The Brightest Galaxies at Cosmic Dawn

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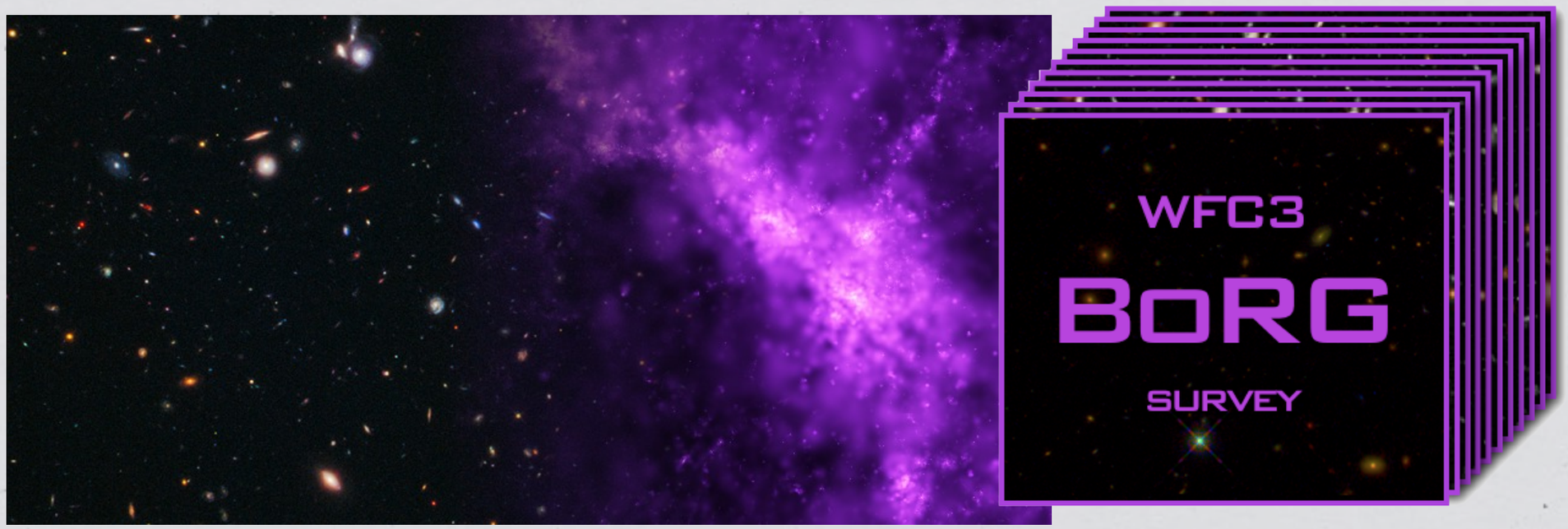


DEEP15 Sintra - March 15, 2015

WFC3: Exploring the first 700Myr

★New discovery space for galaxies at z>7

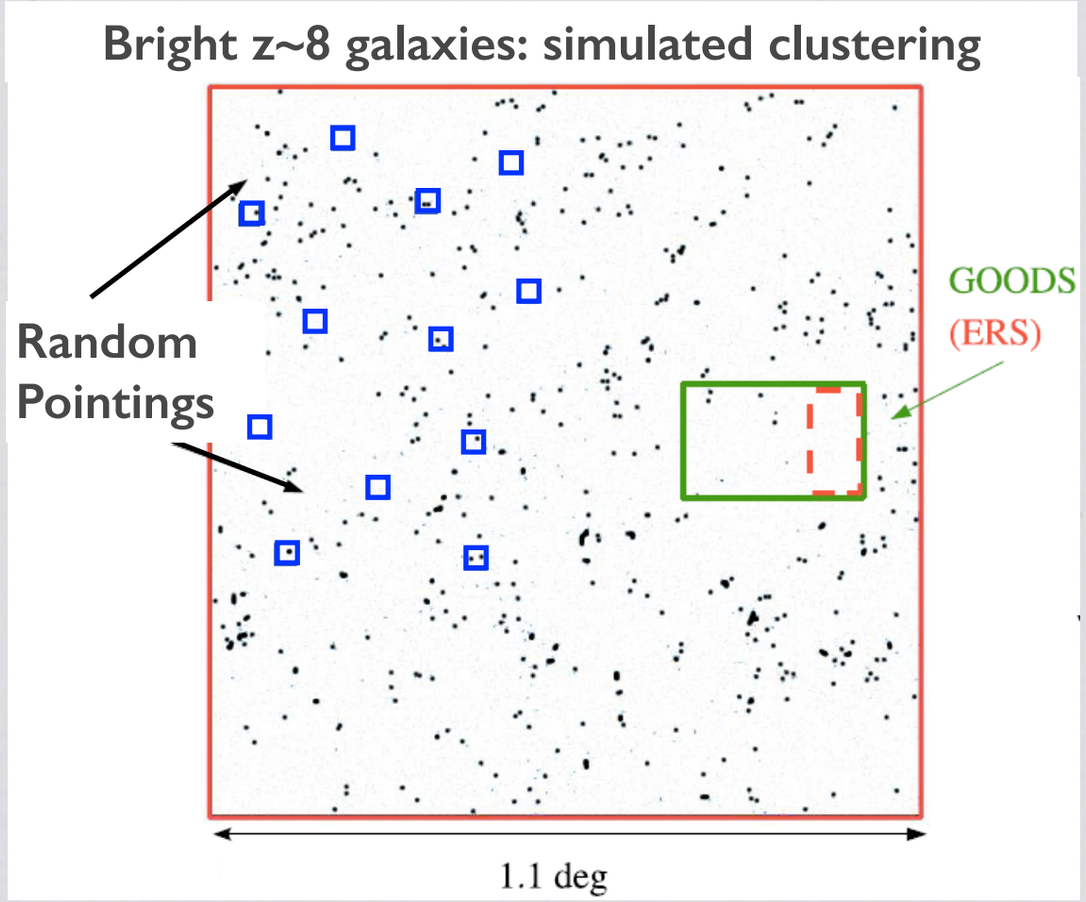
- Exciting results from Hubble legacy fields

