The Brightest Galaxies at Cosmic Dawn

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& the WFC3 BoRG SURVEY *team*

Australian Government
Australian Research Council

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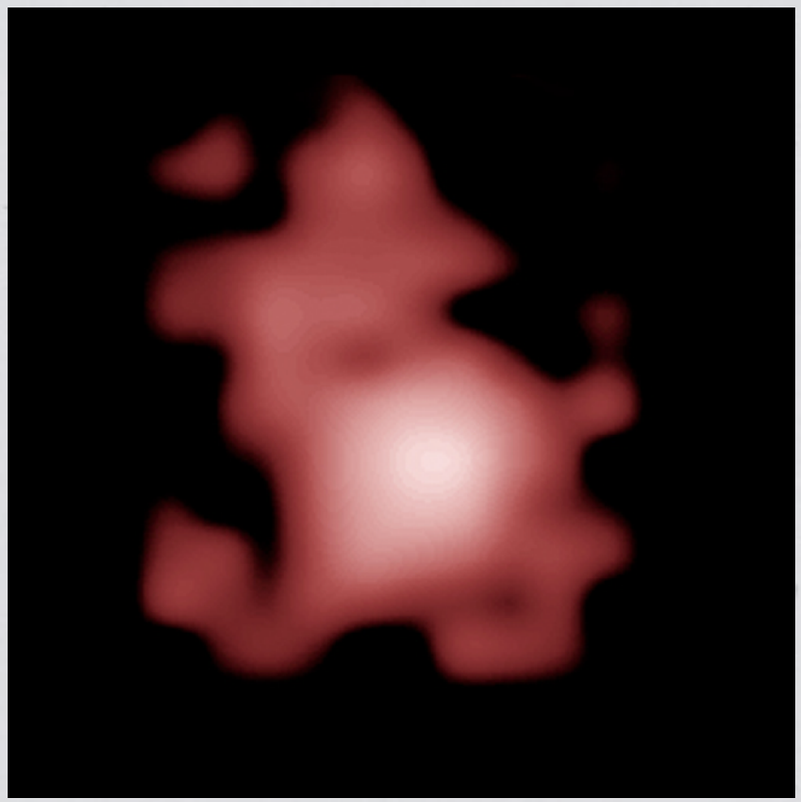
Star formation: now and then

★Was star formation different?

today



~13.4 Gyr ago

Image credits: NASA/ESA

Galaxies in the first 700Myr

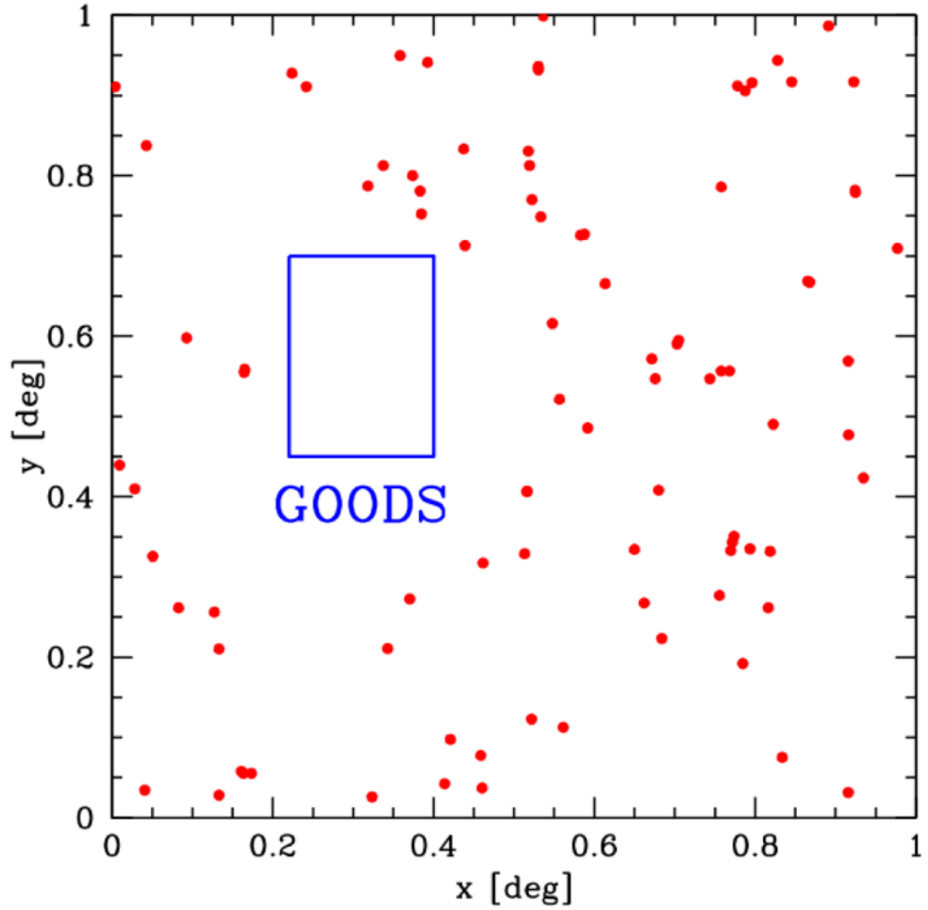
- Exciting results from Hubble legacy fields

★Legacy fields challenges:

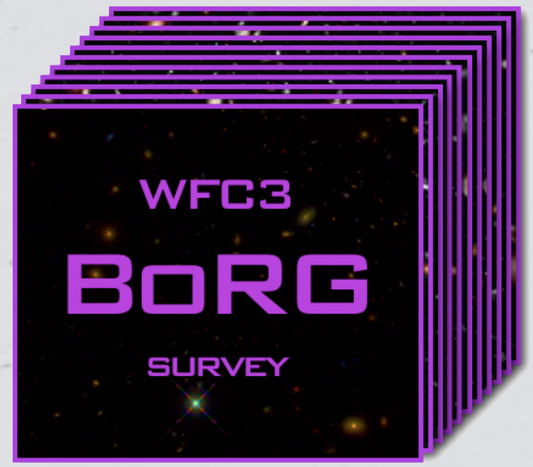
★(Ultra)Deep, small area:
Mostly faint galaxies (L<L*)

