Merger Fractions: Comparing L-Galaxies and Observations

Carl Mundy

Kenneth Duncan (Leiden), Chris Conselice (Nottingham)

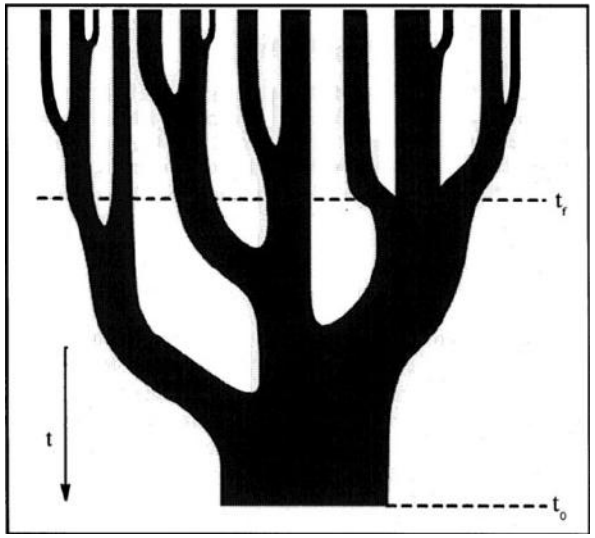
Building Massive Galaxies

Massive structures grow hierarchically – small things merge to form big things

Dark matter N-body simulations (Millennium Run!) predict that halo-halo merger rates go as $\sim(1+z)^{2-3}$

The galaxy-galaxy merger rate is not trivial to deduct from this…

Measuring the galaxy merger rate can help inform the transformation of this halo-halo merger rate to the galaxy merger rate in models



Lacey & Cole (1993)

Building Massive Galaxies

Galaxies build up their stellar mass via two main pathways: SF and mergers.

Observe stark changes in massive galaxies over the last 10 billion years

- SFR density has ↓ by an order of magnitude
- $\mathcal{M}^*$ density has ↑ by a factor of 2-3
- Massive galaxies have gone from SF, disc-dominated systems to quiescent, bulge-dominated systems

The contribution of galaxy mergers towards these observed changes is still not well understood.

SFR density

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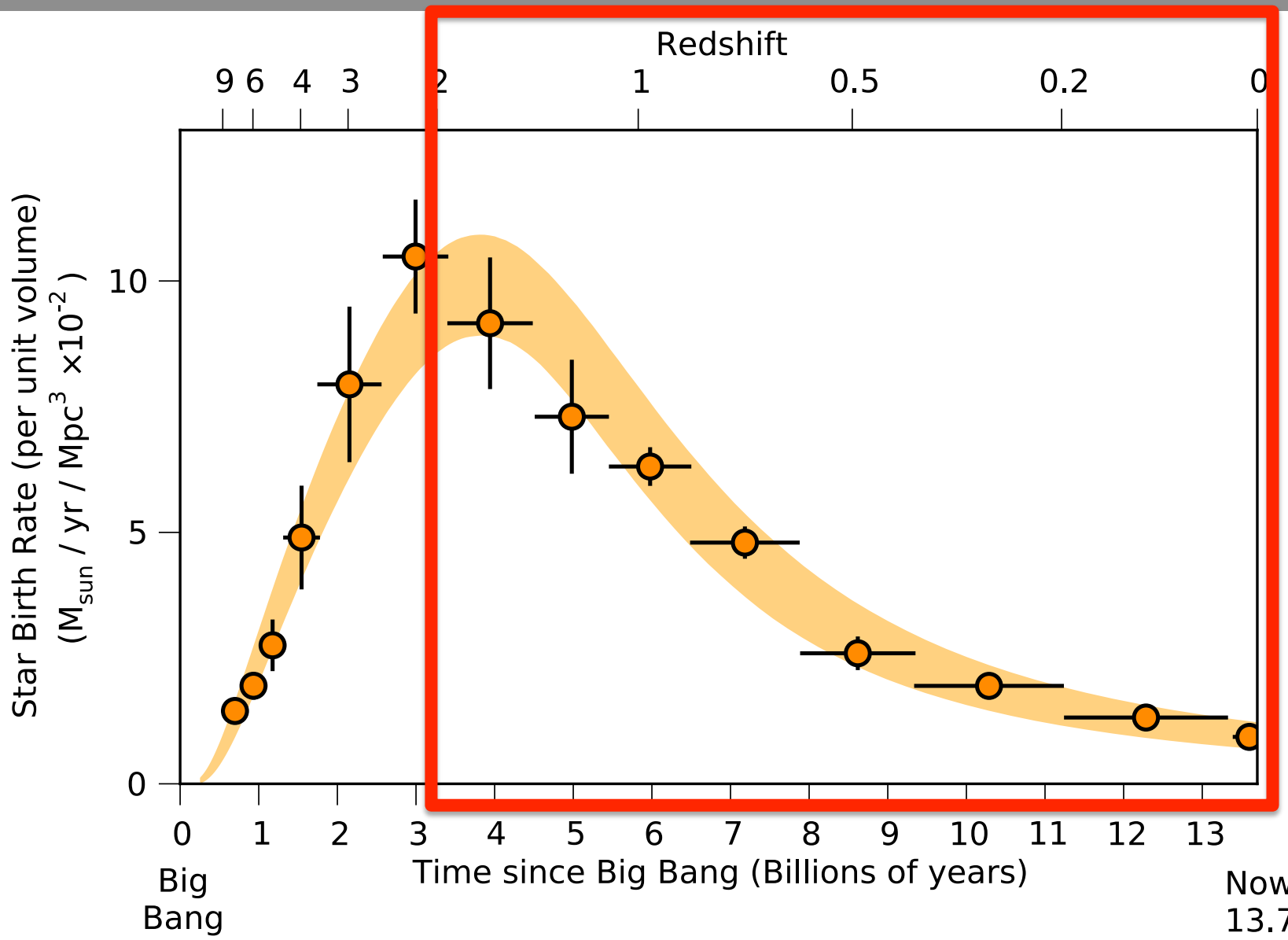

Duncan, K. (priv. comm.)