[Talks by Rychard, Hakim and Pascal earlier today]

★Legacy fields challenges:

★(Ultra)Deep, small area:
Mostly faint galaxies (L<L*)

★ Few lines of sight:
Results affected by
galaxy clustering



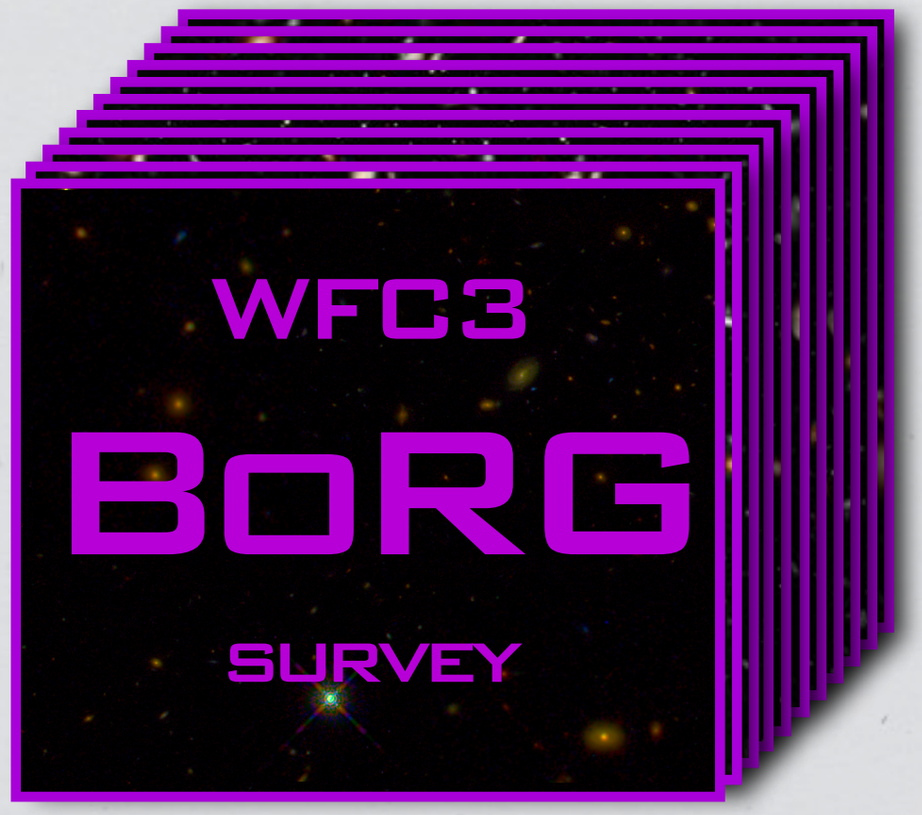
The Brightest of Reionizing Galaxies Survey (2010-2014)

- Primary goal: photometric identification of rare galaxies at z~8 (~650Myr after Big Bang)

- 74 WFC3 independent pointings ~350 arcmin^2, >400 hours (PI Trenti, Cycles 17+19+20)

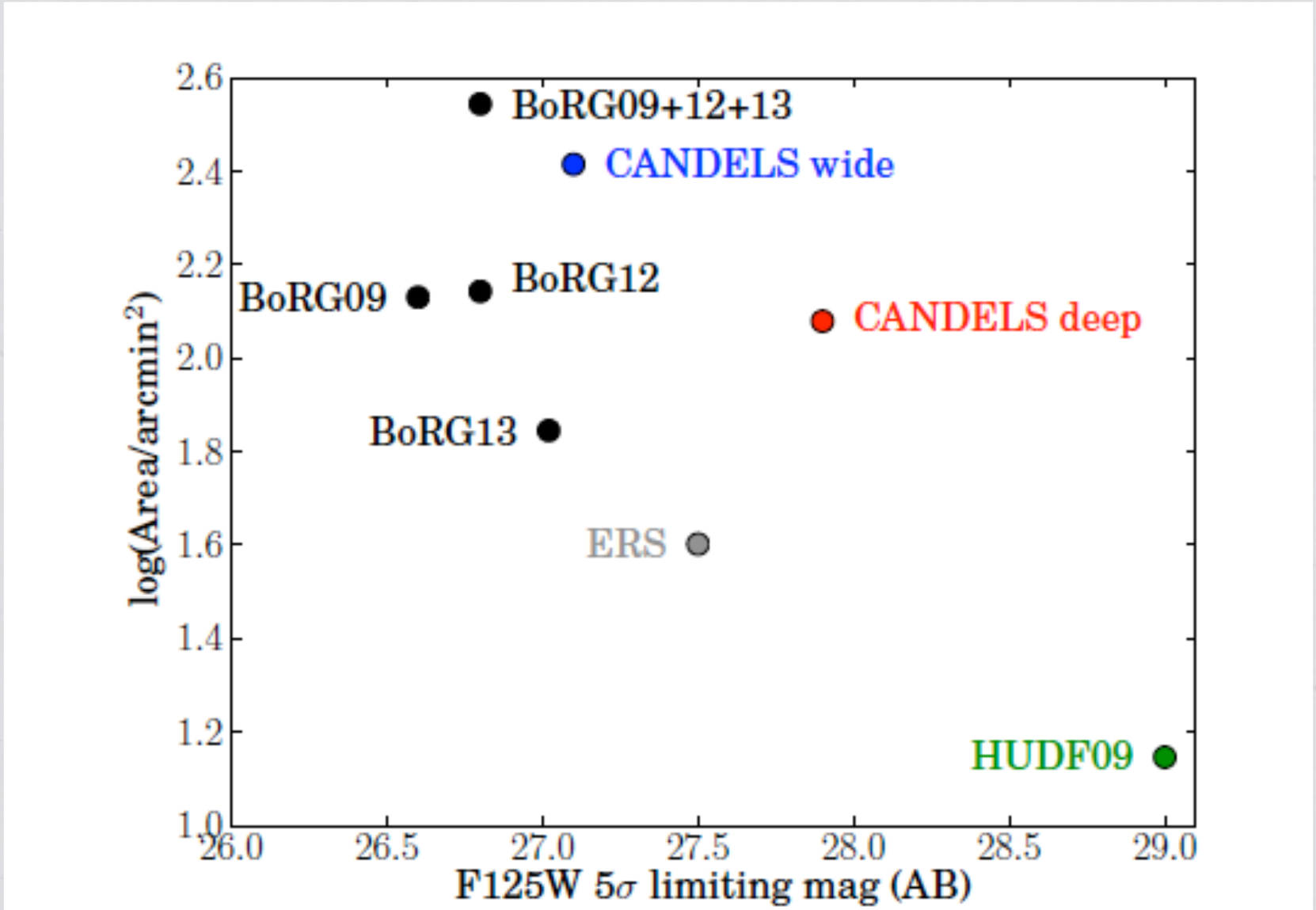
- 4 filters (optical+near-IR): V, Y, J, H

