Environments of z~0.2 Star Forming Galaxies: Building on the Citizen Science Discovery of the Green Peas

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with Meredith Powell, Nico Cappelluti & Meg Urry @ *Yale*

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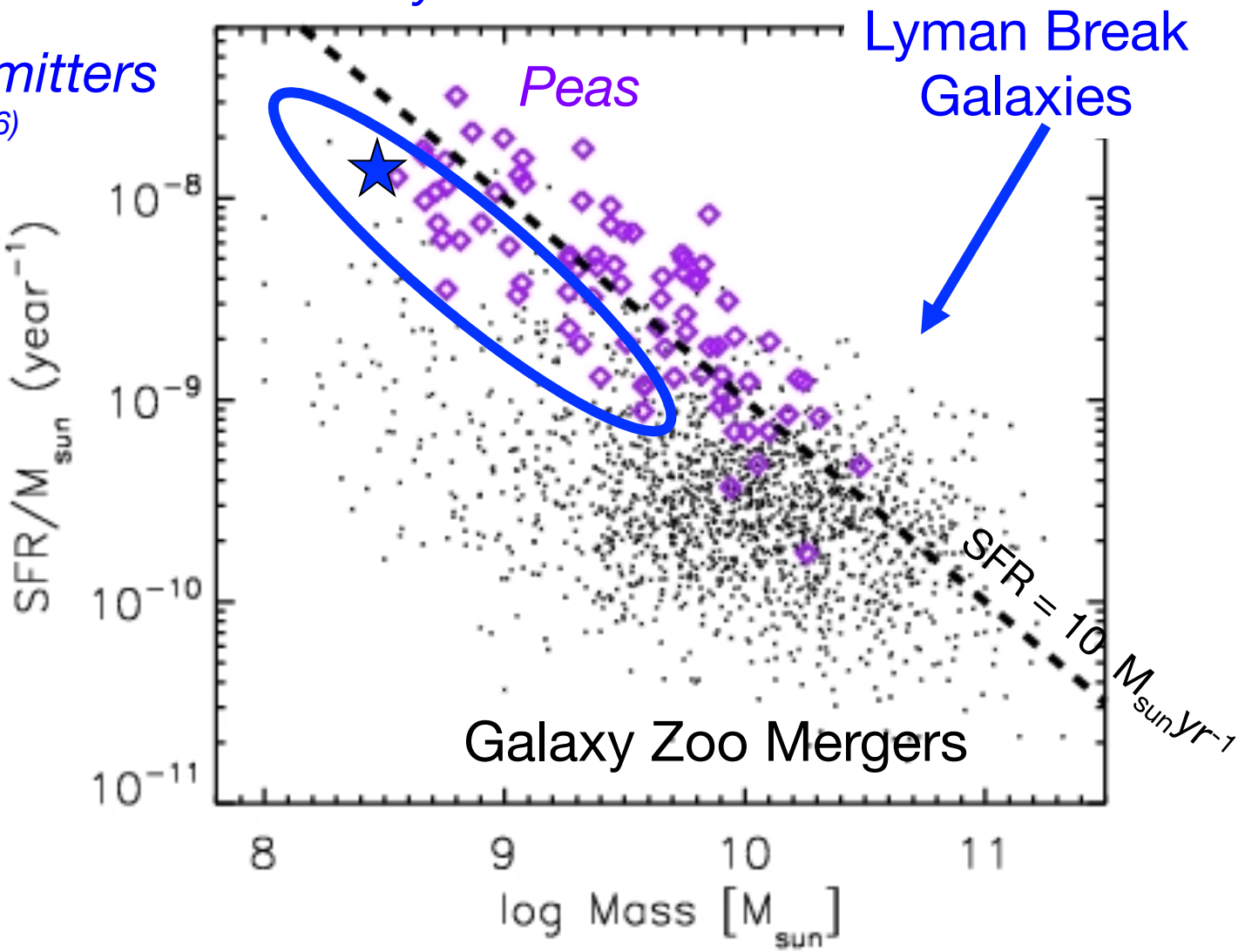
Galaxy Zoo Green Peas: discovery of a class of compact extremely star-forming galaxies

Specific Star Formation Rate

Galaxies from the early Universe

Lyman-a Emitters
(Gawiser et al. 2006)