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STELLAR MASS DENSITY

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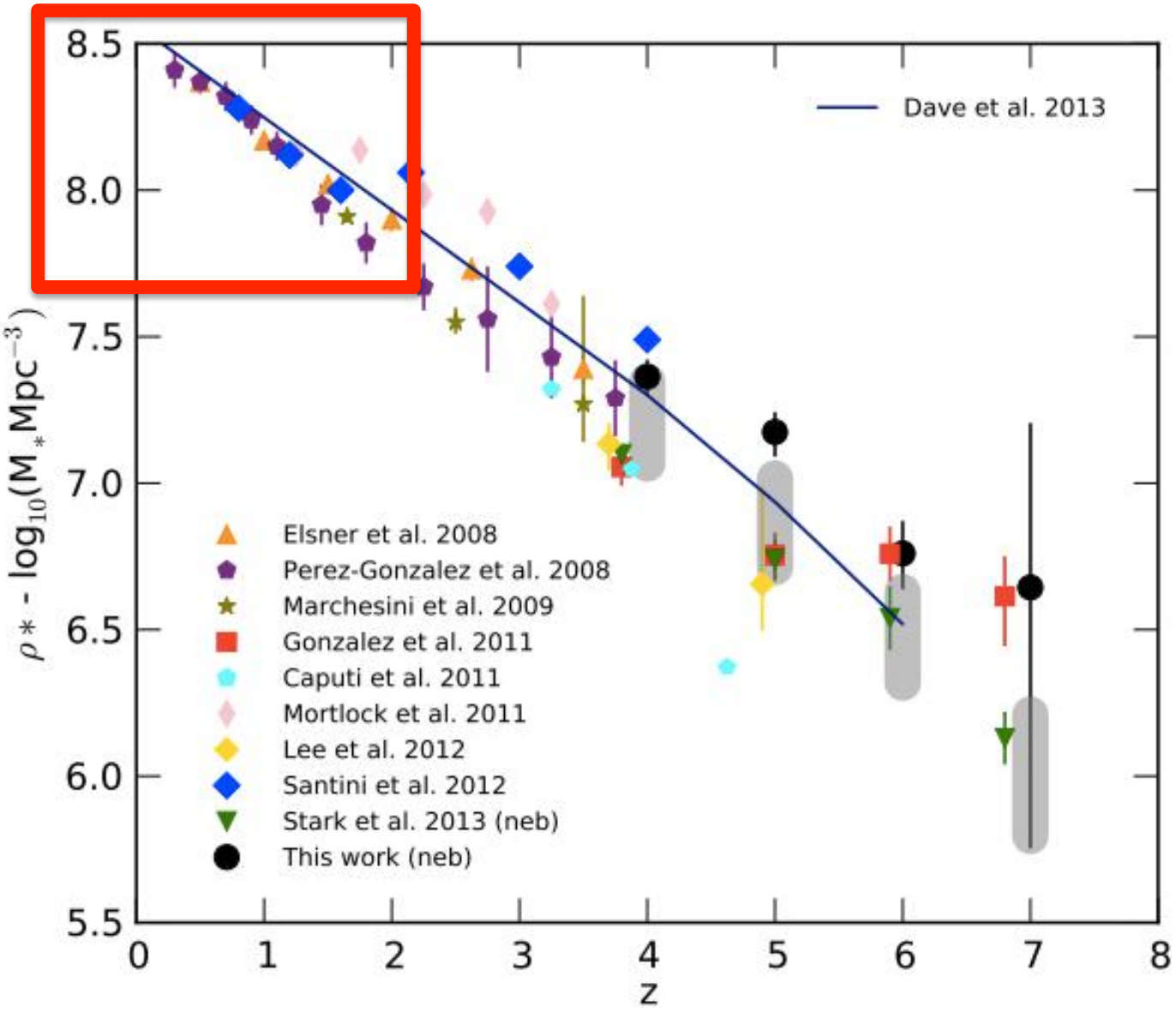

Duncan *et al.* (2014)

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Hunting for Galaxy Mergers

2 main methods used measure the galaxy merger fraction:

- Morphological indicators
- Close-pair analysis

Each has their own pros and cons – photometric redshift uncertainty; volume limitations; S/N requirements…

Close-pair analysis can provide estimates on the merger fraction over large redshift ranges and for low-resolution, ground-based imagery!

Hunting for Galaxy Mergers

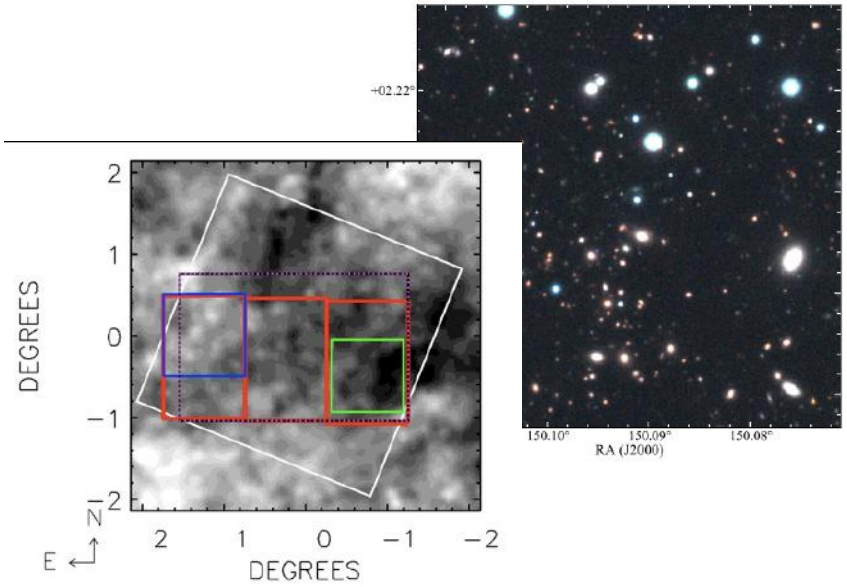
Pyrus – novel method to search for mass-selected galaxy close-pairs

https://github.com/dunkenj/Pyrus

- Evolved from method presented in López-Sanjuan *et al.* (2015)
- Uses the full galaxy redshift PDFs, M*(z)
- Takes into account: photometric redshift quality; masked spatial areas; flux-limited nature of surveys