- 4-6 hours/field: 5σ sensitivity: m_{lim}~27



BoRG compared to legacy fields

- Largest area available to find z~8 galaxies

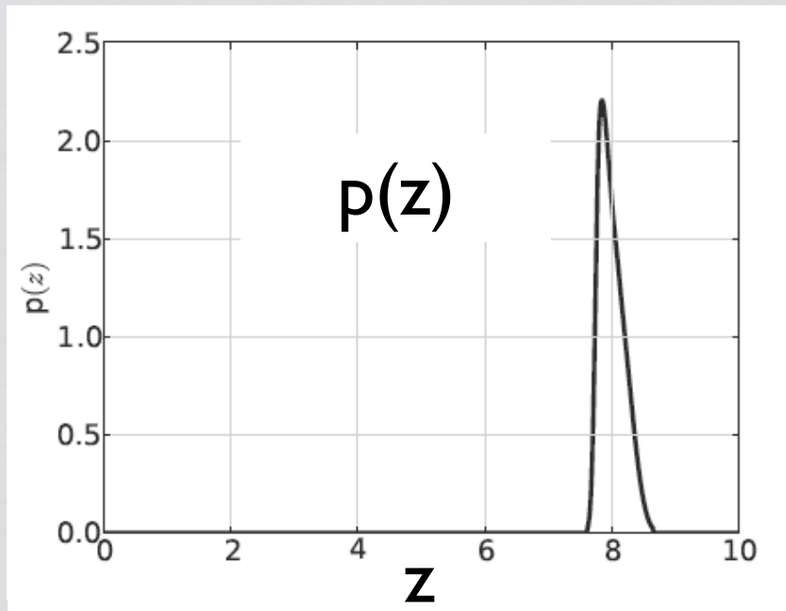


Schmidt et al. (2014)

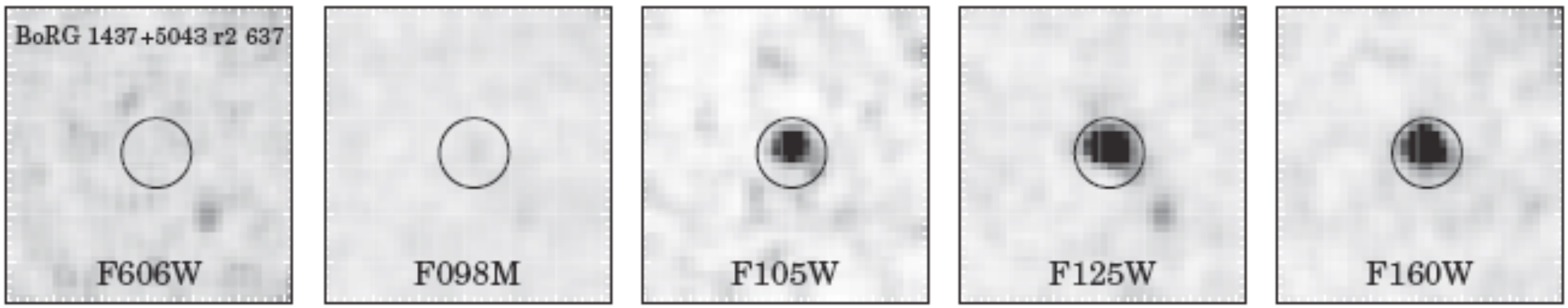
Some z~8 galaxies from BoRG

★ BoRG finds most luminous z~8 galaxies (~650 Myr after Big Bang):

- n=10 at S/N>8 (m<26.5)
- n=28 at S/N>5 (m~27)