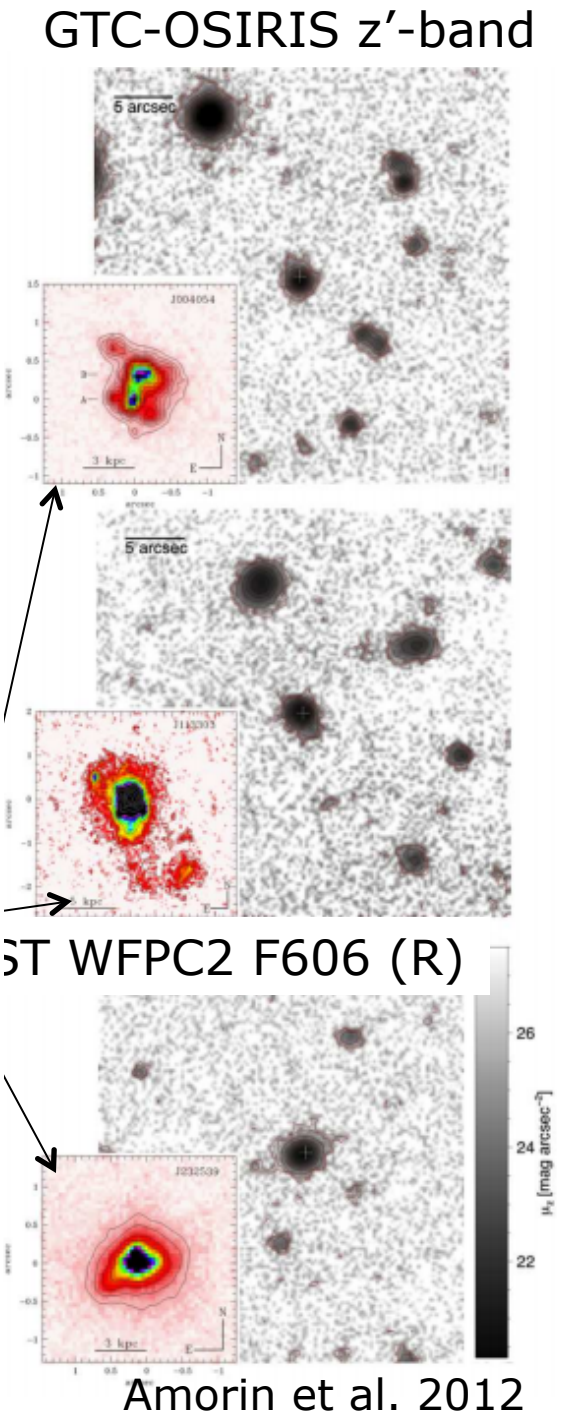
after Castro Cerón et al. 2006

Cardamone et al. 2009

Follow-up Studies

- **Short / Extreme phase of SF**

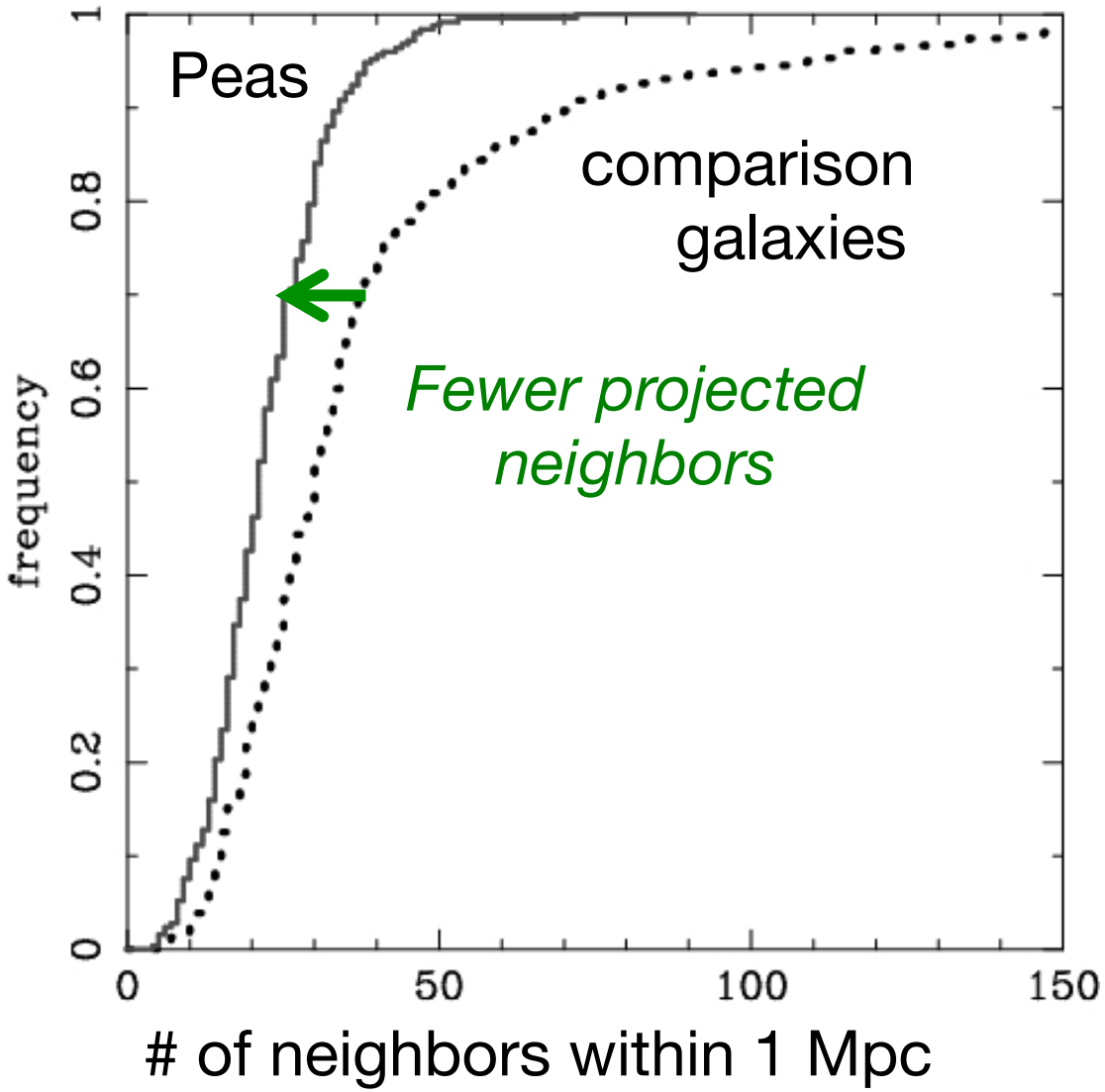
What is their galactic environment?