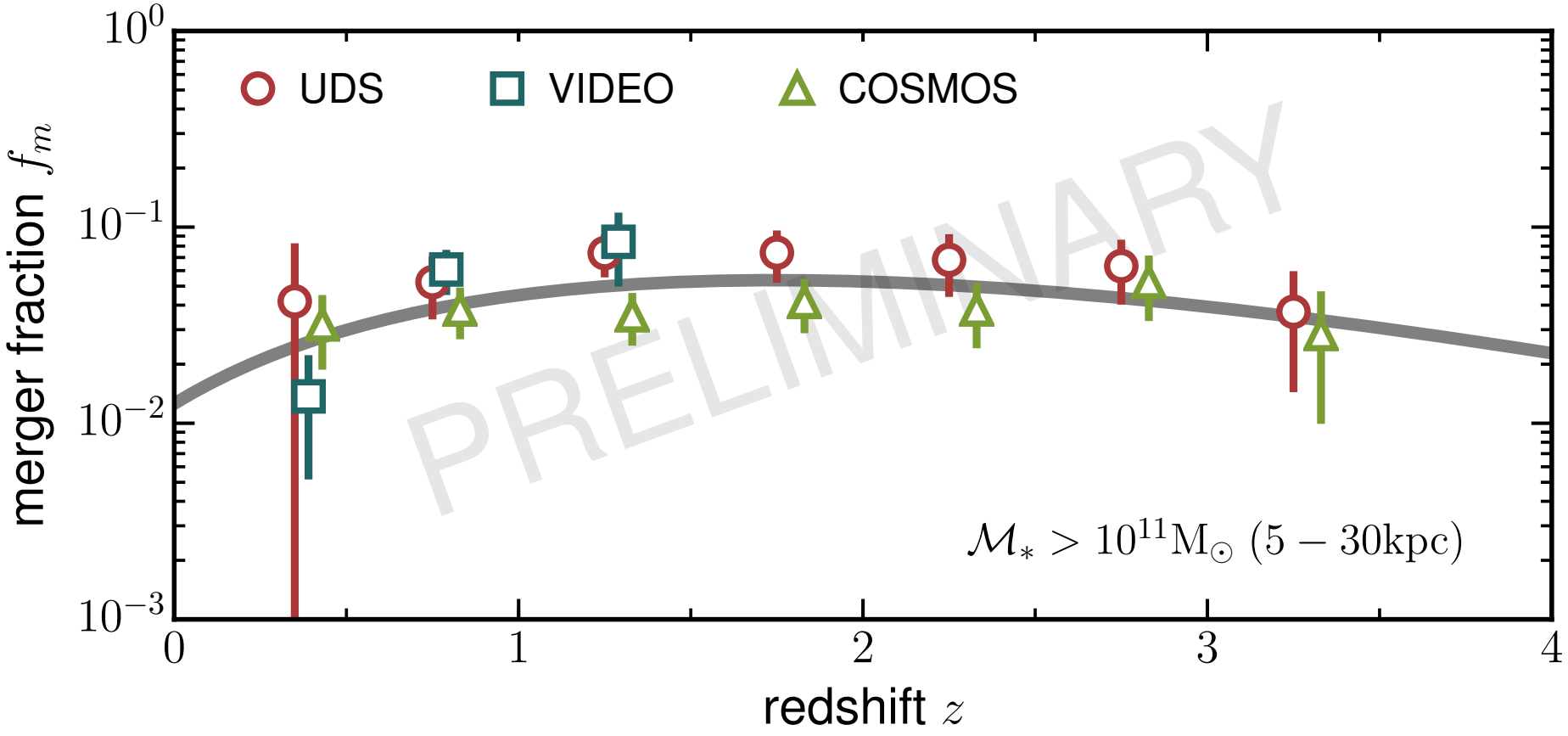
Hunting for Galaxy Mergers

- **UltraVISTA** (*McCracken+2012*)
  - 1.62 sq. deg. down to $m_k = 23.4$
  - FUV to IRAC Ch4 (29 bands)
- **UKIDSS UDS** (*Almaini+in prep*)
  - 0.62 sq. deg down to $m_k = 24.3$
  - u – IRAC Ch4 (11 bands)
- **VIDEO** (*Jarvis+2013*)
  - 1 sq. deg. matched to CFHT-LS data down to $m_k = 22.5$
  - U – K-band (9 bands)