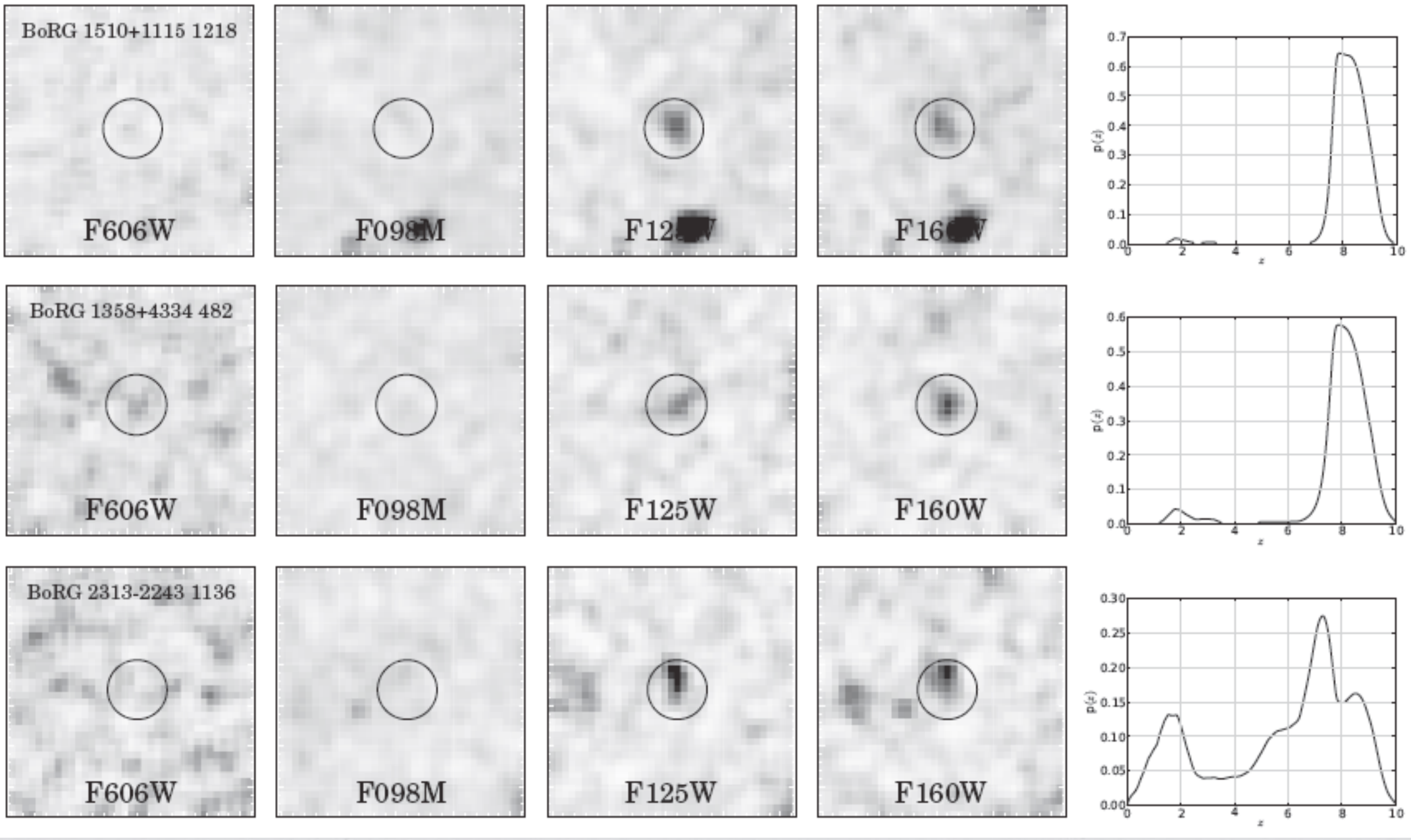


Best BoRG source: m_J=25.9 (S/N>20)



Trenti et al. (2011, 2012); Bradley et al. (2012); Schmidt et al. (2014)

Some z~8 galaxies from BoRG



Schmidt et al. (2014)

The luminosity function at z~8

Large area (~350 arcmin^2) determination

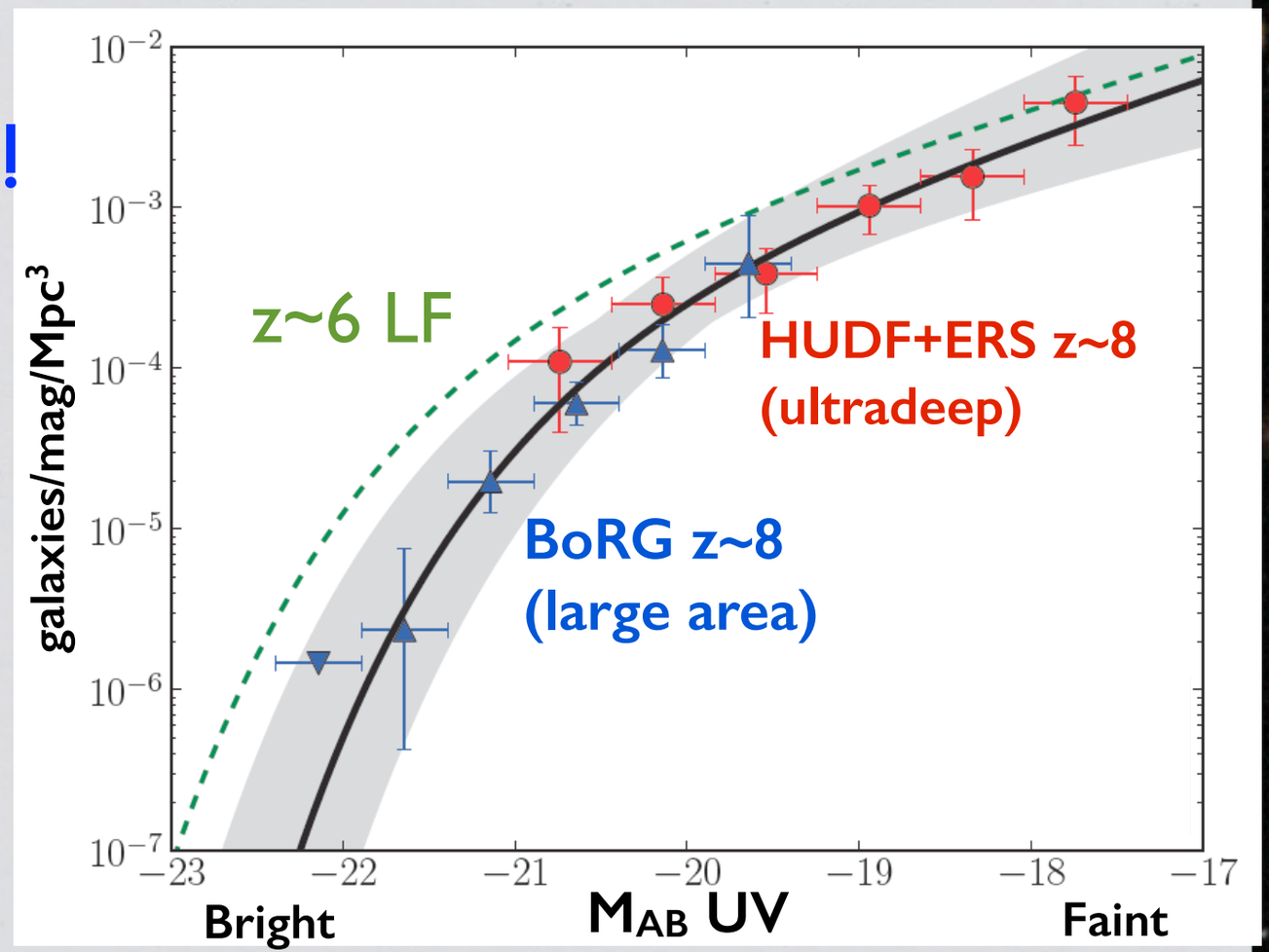
★ BoRG+HUDF/ERS:
97 Y-dropout galaxies

★ None known preWFC3!

