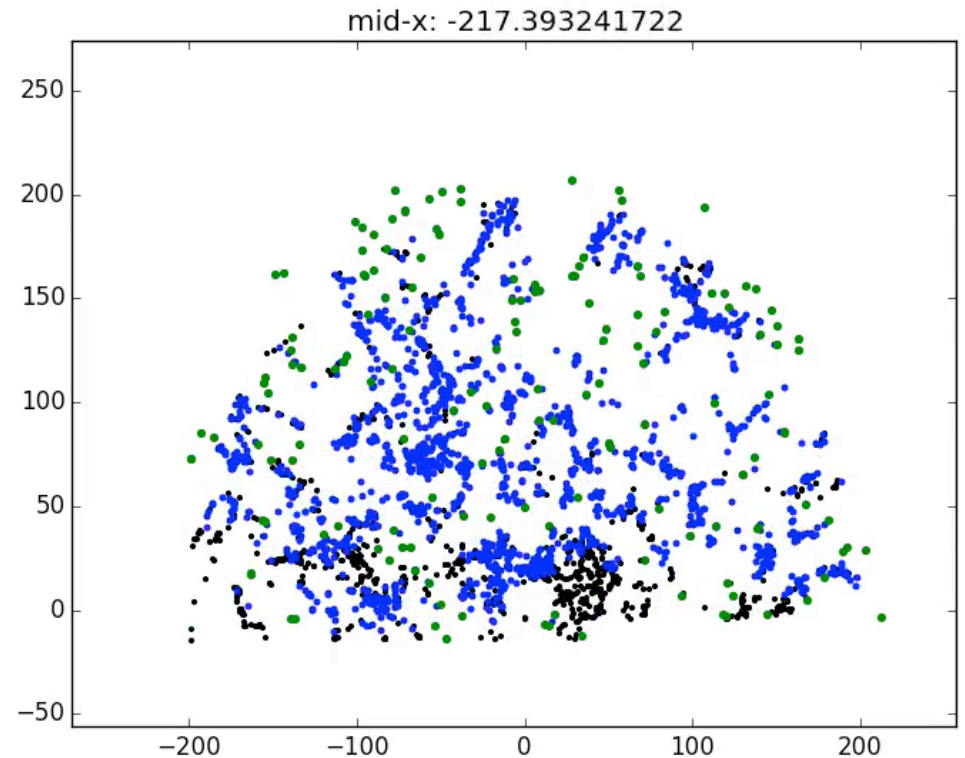


UH OH

Comparing Pan and Nadathur's Void Samples



	Pan	Nadathur
Parent Sample	~120,000	~178,000
Void gals Identified	8046 (7%)	86282 (49%)