★ Few lines of sight:
Large area surveys affected by galaxy clustering

Bright z~9 galaxies (AB mag<27)
Simulated clustering



The Brightest of Reionizing Galaxies Survey (Trenti+ 2011)



Key goal: Identify bright galaxies at z~8-10

★ Optical+near-IR WFC3 pure parallel imaging:
V + Y,J,[JH],H (m_{AB}~26.5-27 @ 5σ)

★ 900 orbits (~60 days) since 2010:
>150 WFC3 independent fields, >700 arcmin^2

★ 21 diverse peer-reviewed publications:
Dataset has legacy value from z~10 to z~0

★ Public data release through MAST

2010-14: The luminosity function at z~8

Large area (~350 arcmin^2) determination [2014]

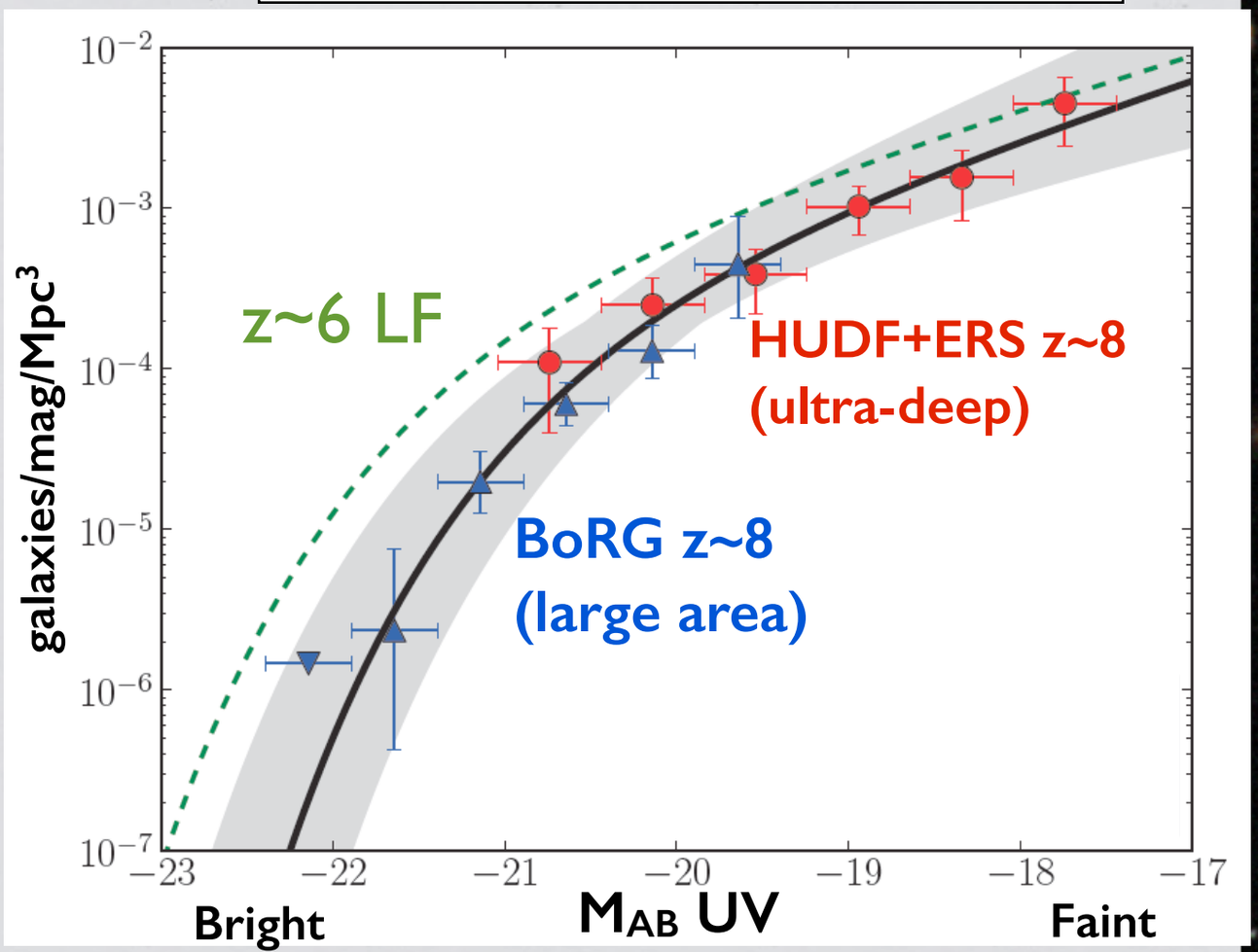
$$\phi(L) = \phi_0 (L/L_*)^{\alpha} \exp(-L/L_*)$$

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

★ None known preWFC3!

★ LF well described by Schechter form

★ Tension with ground-based z~7 results? (Bowler's talk Monday)