★ LF well described by Schechter form

★ Less sources at high-z:
Galaxy density evolution from z~6 to z~8 at 99.995% confidence

$$\phi(L) = \phi_0 (L/L_*)^{\alpha} \exp(-L/L_*)$$



Bradley, Trenti et al. (2012); Schmidt et al. (2014)

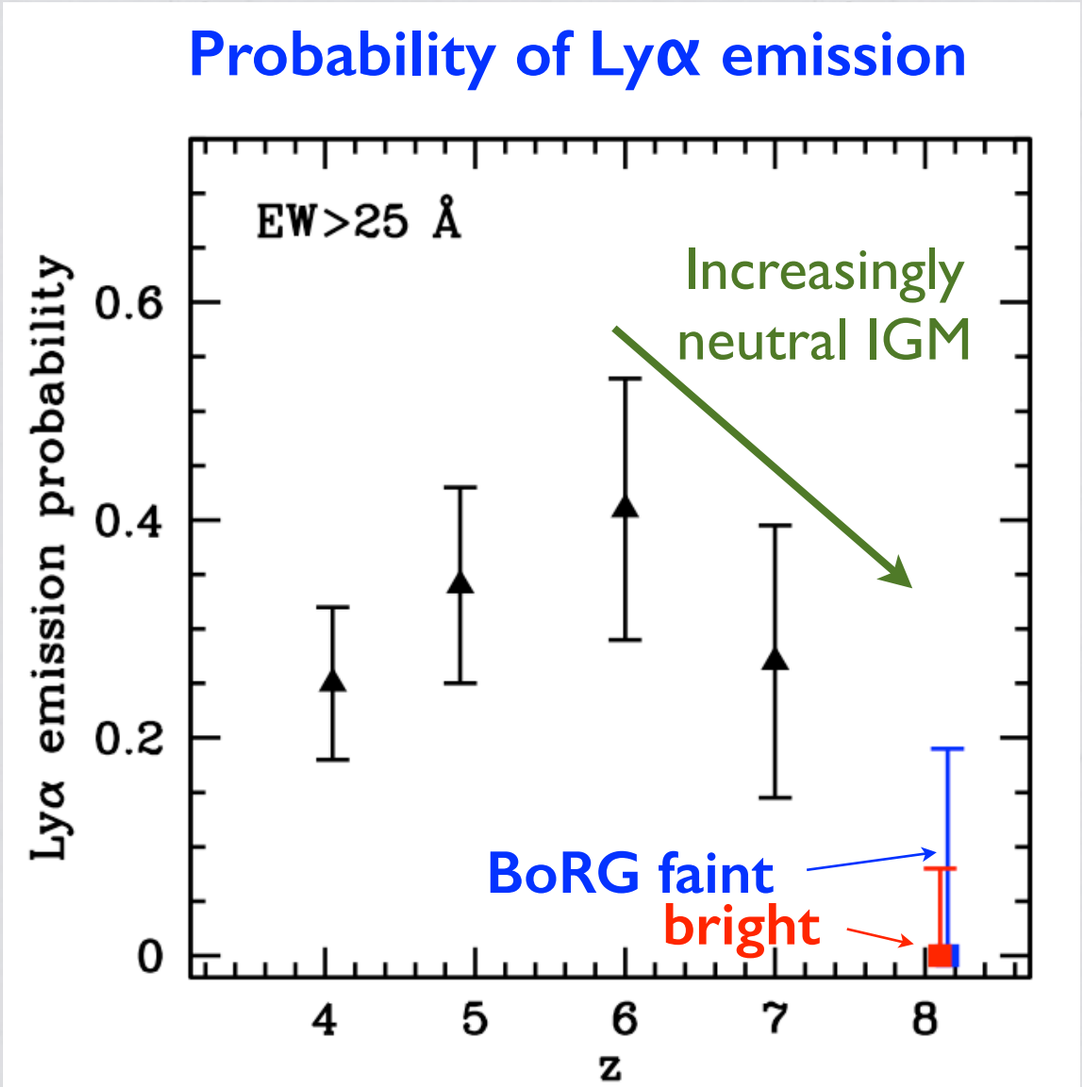
Galaxy properties: Lyα emission

★ BoRG follow-up: Keck (~32h) & VLT (~12h)

★ 15 galaxies observed, no Lyα emission detected (EW>25A)

★ Dramatic evolution of intergalactic medium from z~8 to z~6: Reionization in progress

★ BoRG z~8 limits crucial to establish trend previously hinted by z~7 spectroscopy