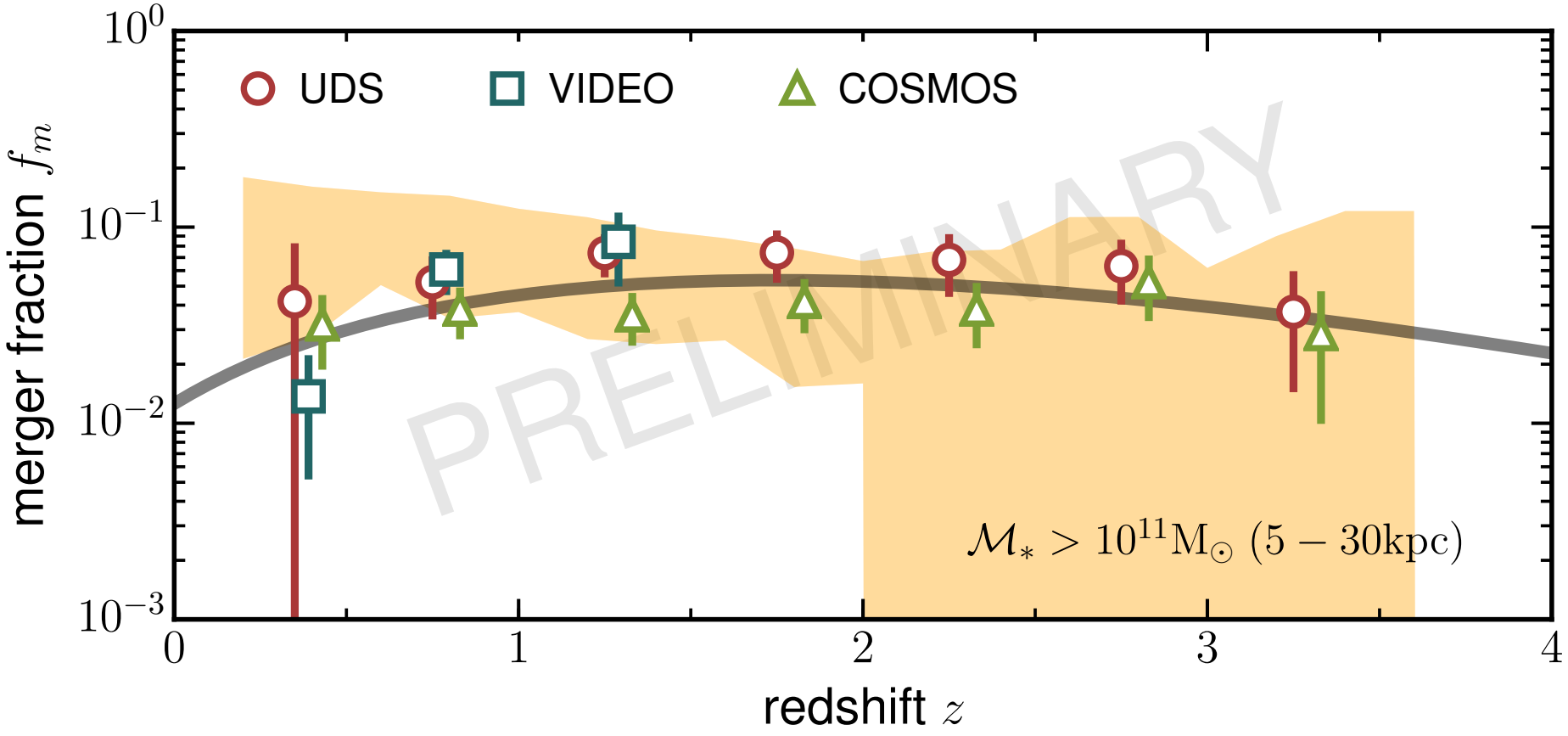


+ CANDELS

Hunting for Galaxy Mergers

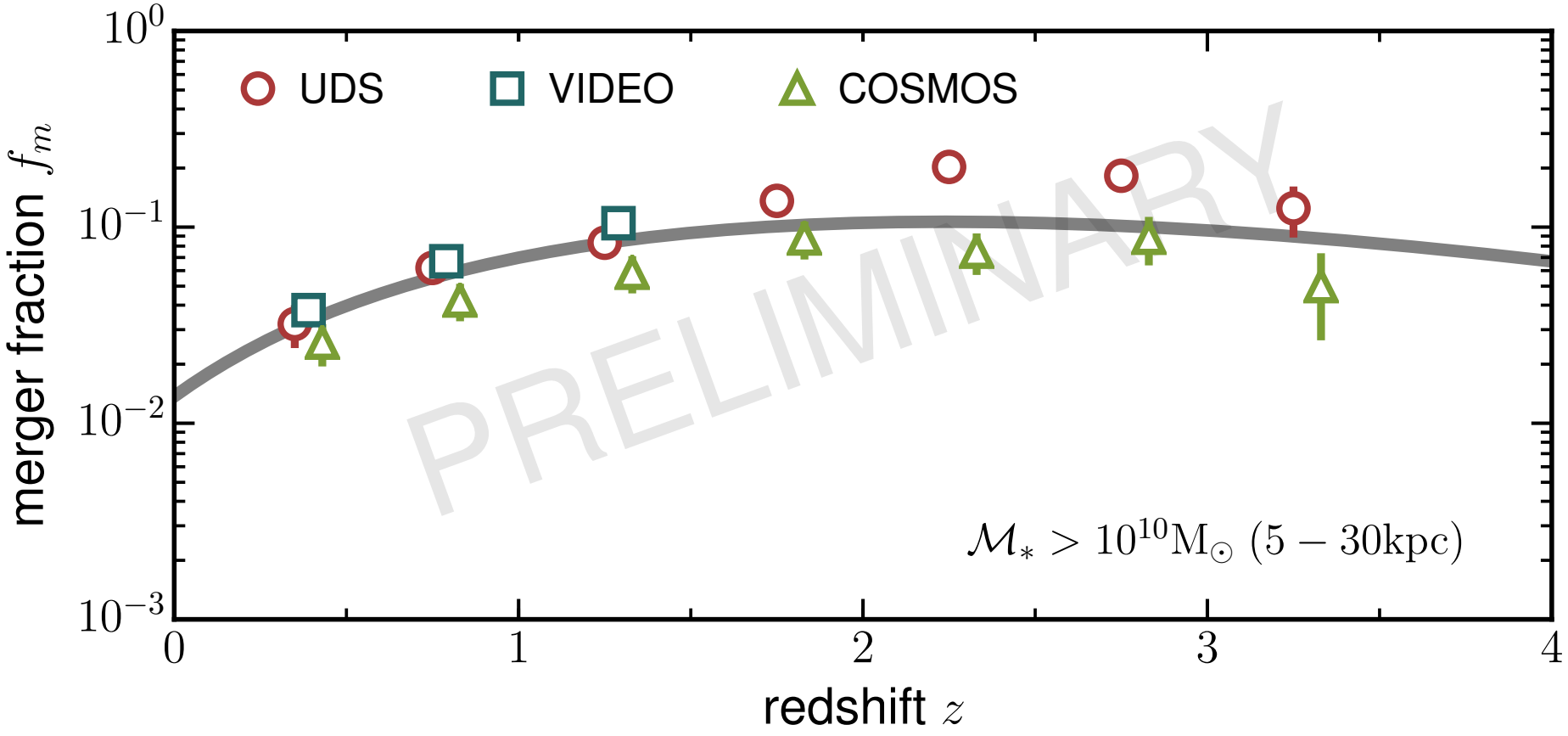


Hunting for Galaxy Mergers



Carl J. Mundy – L-Galaxies Workshop (12/2/2016)
