The brightest galaxies at cosmic dawn with JWST

Michele Trenti

The University of Melbourne

Australian Government

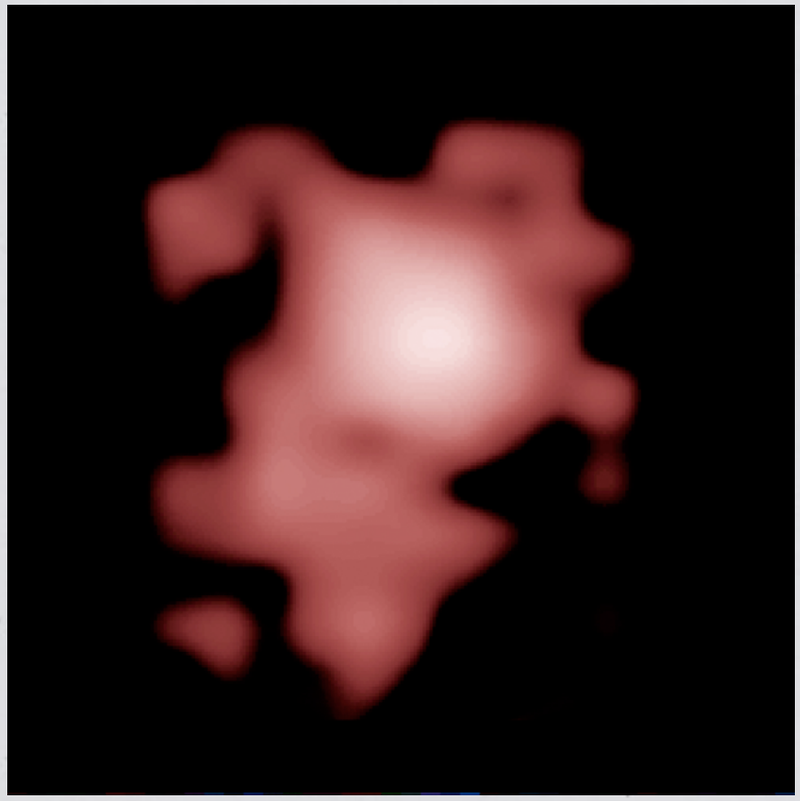
Australian Research Council

JWST@ROE — July 5th 2016

Star formation: now and then

★Was star formation different?