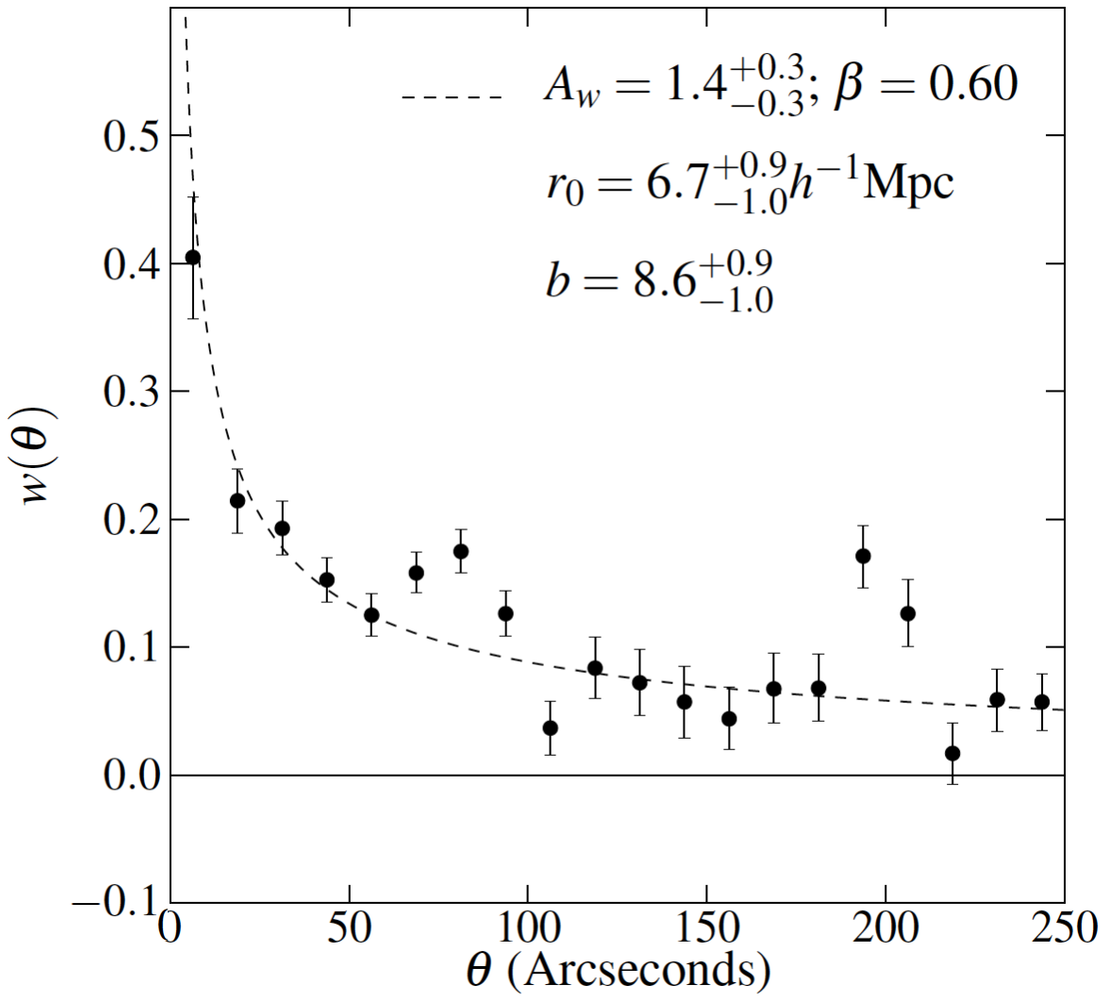
Treu, Trenti et al. (2012, 2013)

Galaxy clustering and halo masses

★First measure of clustering at z>7!

★Two point correlation function from XDF+CANDELS galaxies at z>6.5 [~800 objects]

Correlation function at <z>=7.2



Barone-Nugent, MT et al. (2014)
[Melbourne PhD student]

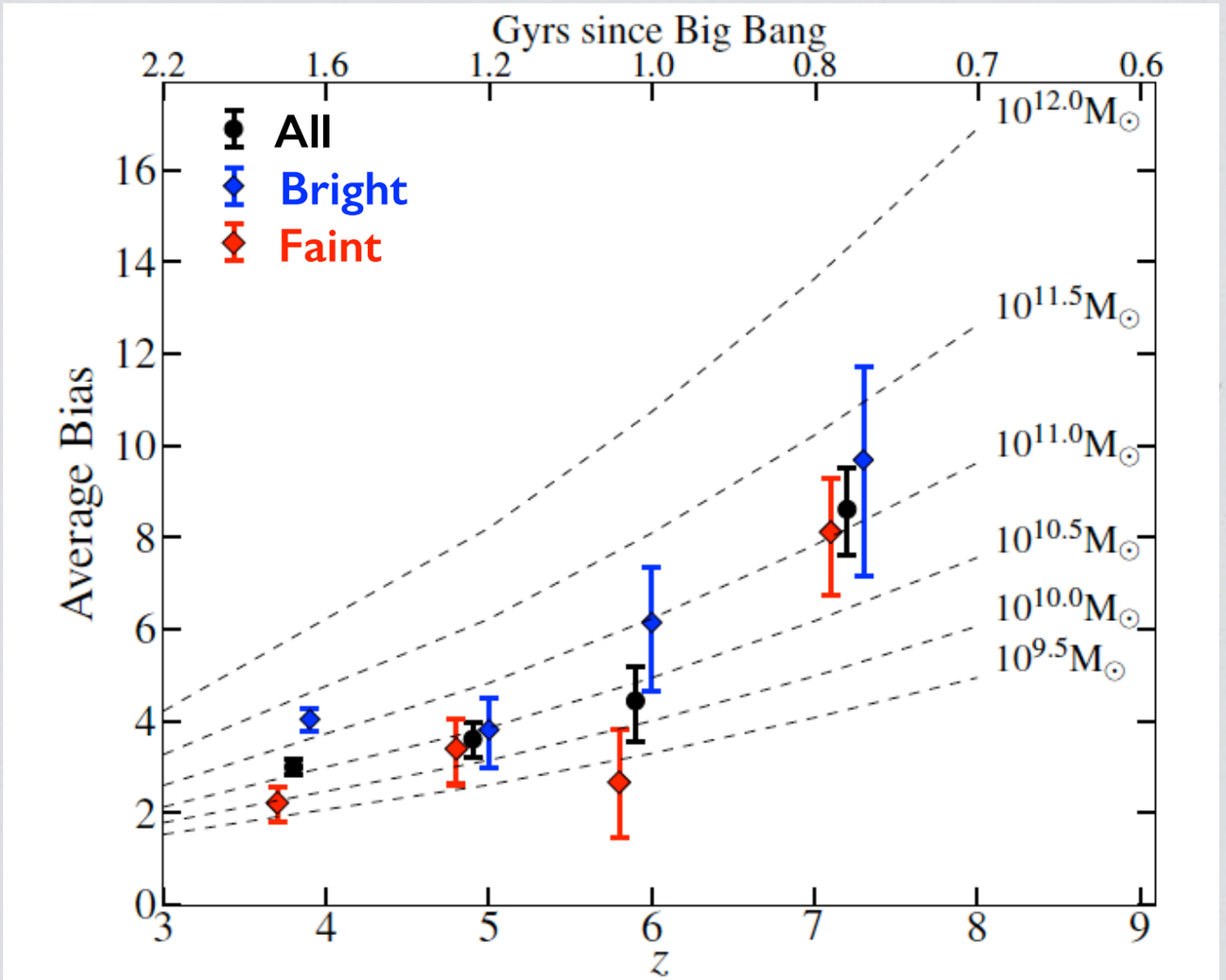
Galaxy clustering and halo masses

★First measure of clustering at z>7!