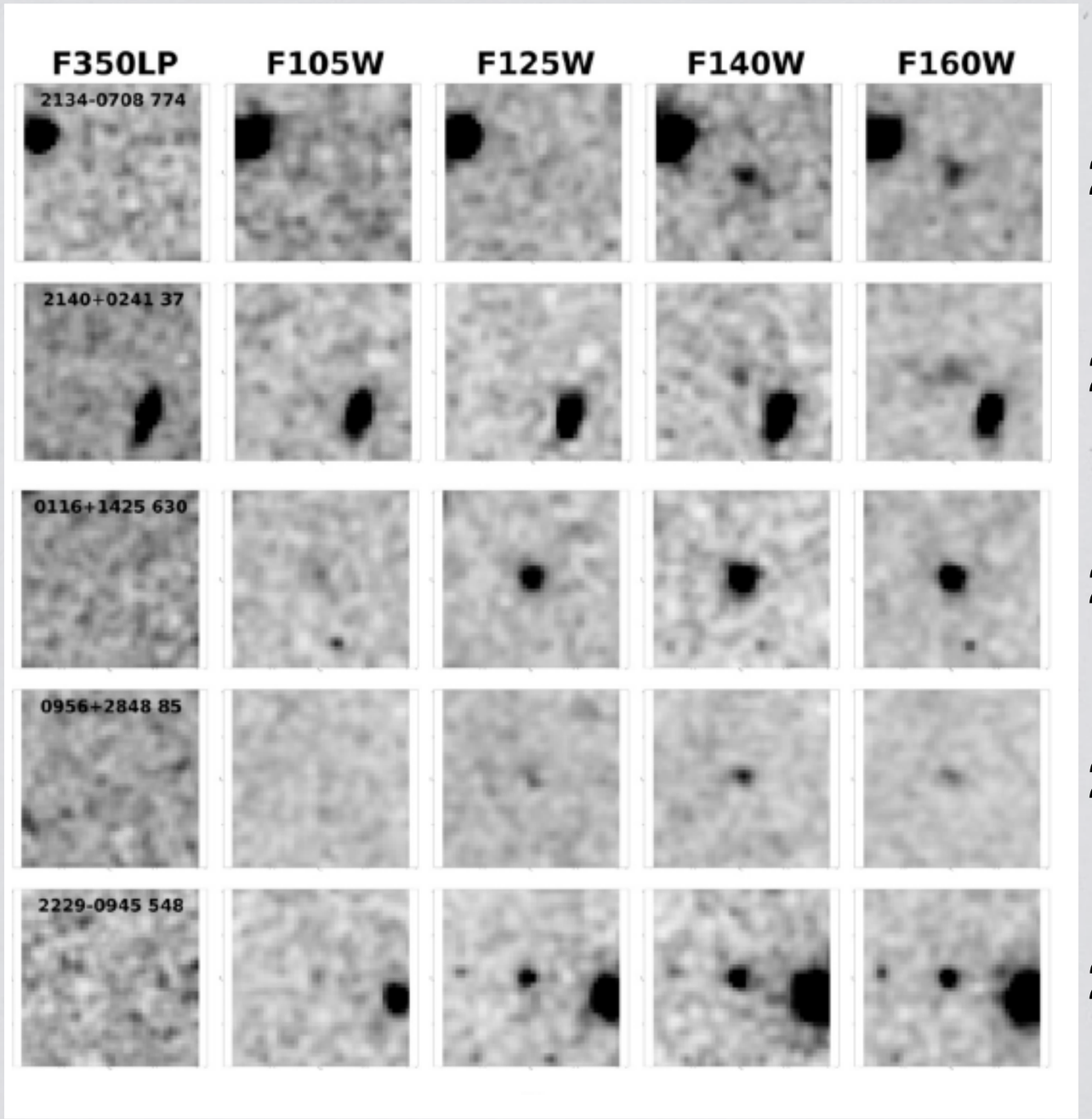


Bradley, MT et al. (2012); Schmidt, MT et al. (2014)

2016: The new frontier: z~8-11

★ Several z~8.5-11 candidates (m_{AB}~24.5-26) from 130 arcmin^2 of new cycle 22 data

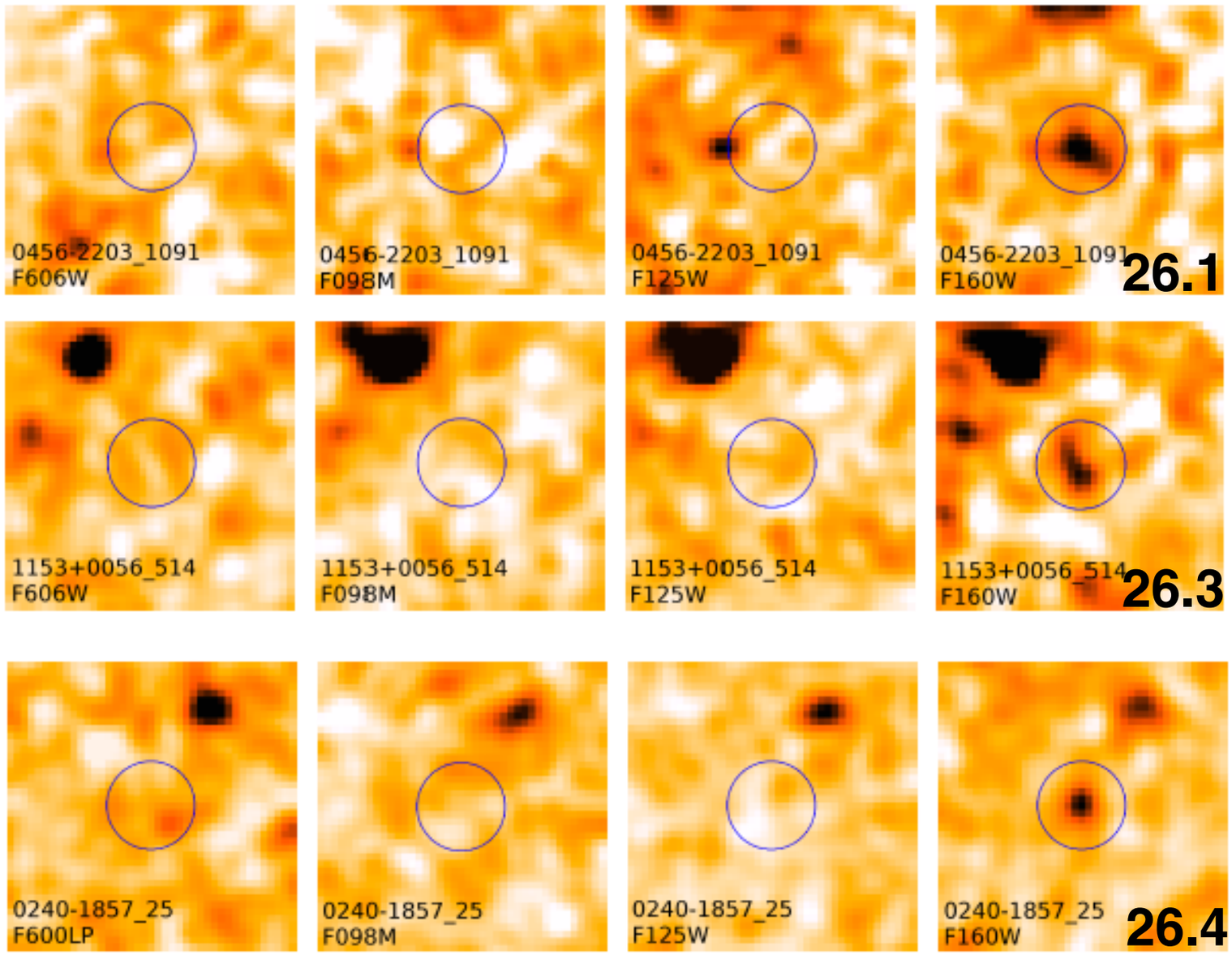
★ Full cycle 22 dataset analysis ongoing (~350 arcmin^2)