today



~13.4 Gyr ago

Image credits: NASA/ESA

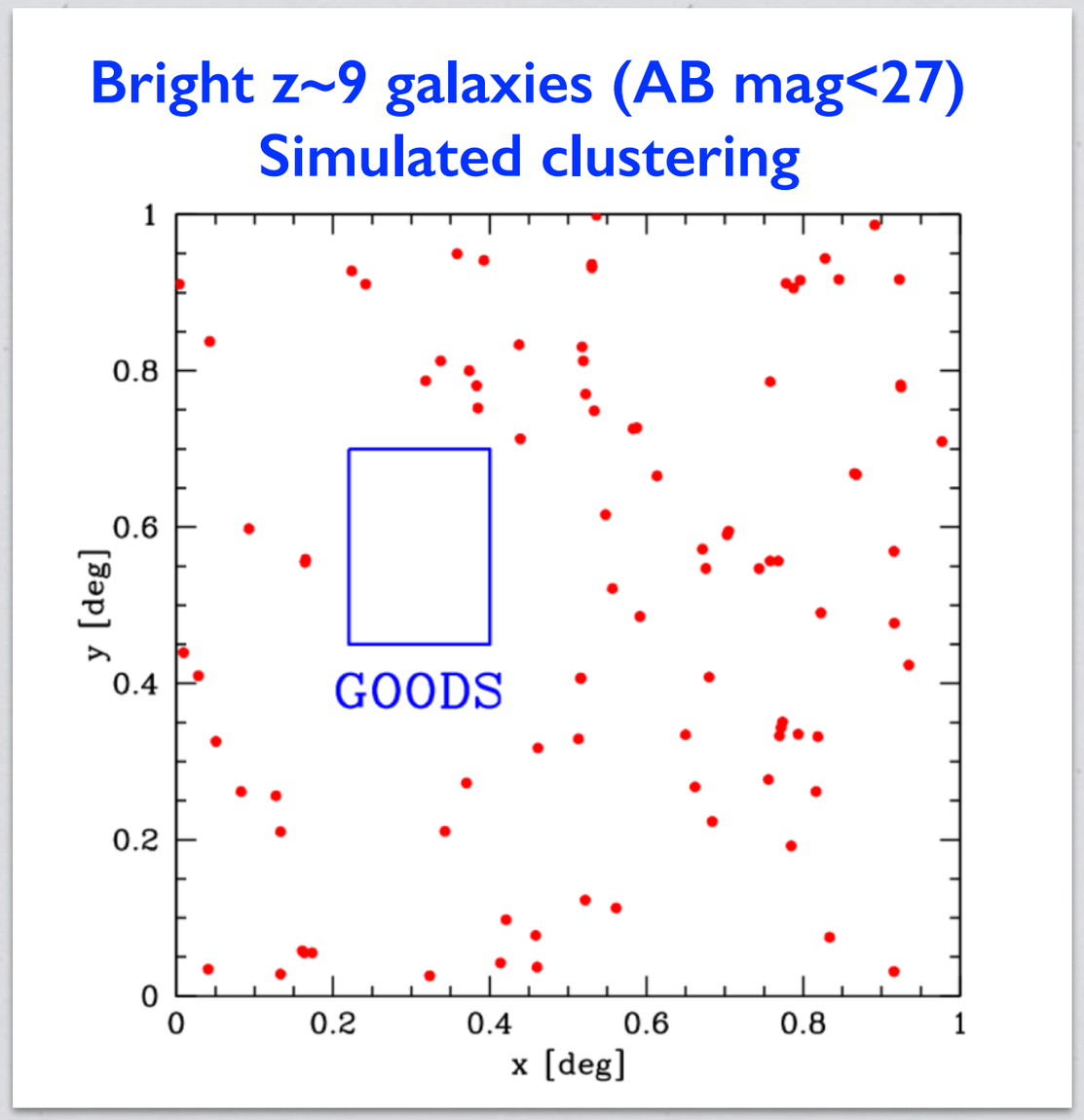
Bright galaxies in the first 700Myr

- Space telescopes needed
  - Exciting results from HST legacy fields

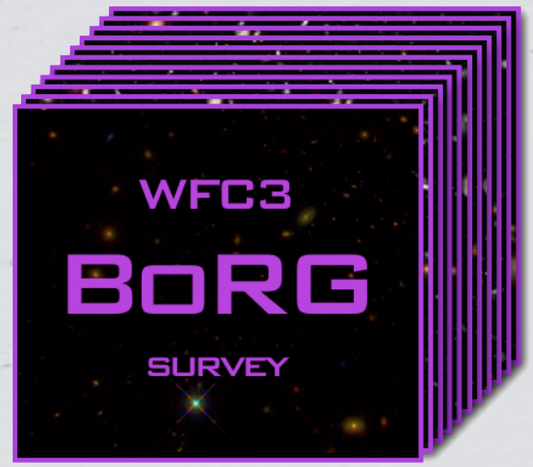
★ But challenges as well:

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

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



The Brightest of Reionizing Galaxies Survey (Trenti+ 2011)