★Derived DM halos
~$10^{11}M_{sun}$

★Galaxies at z>7 expected below HST detection limit in 10^{8}-10^{10} M_{sun} halos

Bias: galaxies vs. DM halos



Barone-Nugent, MT et al. (2014)
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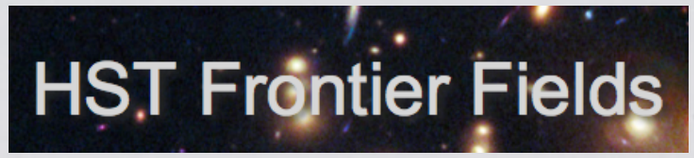
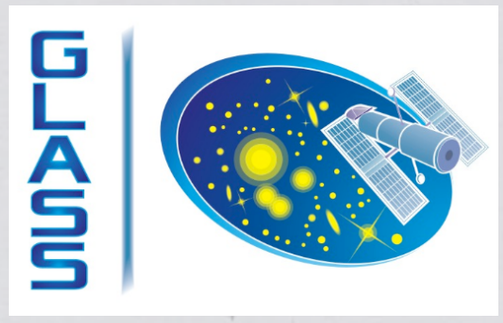
The Future: Hubble

★HST is photon and wavelength limited to z~10 but key facility for short-term progress:

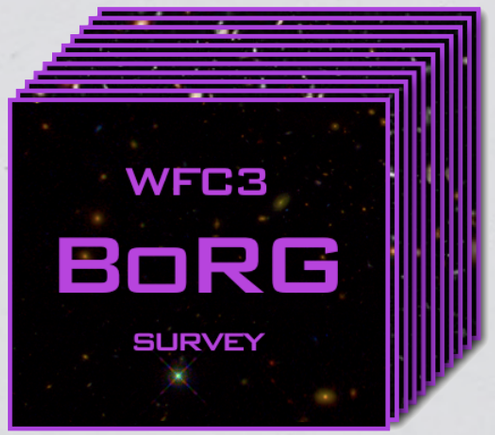
★ Frontier Fields DDT Initiative uses lensing to identify intrinsically faint galaxies [several talks today]



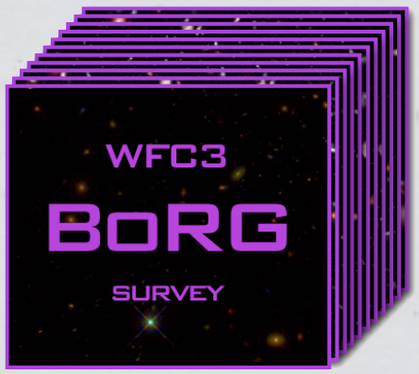
★ GLASS survey provides spectra of faint z≲8 sources (synergic with BoRG) [see Kasper's talk]



★ New XXL BoRG survey targeted at z~9-10 to find rare bright catches (easiest to follow-up)