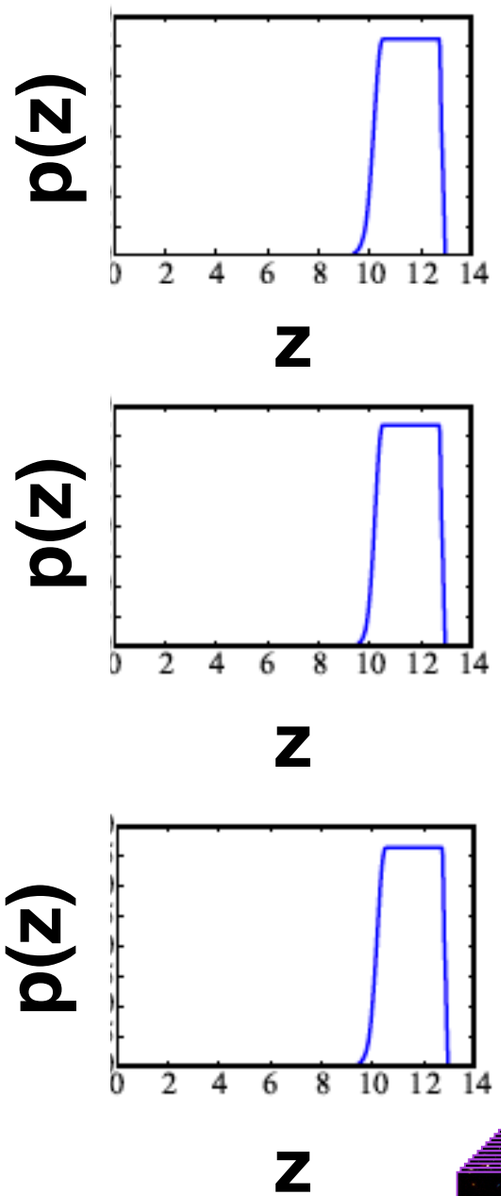


Calvi et al. (2016)

2016: The new frontier: z~10

- Analysis of archival BoRG yields z~10 catches





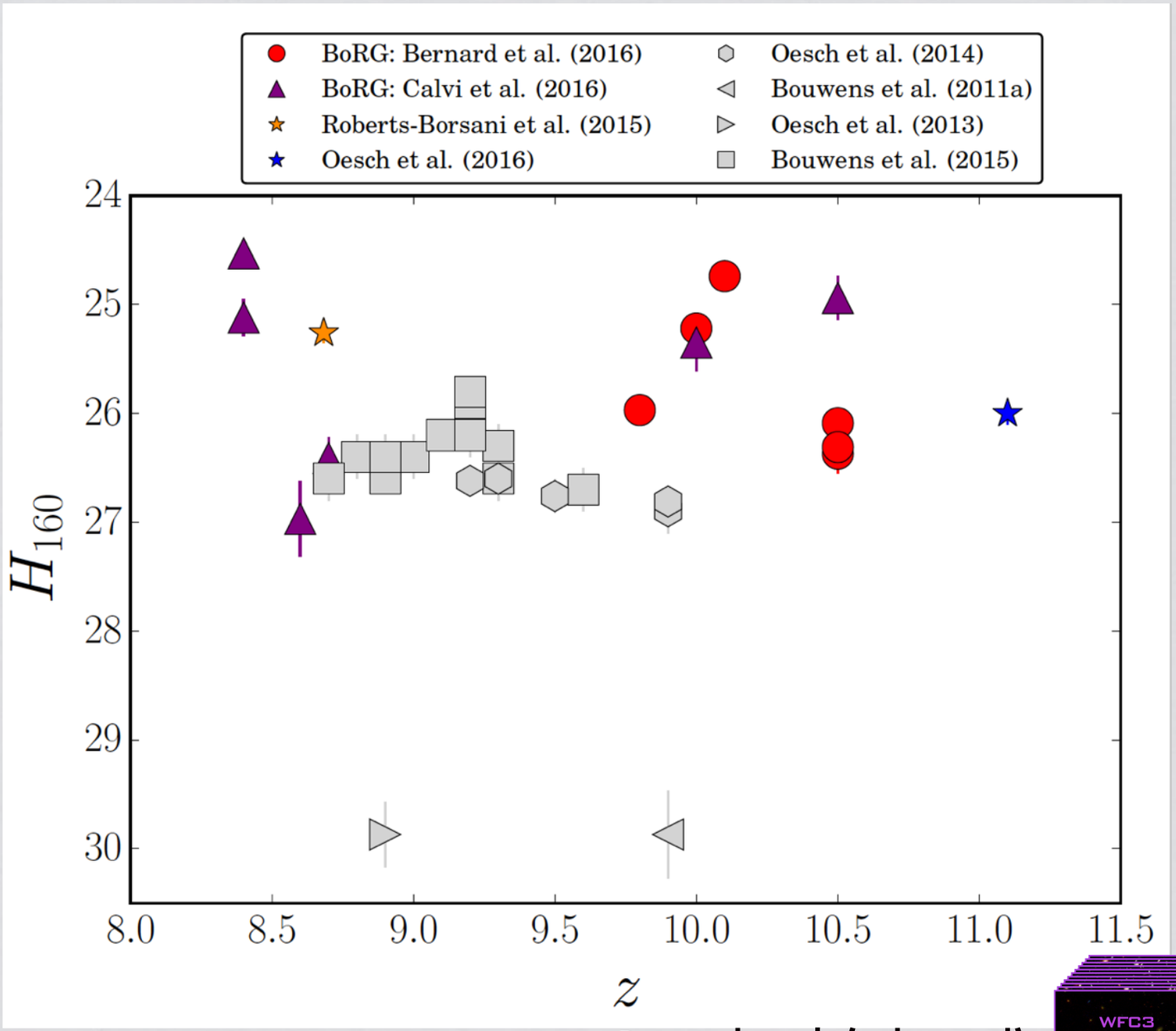
Bernard et al. (submitted)

Bright Galaxies at 500 Myr?