http://nottingham.ac.uk/~ppxcjm

Hunting for Galaxy Mergers



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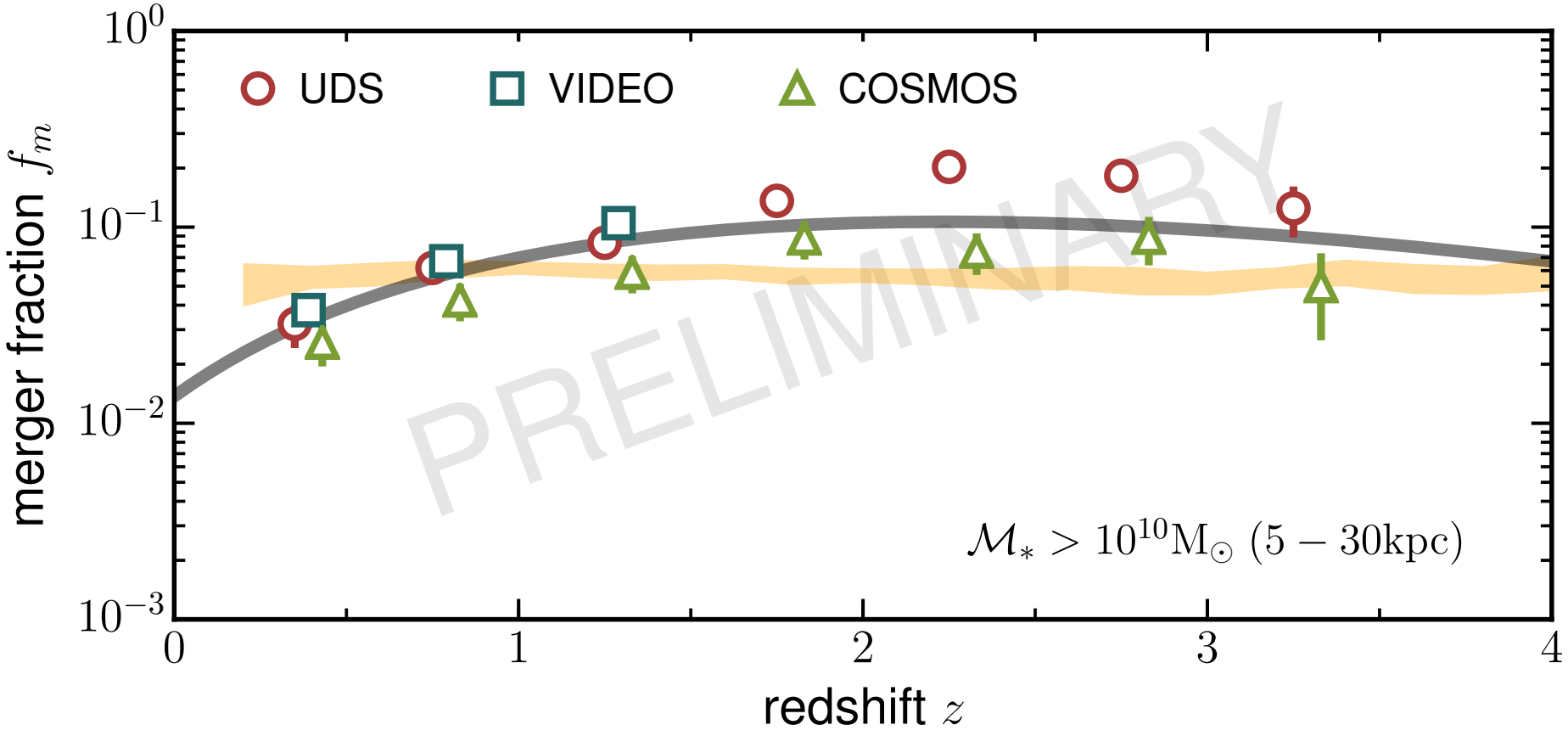