Key goal: Identify bright galaxies at z~8-11

★ 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

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

★ Public data release through HST mission archive

2010-14: The luminosity function at z~8

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

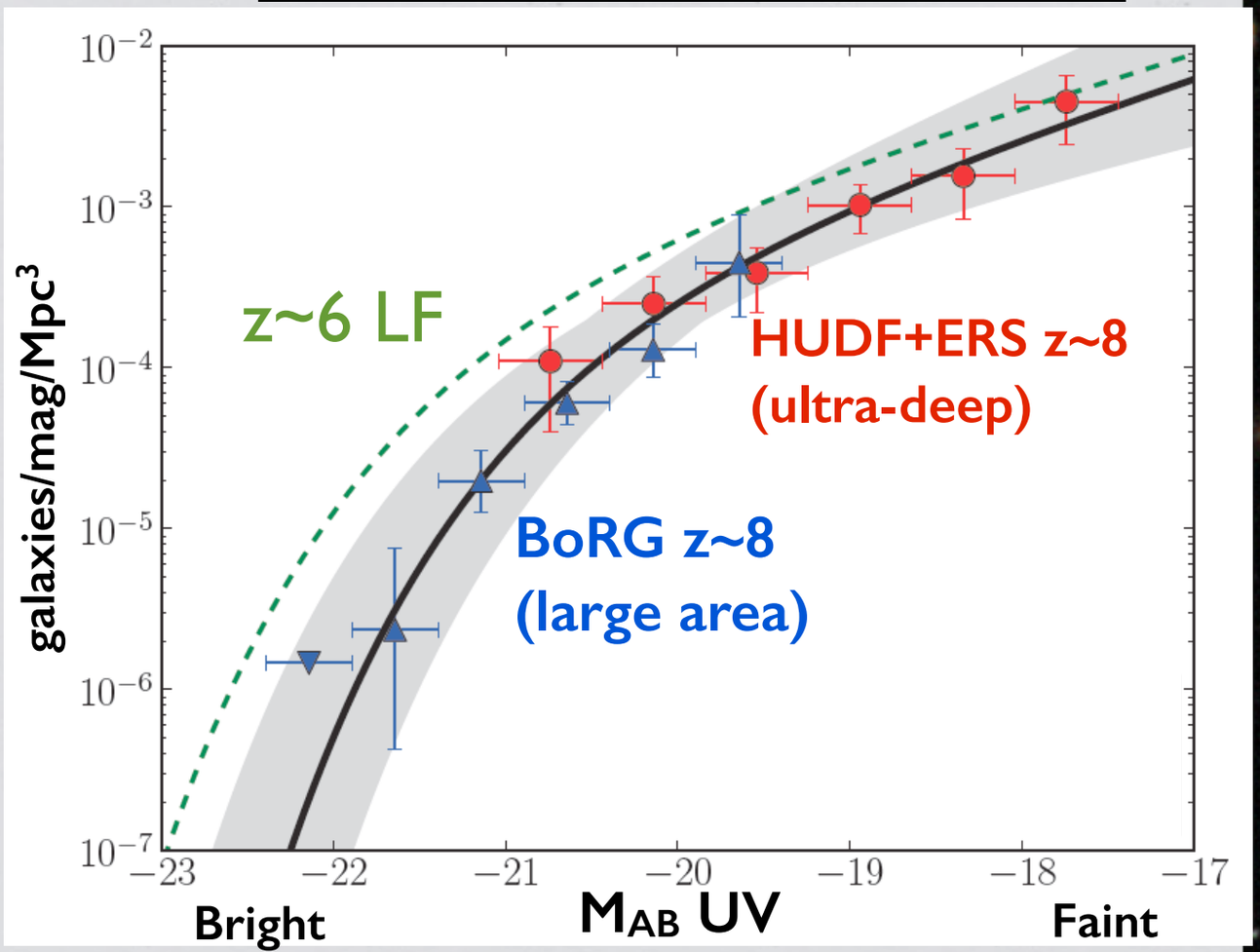
$$\phi(L) = \phi_0 (L/L_*)^{\alpha} \exp(-L/L_*)$$

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

★ None known preWFC3!