★BoRG z~10 candidates are very luminous

★ But comparable to sources with spectroscopic confirmation

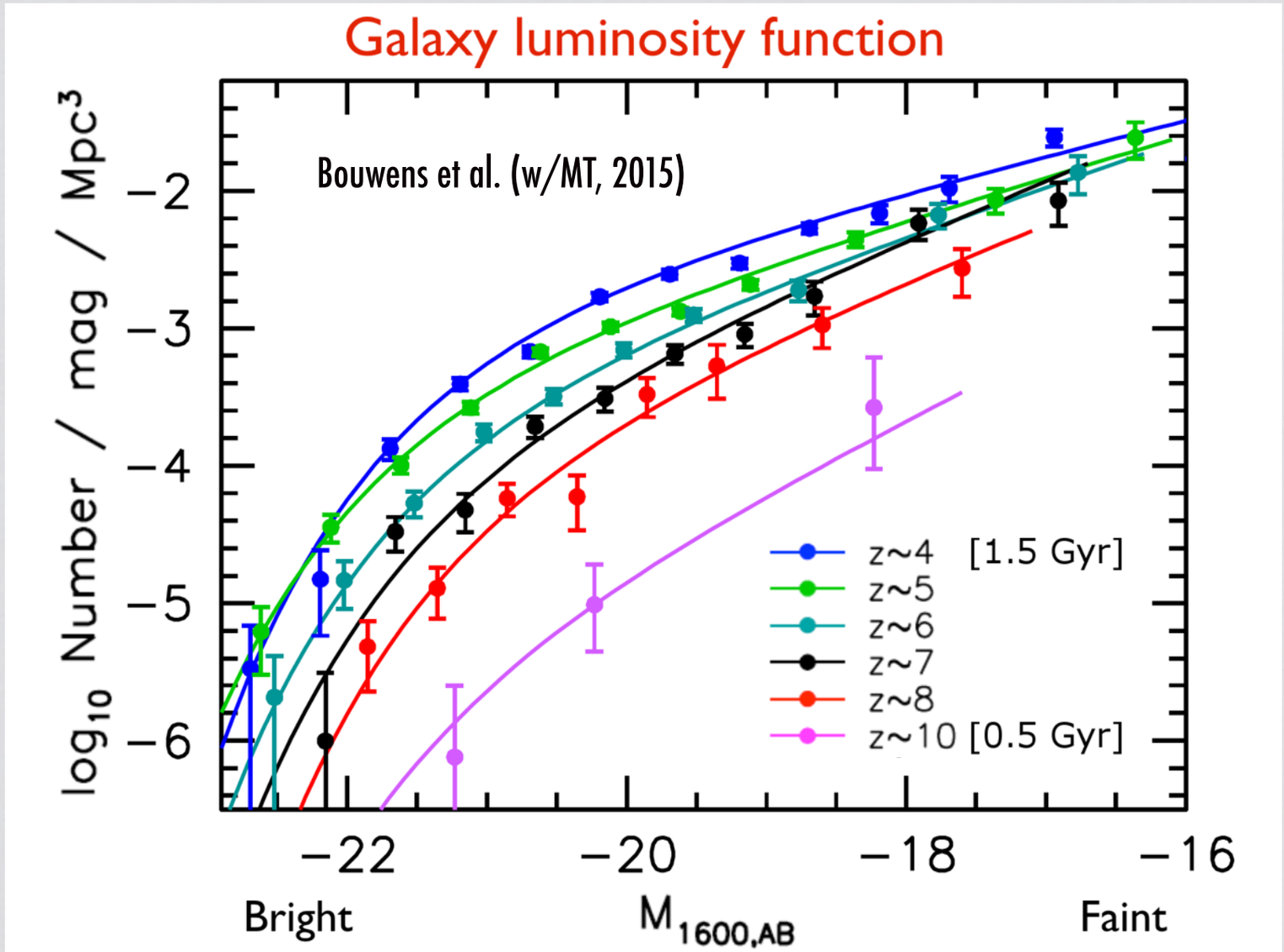
★ Keck and Spitzer follow-up approved and underway!



Bernard et al. (submitted)