Amorin et al. 2010, Amorin et al. 2011, Izotov et al. 2011, Amorin et al. 2012, Hawley 2012, Pilyugin et al. 2012, Chakraborti et al. 2012, Henry et al. 2015, Rutkowski et al. 2017, Greis et al. 2017

Peas may live in under-dense regions

Cumulative Distribution



Correlation functions provide a better measure of the 3D environment

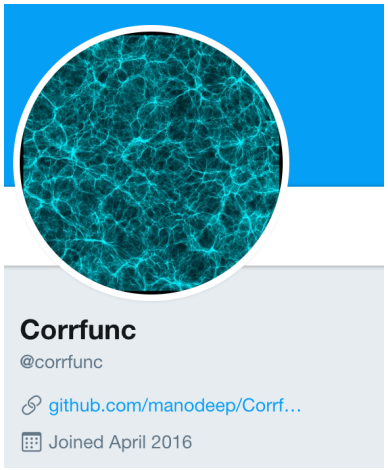
Cardamone et al. 2009

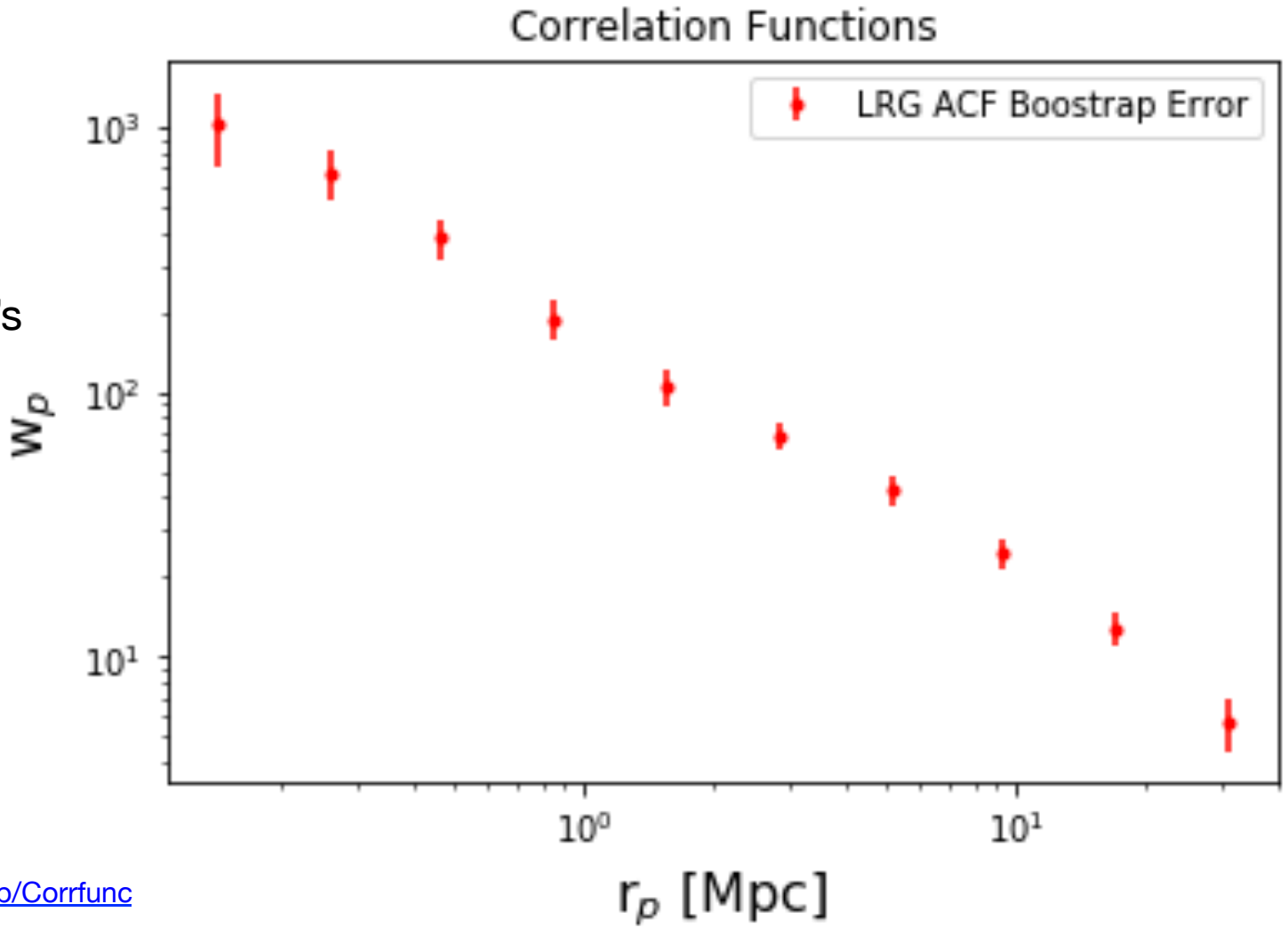
Correlation Function

Pair Counting: a pair of galaxies are a distance r