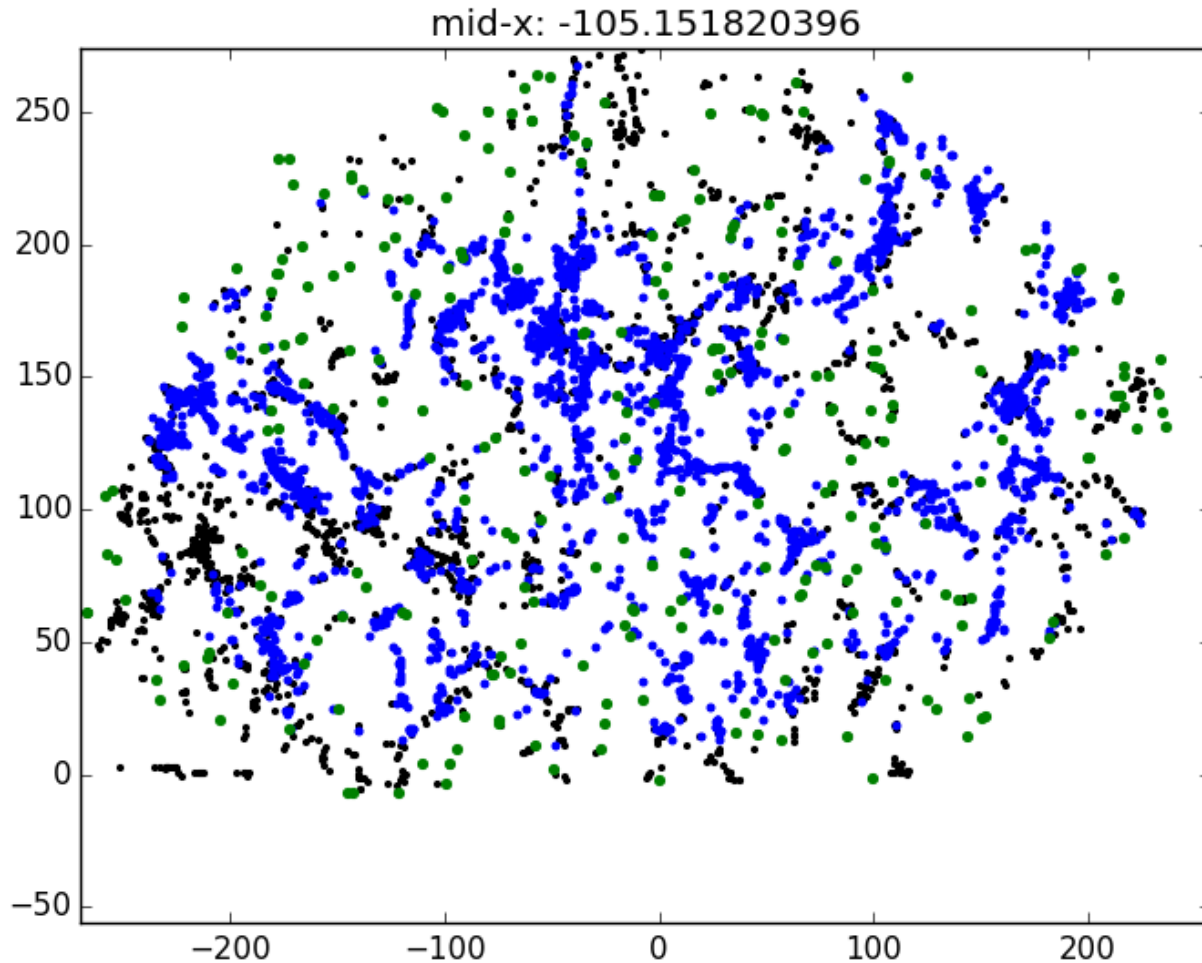


Black Galaxy

Blue Nadathur Void Galaxy

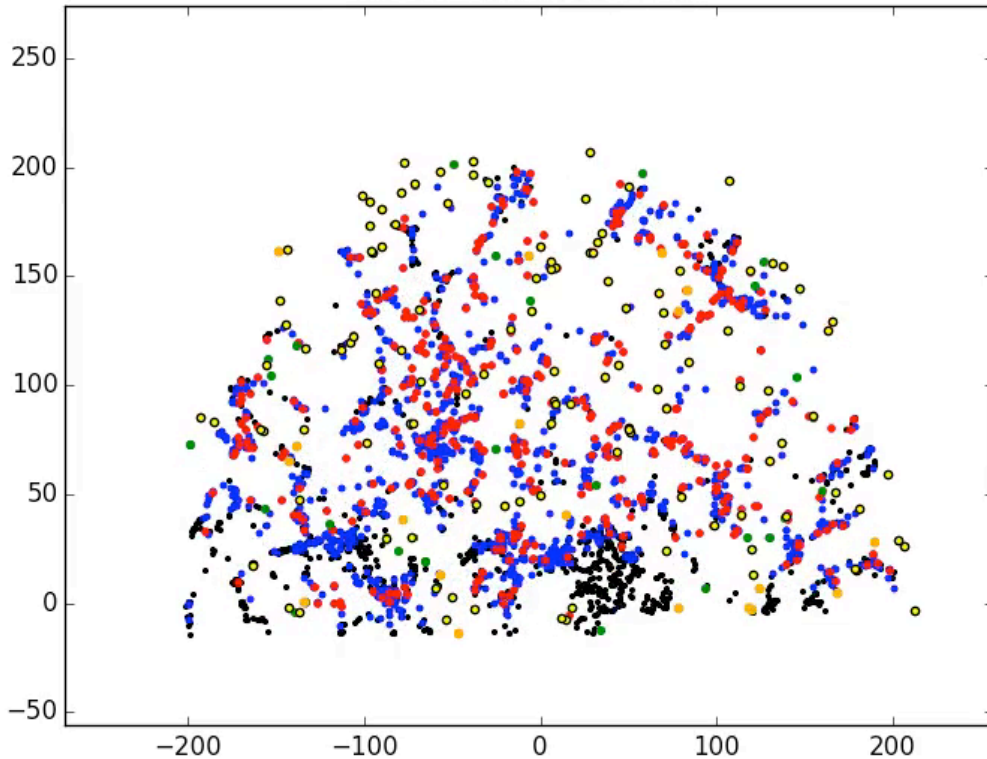
Green Pan Void Galaxy

Optimizing Voids with Nadathur's Void Finder Algorithm



Comparing Pan and optimized Nadathur's Void Samples

mid-x: -216.199184048



	Pan	Nadathur
Parent Sample	120,000	178,000
Void gals Identified	8046 (7%)	86282 (39%)
Void gals with my cut		19122 (10.7%)

Black Galaxy

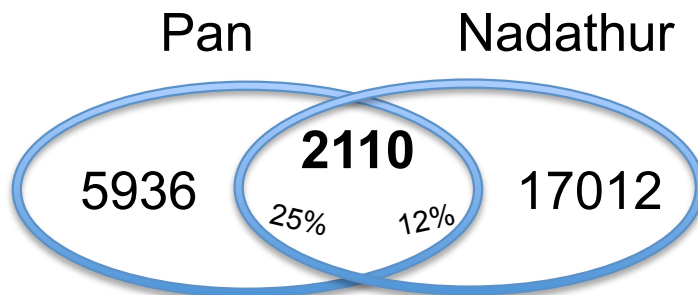
Blue Nadathur Void Galaxy

Green Pan Void Galaxy

Red N. Void Galaxy w/Density Cut

Orange Pan & N. Void Galaxy

Yellow Pan & N. Void Galaxy W/Density Cut



Now the Fun Begins...

- Much to do:
 - Try other density cuts
 - Stronger tests of consistency
 - Resolve absolute magnitude disparity
- All with the **final goal** of comparing properties of galaxies in voids and in walls (normal density regions)

Questions