High-z galaxies: Extending the frontier

★ WFC3/HST: Galaxies found at z~7-11



★Next step: Characterize their properties

★ Brightest z>8 galaxies: *rare but ideal targets*

Halo masses from galaxy clustering

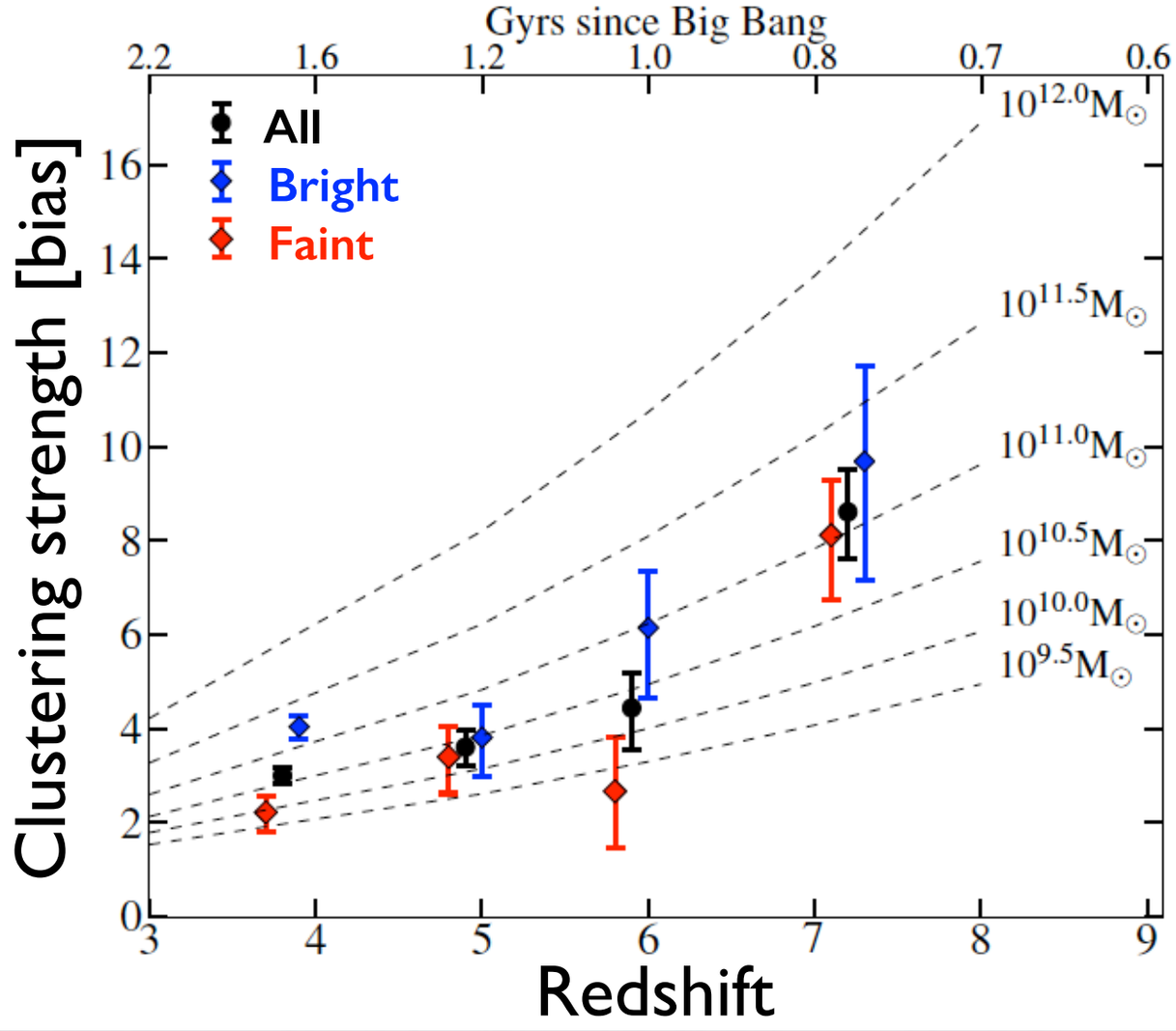
Strength of galaxy clustering gives statistical weight of the parent DM halos

★ First measure of galaxy clustering at z>7 (CANDELS data)

★ Observed galaxies have DM halos of 10^{10}-10^{11} M_{sun}

★ Consistent w/theory (e.g. Mason et al. 2015)