★ LF well described by Schechter form

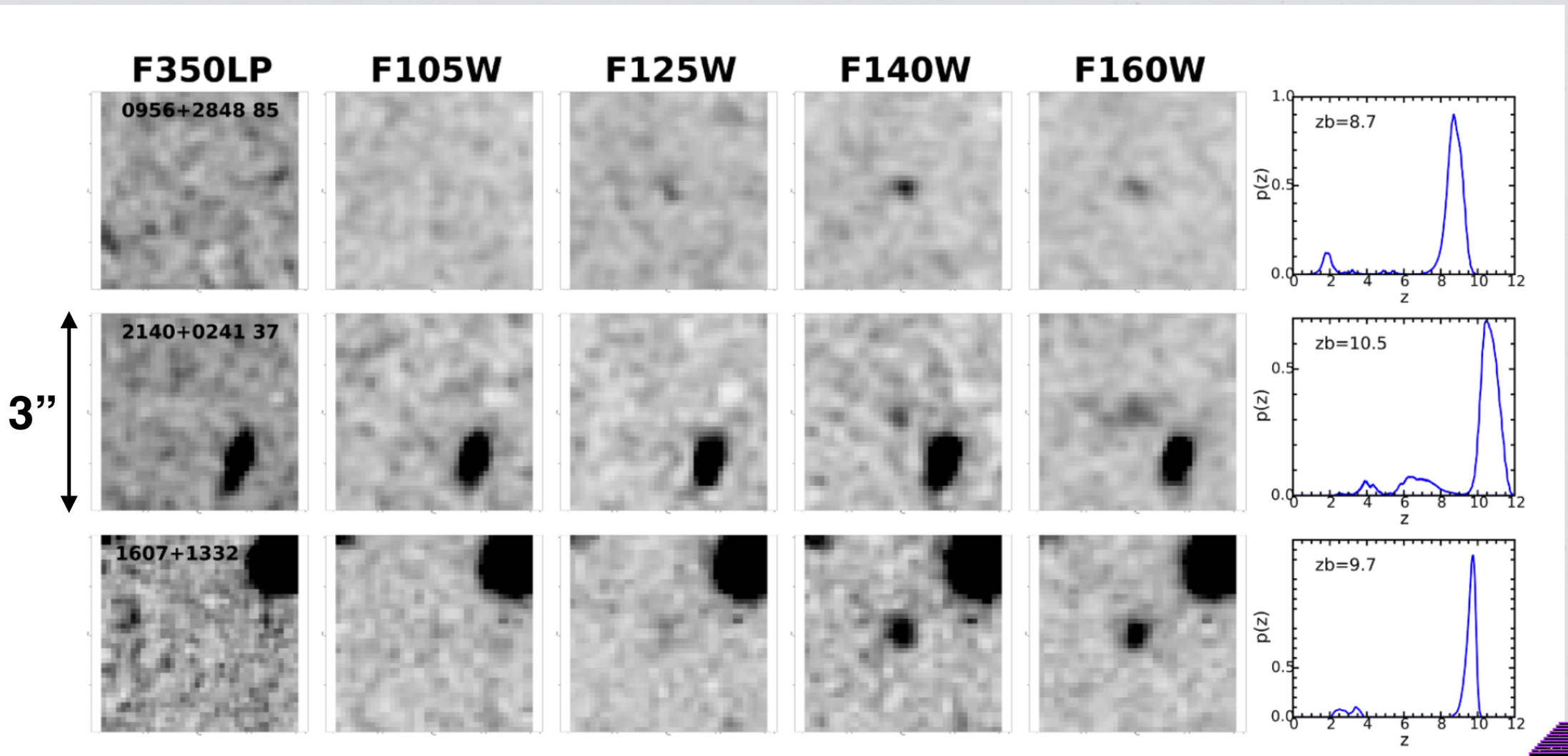
★ Clear evolution from z=6



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

The new frontier: z~8-11