$$w_p(r_p) = 2\int_0^{\pi_{max}} \xi(r_p, \pi) d\pi$$

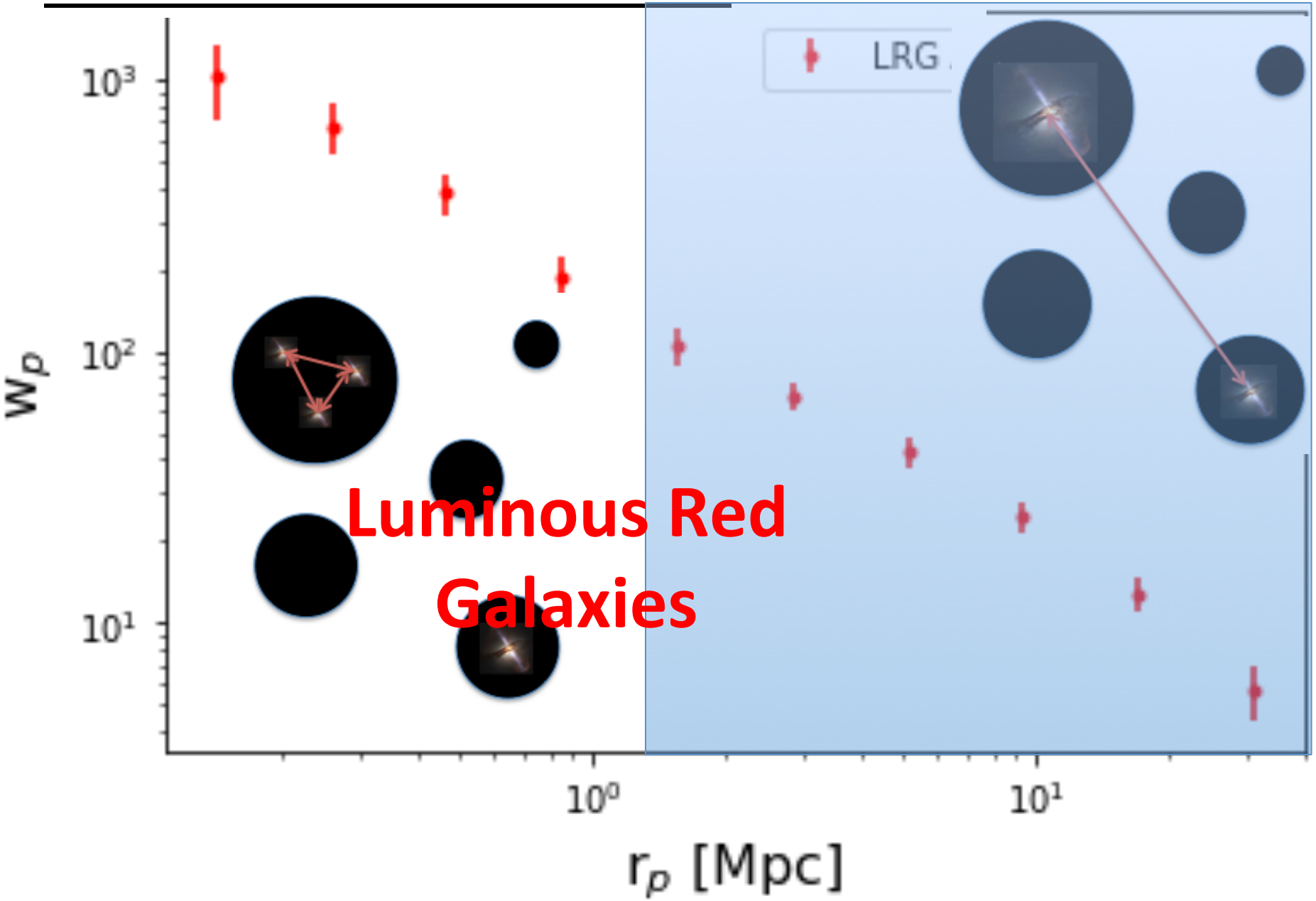
Manodeep Sinha's CorrFunct



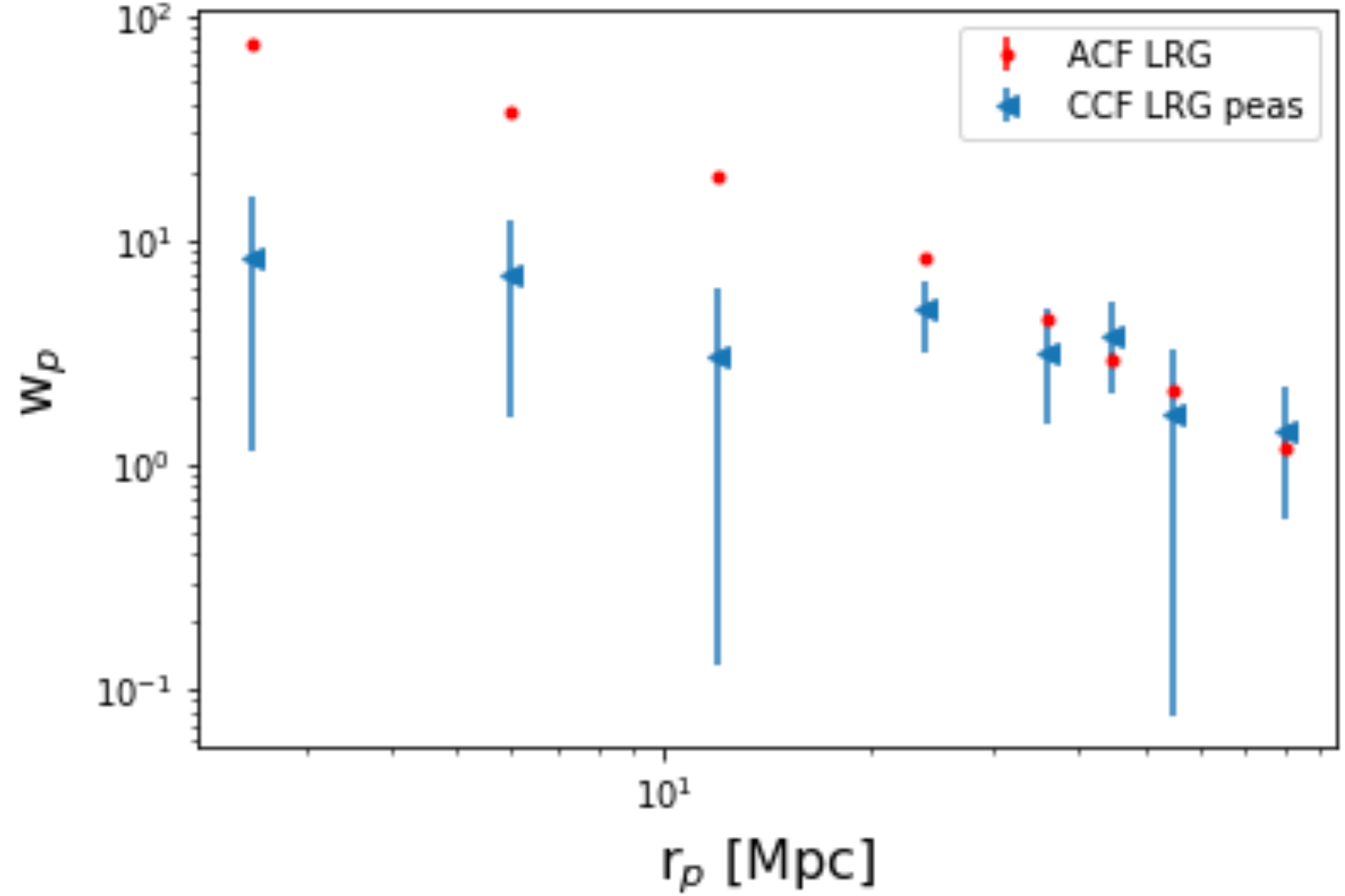


https://github.com/manodeep/Corrfunc

Correlation Function



Cross-Correlation Function (r > 1 Mpc)