The future at z~9-10

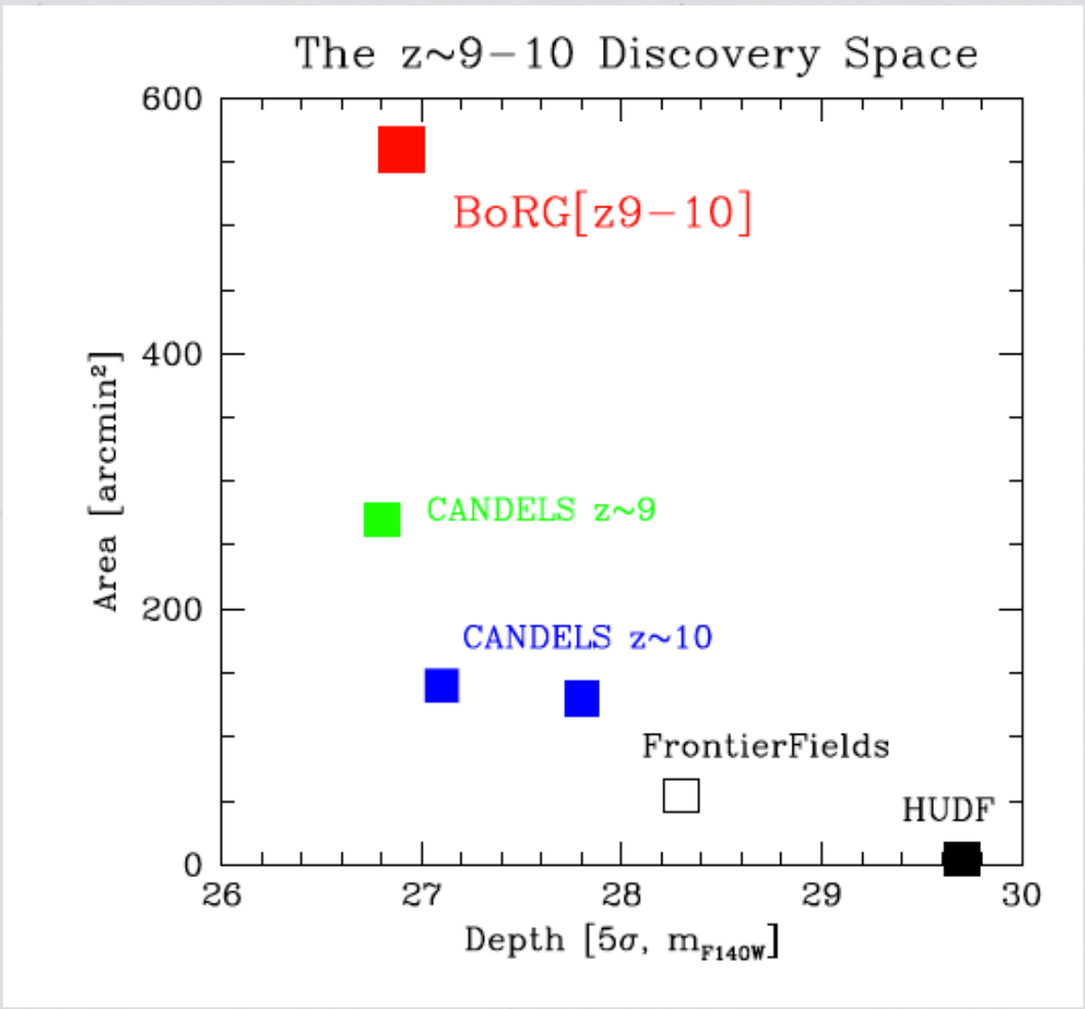


Bright Galaxies at Hubble's Detection Frontier (PI Trenti)

★ **Largest Cycle 22 HST program (32 days!)**

★ **Wide area, near-IR: 550 arcmin^2; 120 sight-lines**

★ **~20 galaxies at z~9-10; ~200 at z~7-8; [m_{AB}<27]**



Aim: Investigate star formation in rare, massive halos (n~10^{-6} Mpc^3)

Bright galaxies at z~10

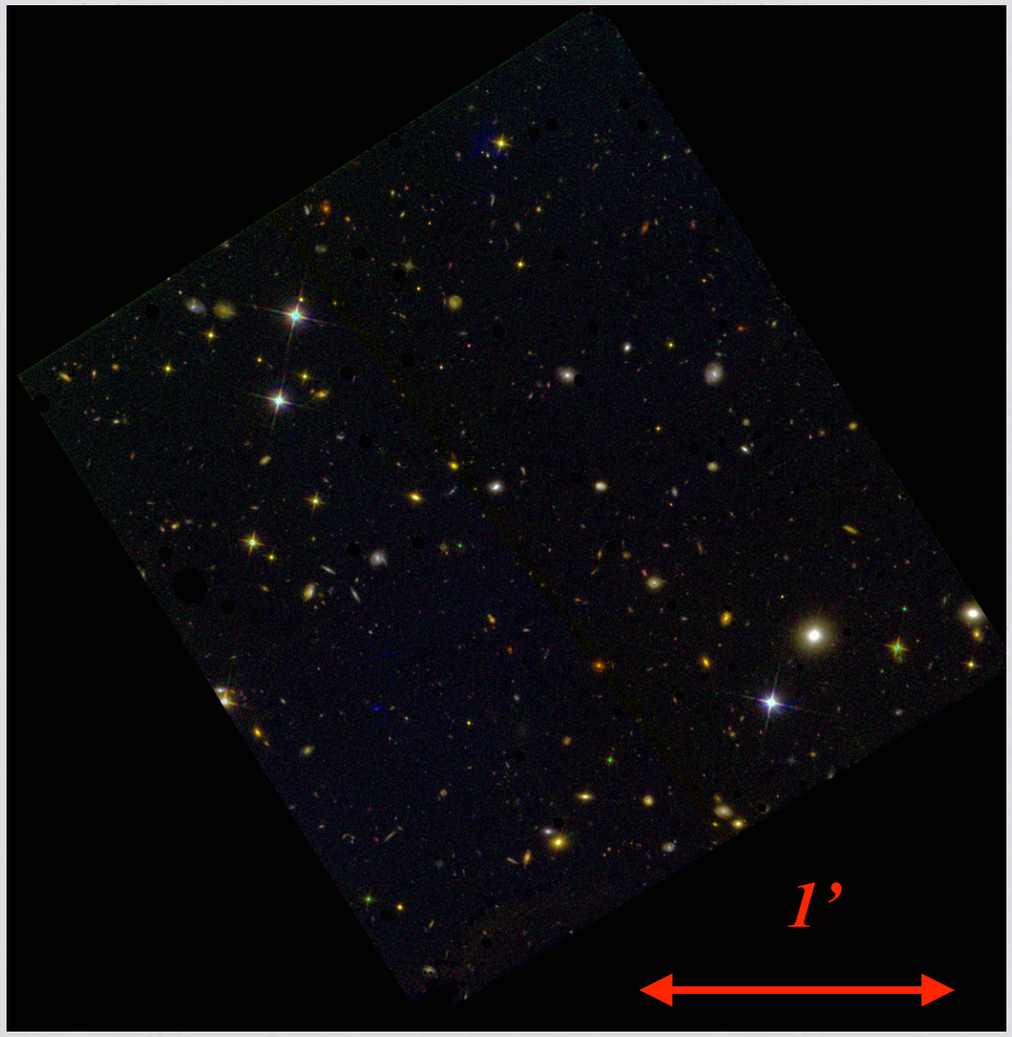
★ **Luminosity density drops by 10x from z~8 to z~10**

★ **But several bright z~9-10 candidates (m_{AB}~26.5) found in CANDELS/GOODS-N**
(Oesch et al. 2014)

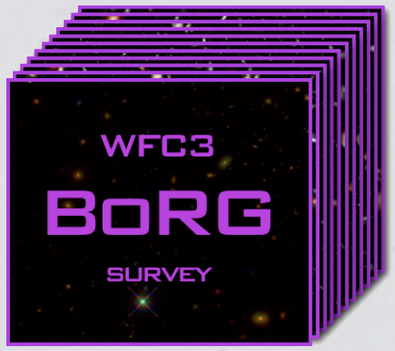
★ **Lucky catch or evolution in galaxy properties?**

★ **BoRG[z9-10] observations will solve the question!**

First BoRG[z9-10] field [Dec14]



119 more coming...



Summary

- **Hubble's WFC3 transformed our view of galaxy evolution in the first 700 Myr**
  - BoRG random-pointing imaging, and our spectroscopic followup, is playing a key role in this revolution
- Exciting new results coming from Hubble in the short term (e.g. with our BoRG survey at z~9-10)
- Next leap just behind the corner: JWST will amaze with unprecedented deep observations in the infrared!