★ Several z~8.5-11 candidates (m_{AB}~24.5-26) from latest BoRG data



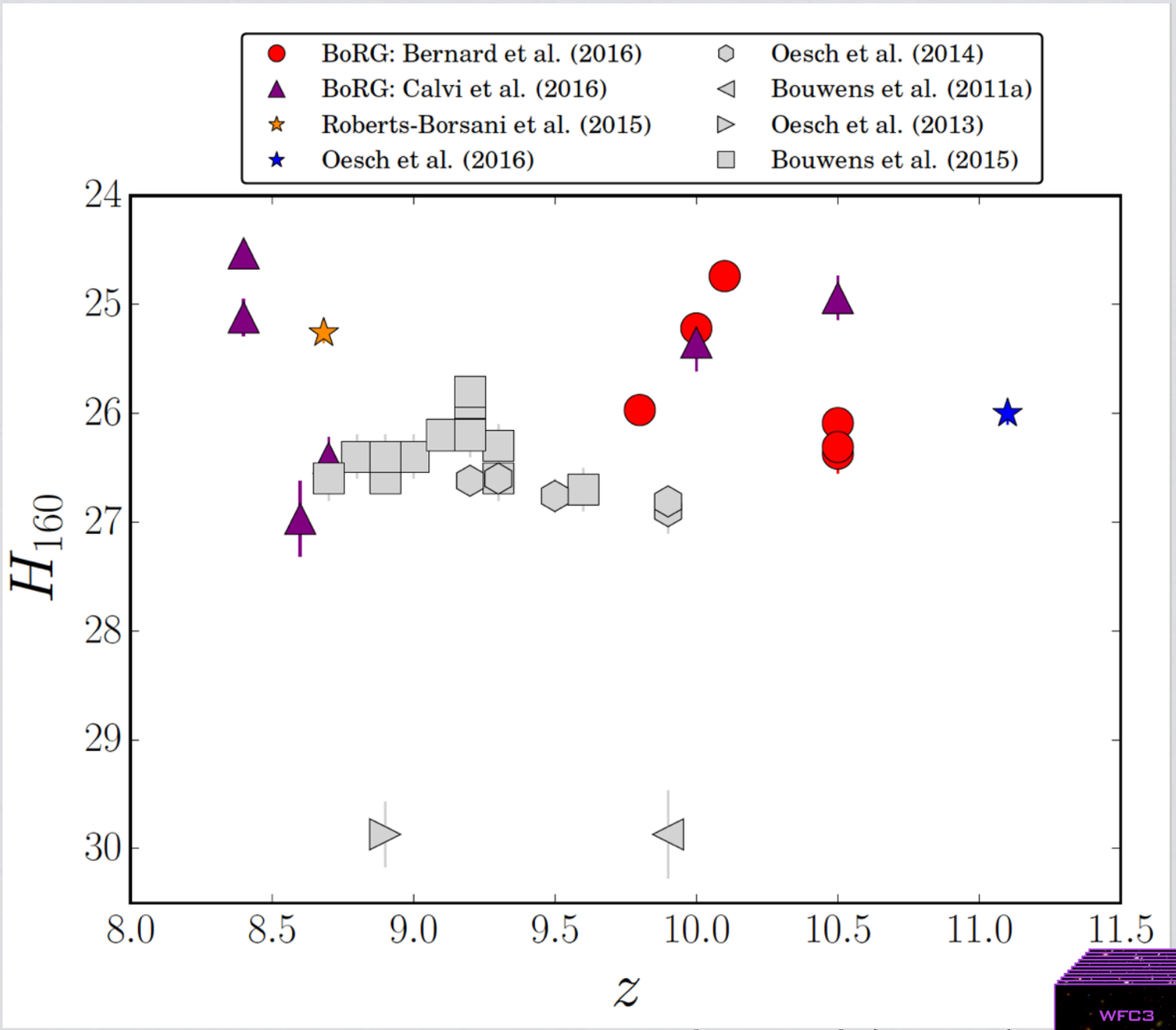
Calvi, MT et al. (2016)

Bright Galaxies at 500 Myr?