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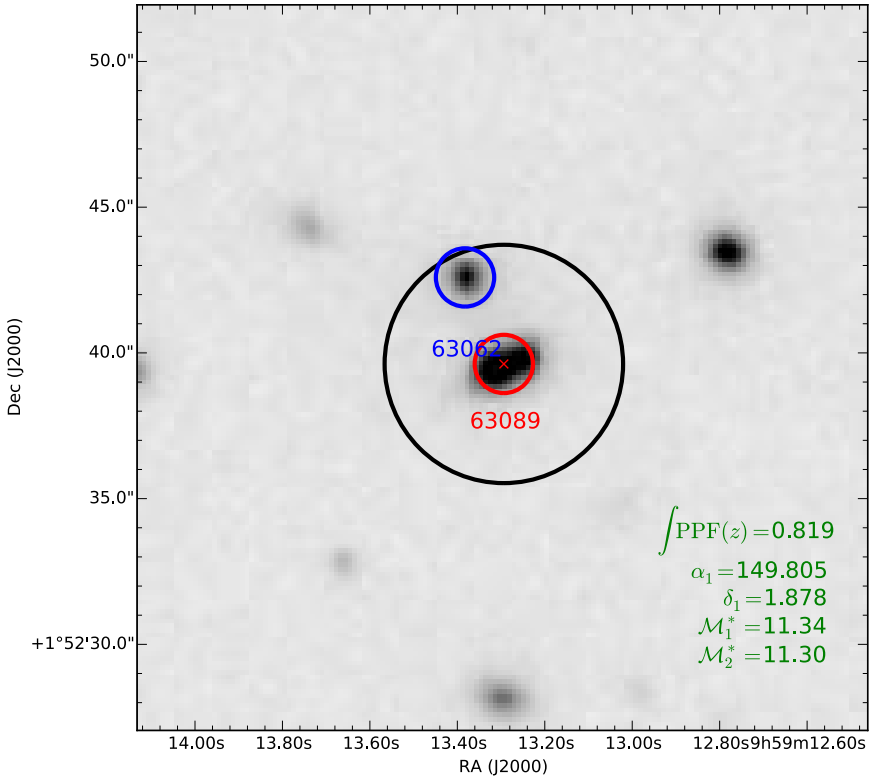
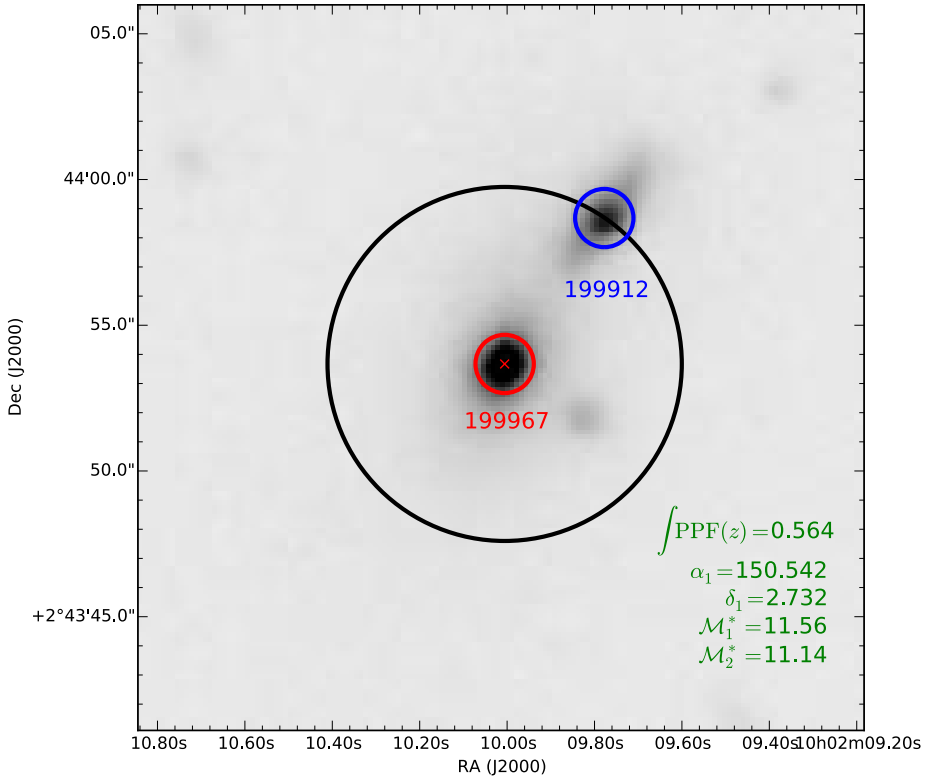
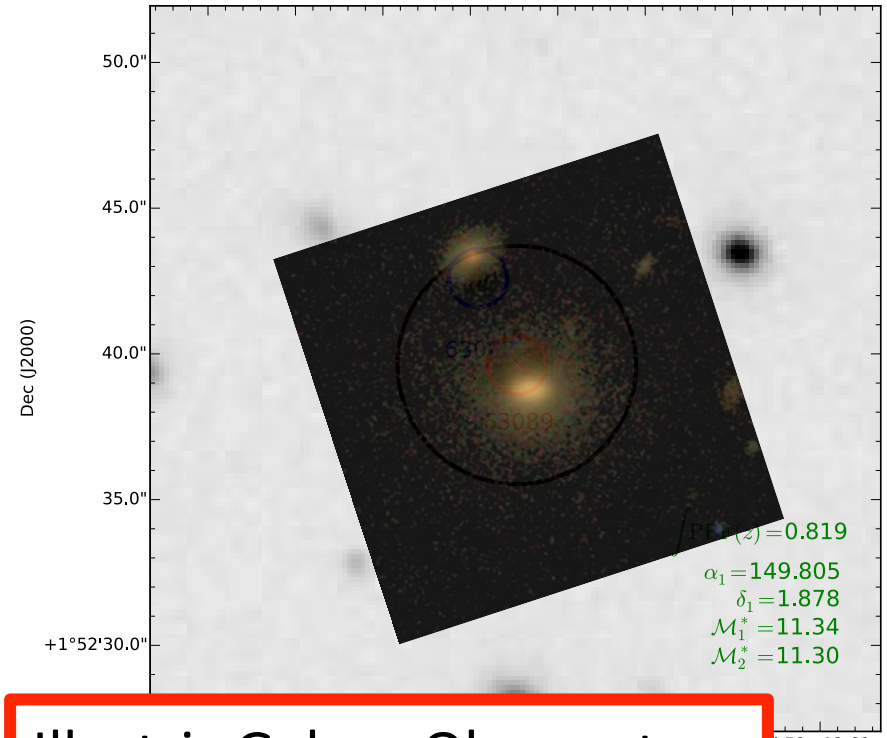
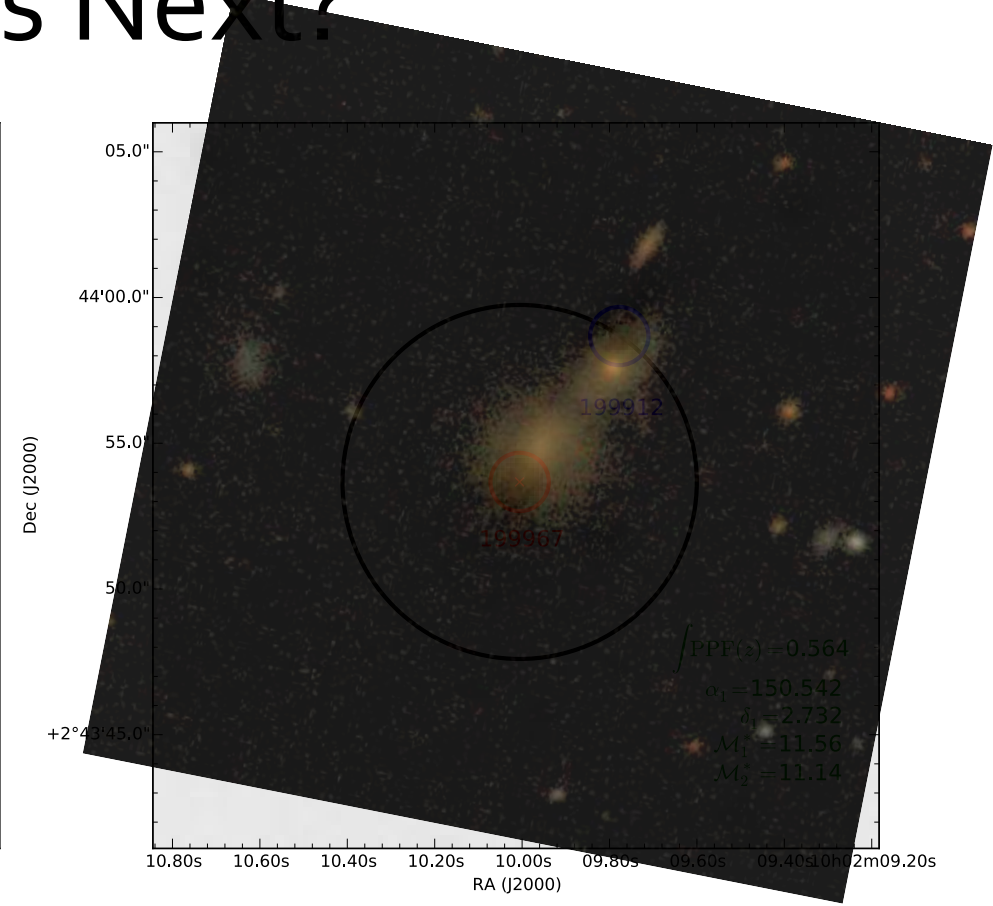
What's Next?