Clustering: galaxies vs. DM halos

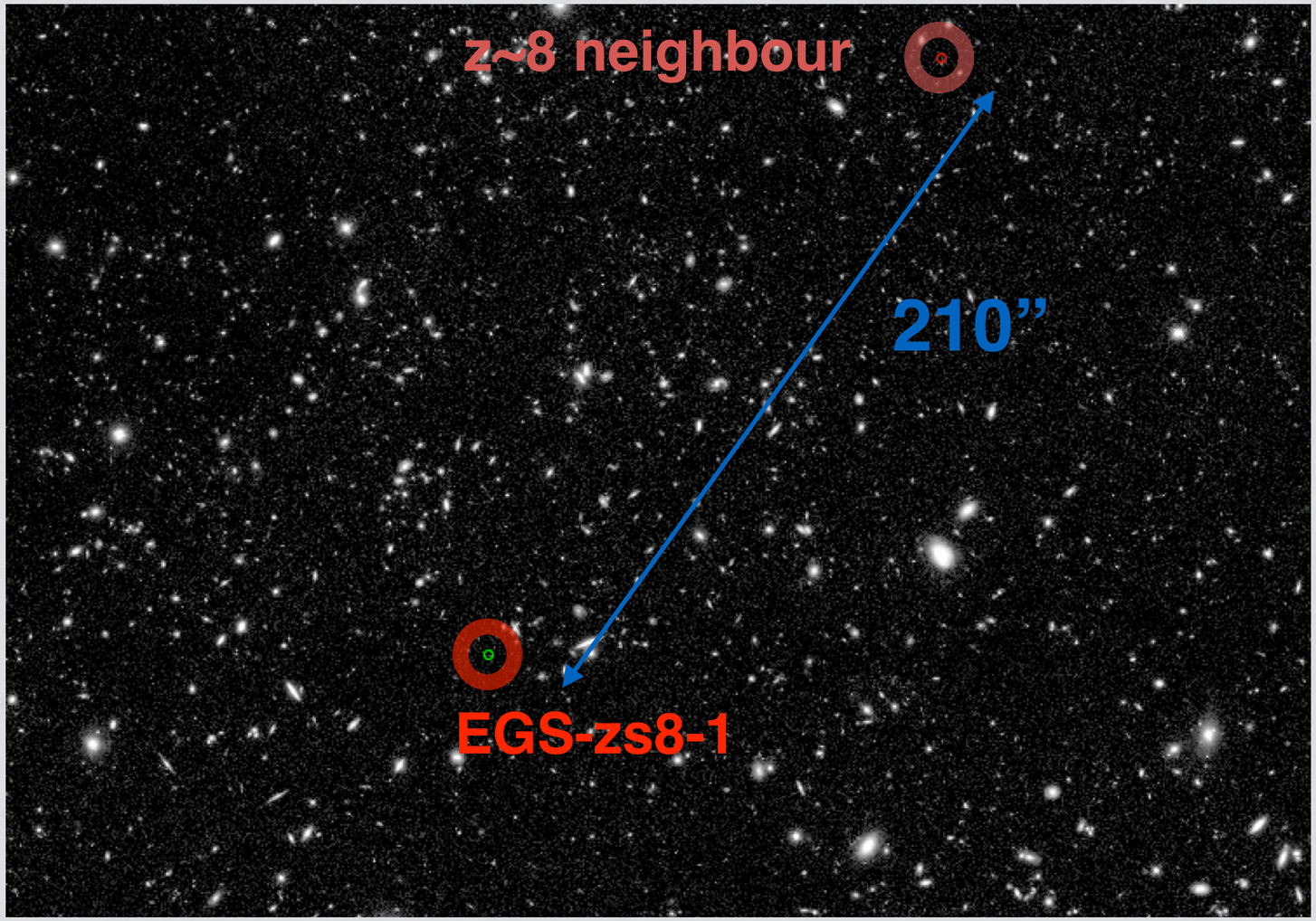


Barone-Nugent, Trenti et al. (2015)

Mysteries of (weaker?) clustering

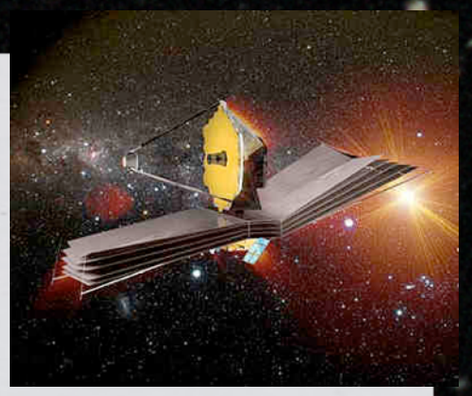
★Why are the brightest galaxies isolated?

m_{AB}=25 galaxy at z_{spec}=7.7: No neighbours in r=200” (m_{AB}<26.3)



Oesch et al. (2015)

Beyond Hubble: JWST (2018)



★James Webb Space Telescope giant leap:

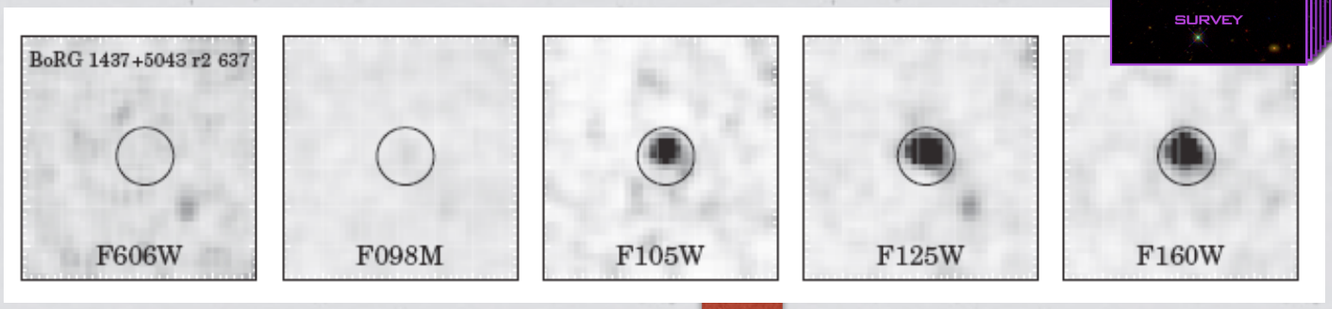
- Gain in sensitivity, resolution, wavelength range [6.5m mirror, λ~0.6-27 μm]

Hubble
H band
(1.6 μm)

JWST
H band
(1.6 μm)

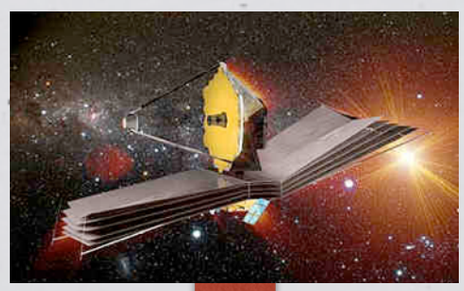
image simulation by
M. Stiavelli, STScI

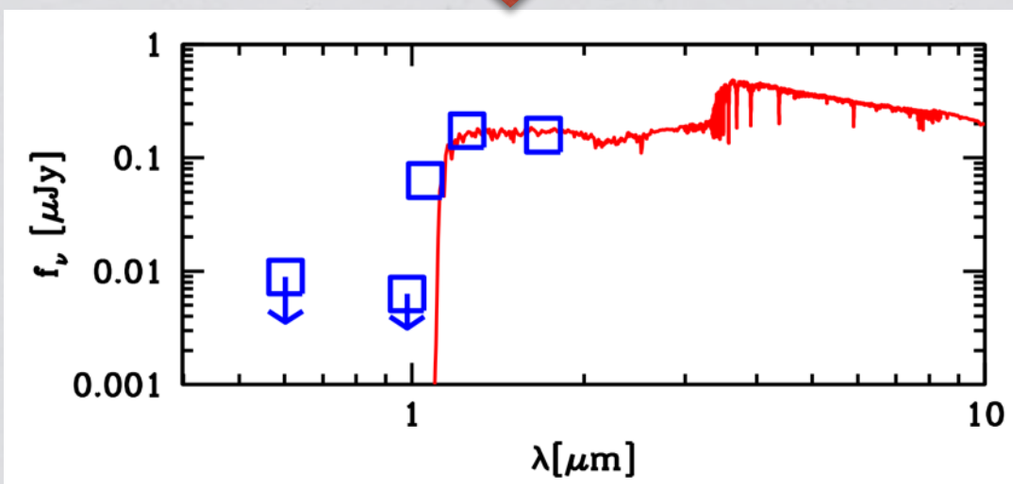
Stellar populations at z~8-10



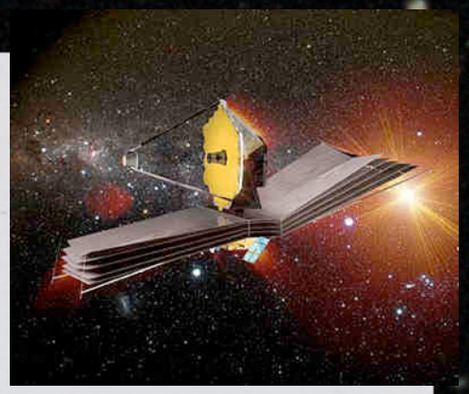
★~3h NIRSPEC: Medium-res **continuum spectrum** at restframe optical for z~8-10 BoRG galaxies [G395M, R=1000]

★Opportunity to identify new targets with HST is now!