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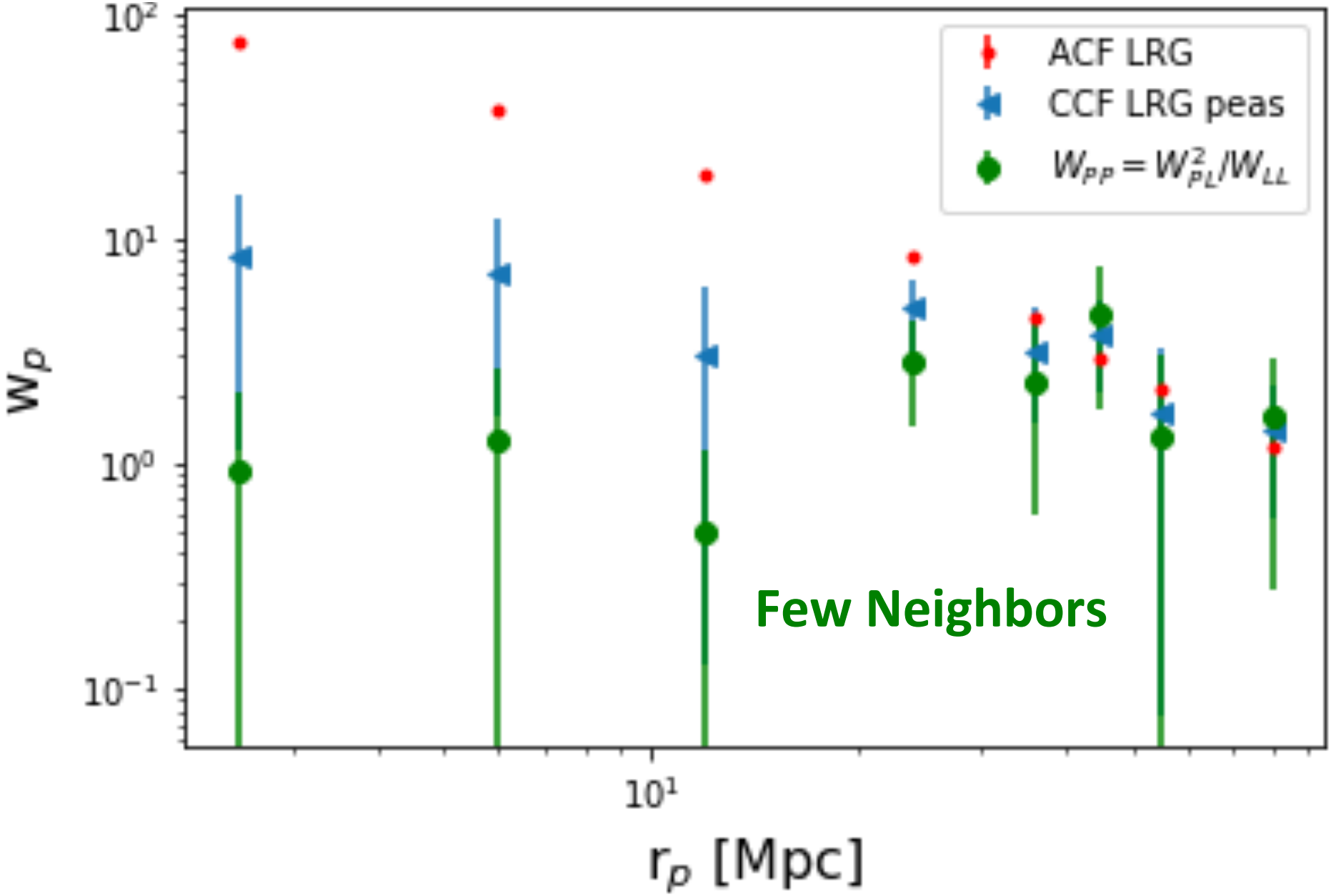

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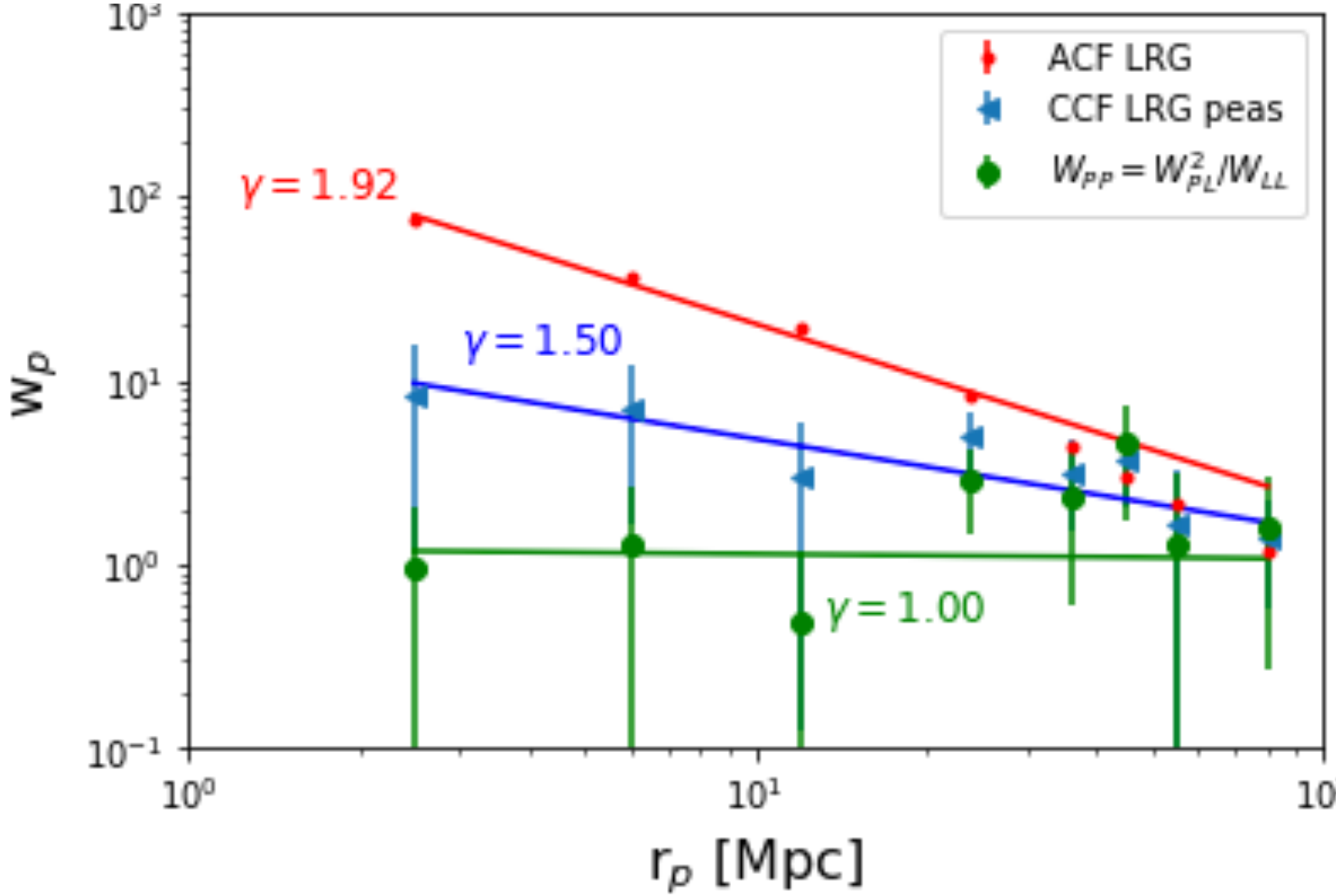