50.0"
45.0"
40.0"
35.0"
+1°52'30.0"
Dec (J2000)
63062
63089
$\int \mathrm{PPF}(z) = 0.819$
$\alpha_1 = 149.805$
$\delta_1 = 1.878$
$\mathcal{M}_1^* = 11.34$
$\mathcal{M}_2^* = 11.30$
14.00s
13.80s
13.60s
13.40s
13.20s
13.00s
12.80s
9h59m12.60s
RA (J2000)


05.0"
44'00.0"
55.0"
50.0"
+2°43'45.0"
Dec (J2000)
199912
199967
$\int \mathrm{PPF}(z) = 0.564$
$\alpha_1 = 150.542$
$\delta_1 = 2.732$
$\mathcal{M}_1^* = 11.56$
$\mathcal{M}_2^* = 11.14$
10.80s
10.60s
10.40s
10.20s
10.00s
09.80s
09.60s
09.40s
10h02m09.20s
RA (J2000)

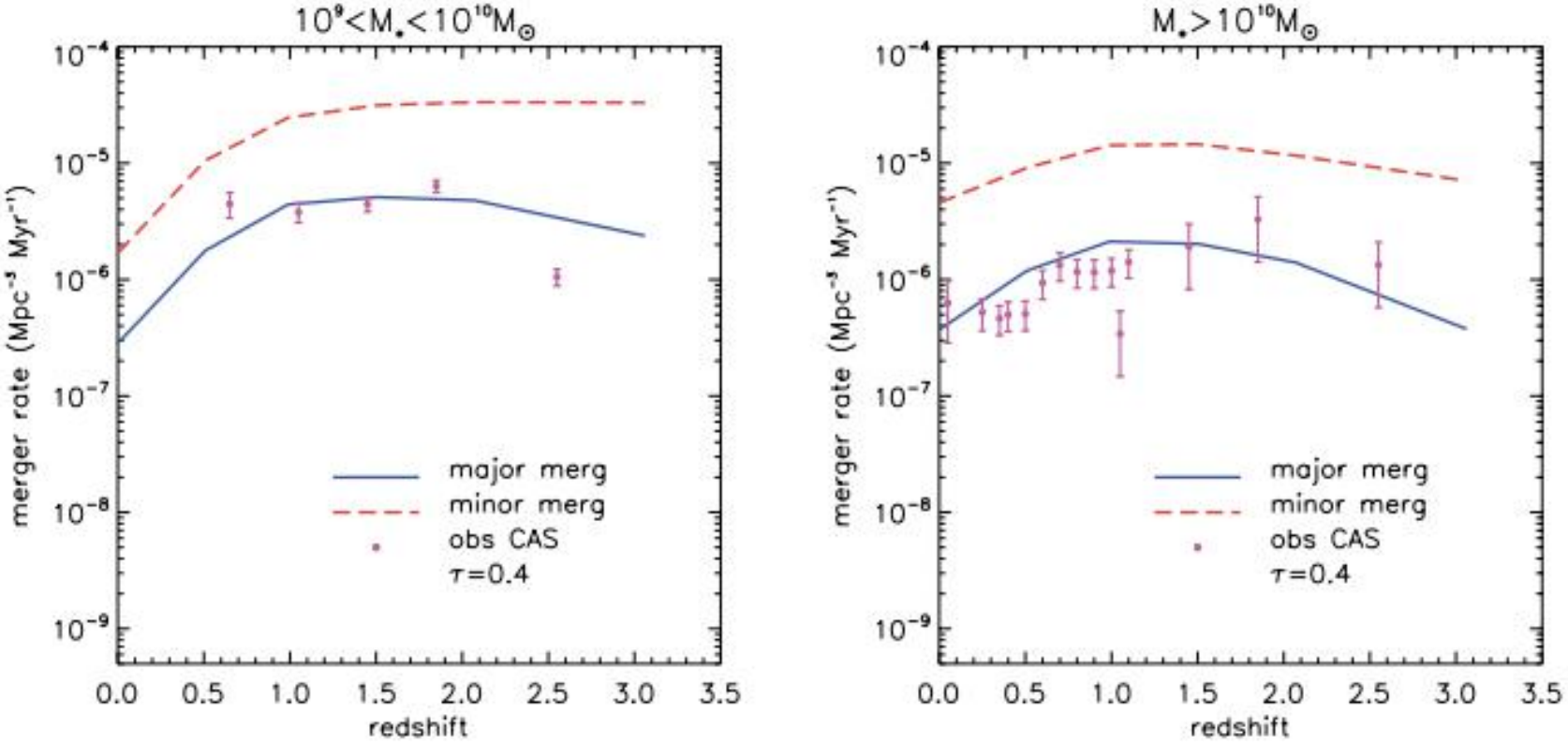
What's Next?