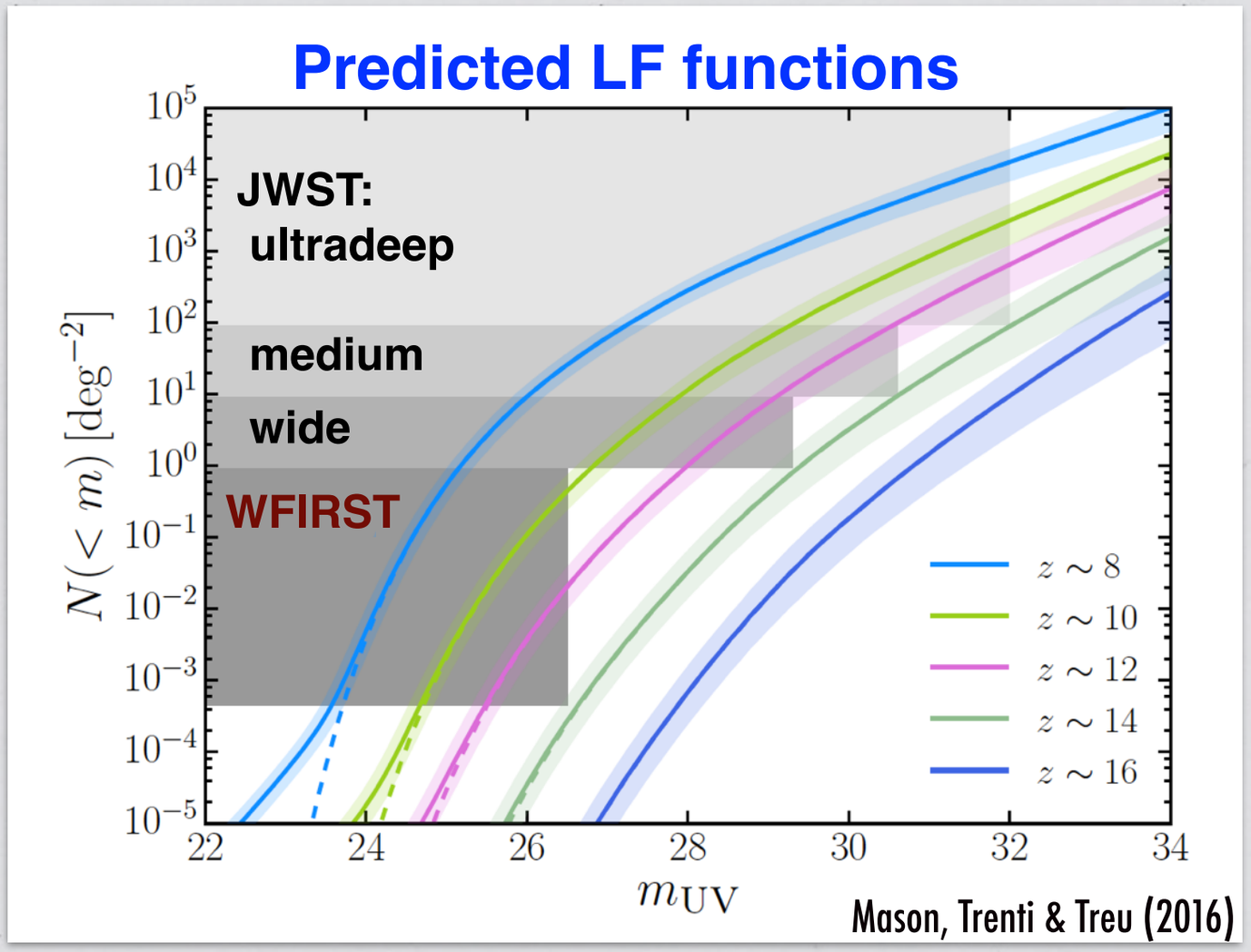




Extending the frontier

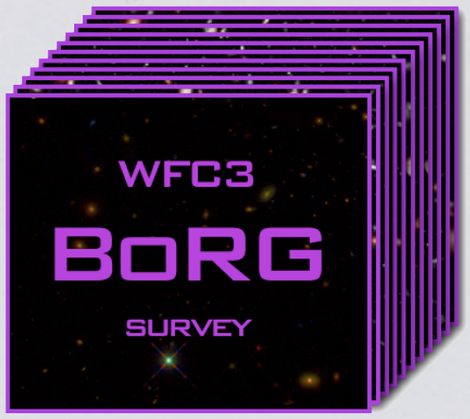


★ JWST imaging will explore the z>10 Universe

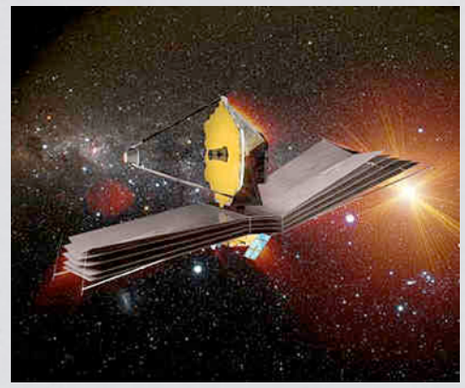


Redshift frontier is reached by wide area surveys:

Opportunity for BoRG-like JWST parallels!



Summary



- Hubble's WFC3 transformed our view of high-z galaxy evolution
- HST parallels have proven potential to explore the z~10 frontier
- Brightest galaxies ideal to advance data-model comparison
- Parallel imaging with JWST will be an amazing opportunity for unprecedented deep observations in the infrared!