Conclusions

- Peas do not trace dark matter distributions.
- Peas live in under dense regions compared to Luminous Red Galaxies.
  - Small bias value (< 0.5)
- Next Step: Use dark matter model to characterize bias


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Comparison to Higher Redshift

	LBG / LαE	***The Peas***
Redshift	*z ~ 3.0*	*z ~ 0.2*
Low Reddening	E(B-V)~0.05-0.2 (Verhamme et al. 2008)	E(B-V) ≤ 0.2
Compact Morphology	compact/disturbed (Giavalisco et al. 1996, Bremer et al. 2004)	compact/disturbed (HST)
High Specific Star Formation Rate	~10s Msun/yr (Carilli et al. 2008; Coppin et al. 2007; Lehmer et al. 2005; Barmby et al. 2004)	~ 0.3 - 30 Msun/yr
Lower Metalicity	10-50% solar	~50% solar
Environment	dense regions (Giavalisco 2002)	under-dense regions

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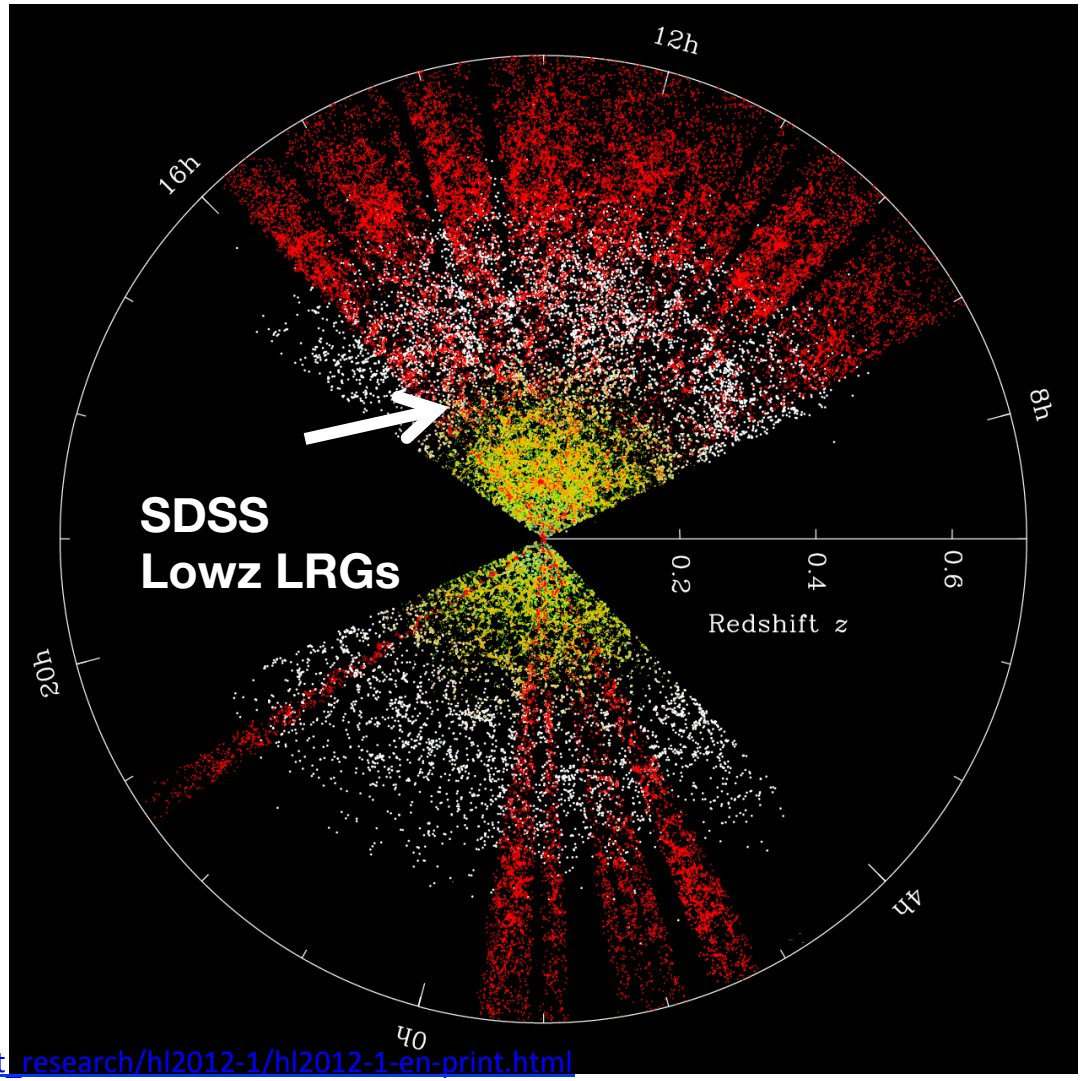
Cross-Correlation Function