Illustris Galaxy Observatory
Torrey+14, Snyder+14

What's Next?



Bertone & Conselice (2009)

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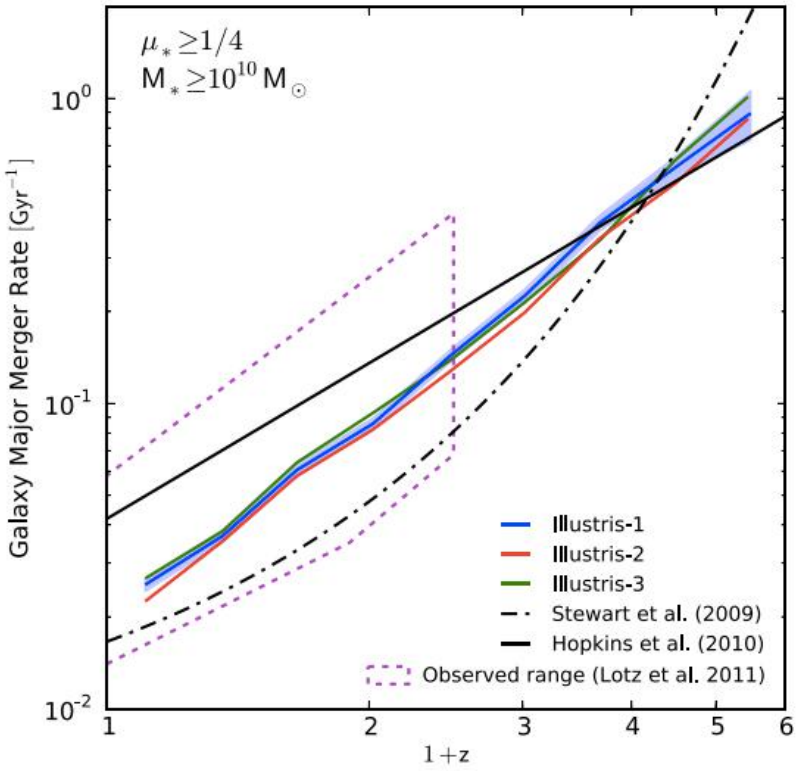

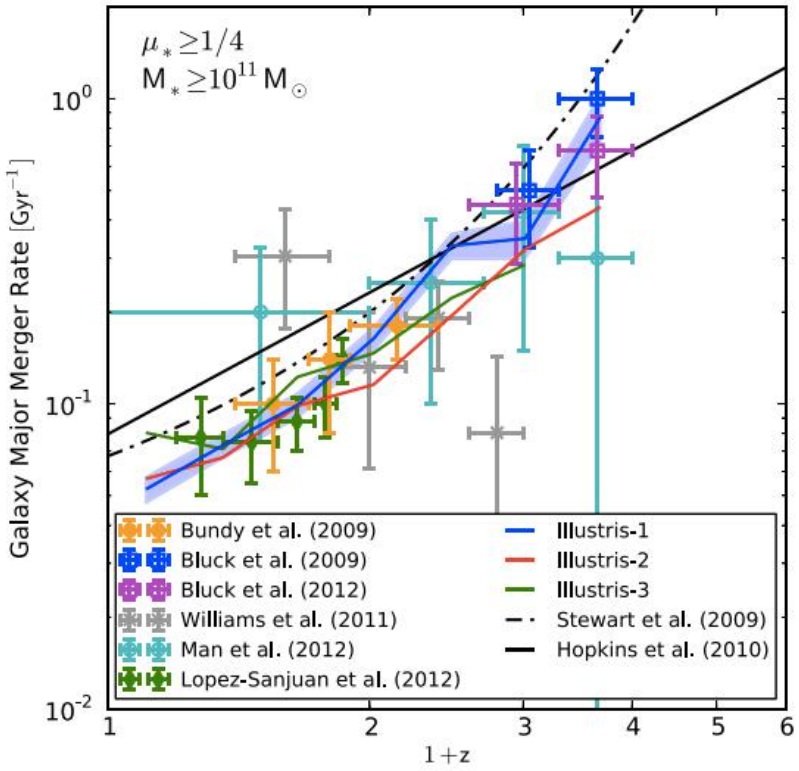

Rodriguez-Gomez et al. (2015)

Final Words

- Merger fractions peak at $z\sim2$ and decline either side
- Merger fractions arguably quantitatively and qualitatively inconsistent with those obtained using H15

- Merger rates allow us to compare apples with apples – conversion to rates not trivial!
- How do these compare to that of the halo-halo merger rate?
- Joint study in the CANDELS fields stretches this study out to $z\sim6$
- How do properties (e.g. colour, morphologies) of close-pair selected mergers compare with models?

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