Luminous Red Galaxies

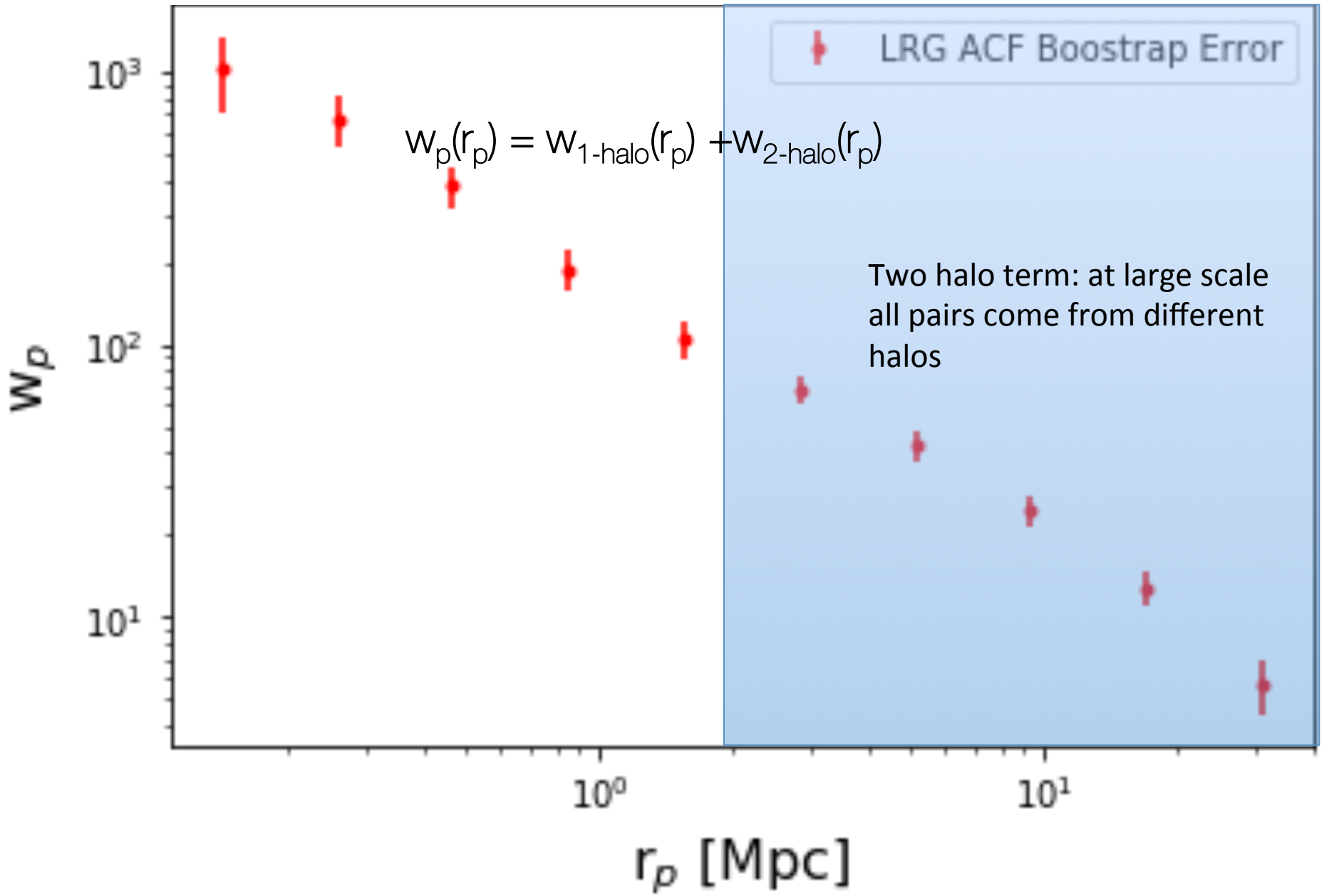


- Homogenous well studied sample
- Successfully constrained cosmological parameters (e.g., Tegmark et a. 2004)
- HOD models are good fit (Zehavi et al. 2005, Reid & Spergel 2009, White et al. 2011)

http://wwwmpa.mpa-garching.mpg.de/mpa/research/current_research/hl2012-1/hl2012-1-en-print.html

Luminous Red Galaxy Auto-Correlation Function

(sample provided by N Padmanabhan, BOSS)



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