★ BoRG z~10 candidates are very luminous

★ But comparable to sources with spectroscopic confirmation

★ Keck and Spitzer follow-up underway



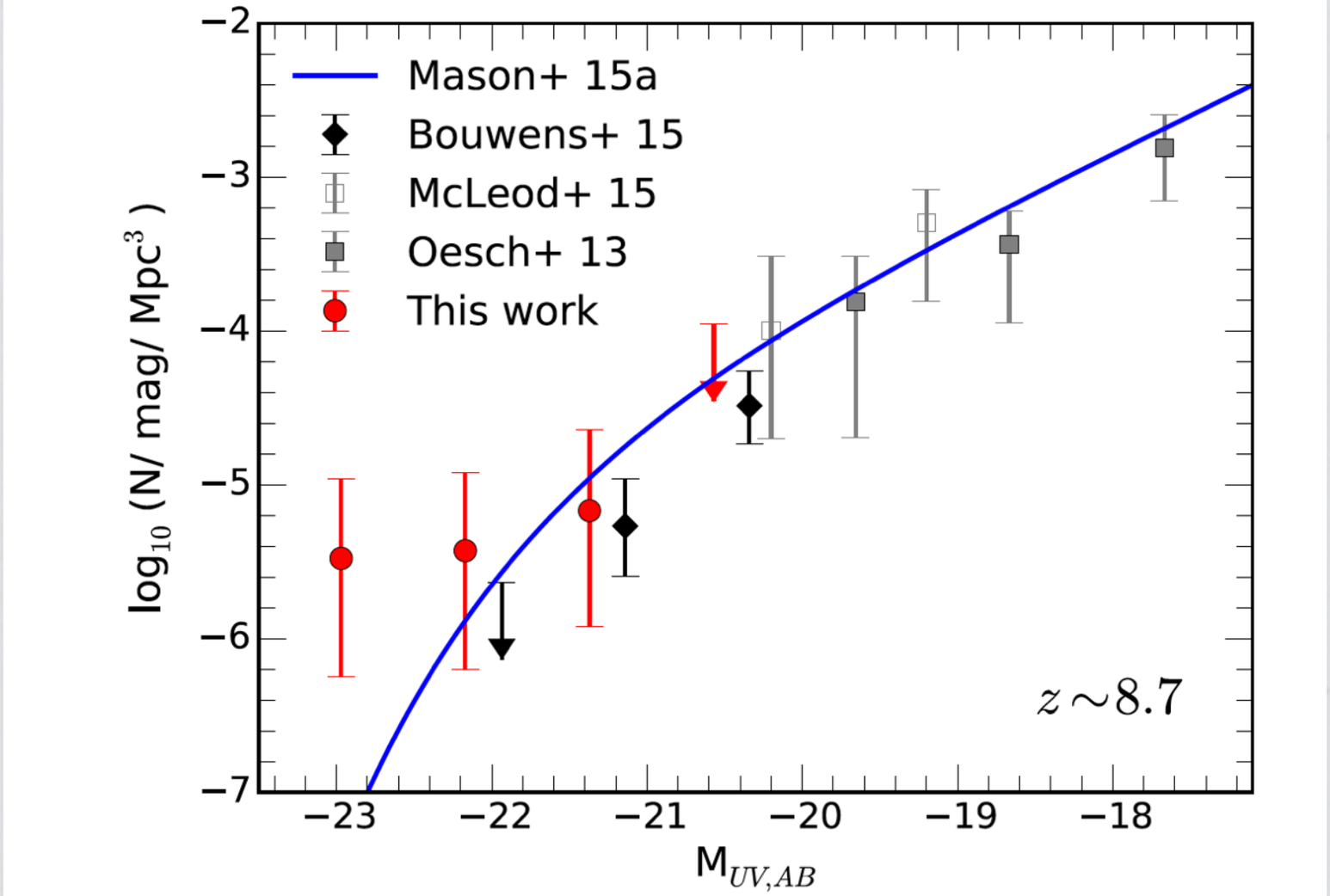
Bernard, MT et al. (in press)

Bright Galaxies at 500 Myr?

★ Is the LF Schechter at z>8?

★ Data not conclusive (yet)

★ Further large-area surveys needed



Calvi, MT et al. (2016)

★ What is the theoretical expectation?

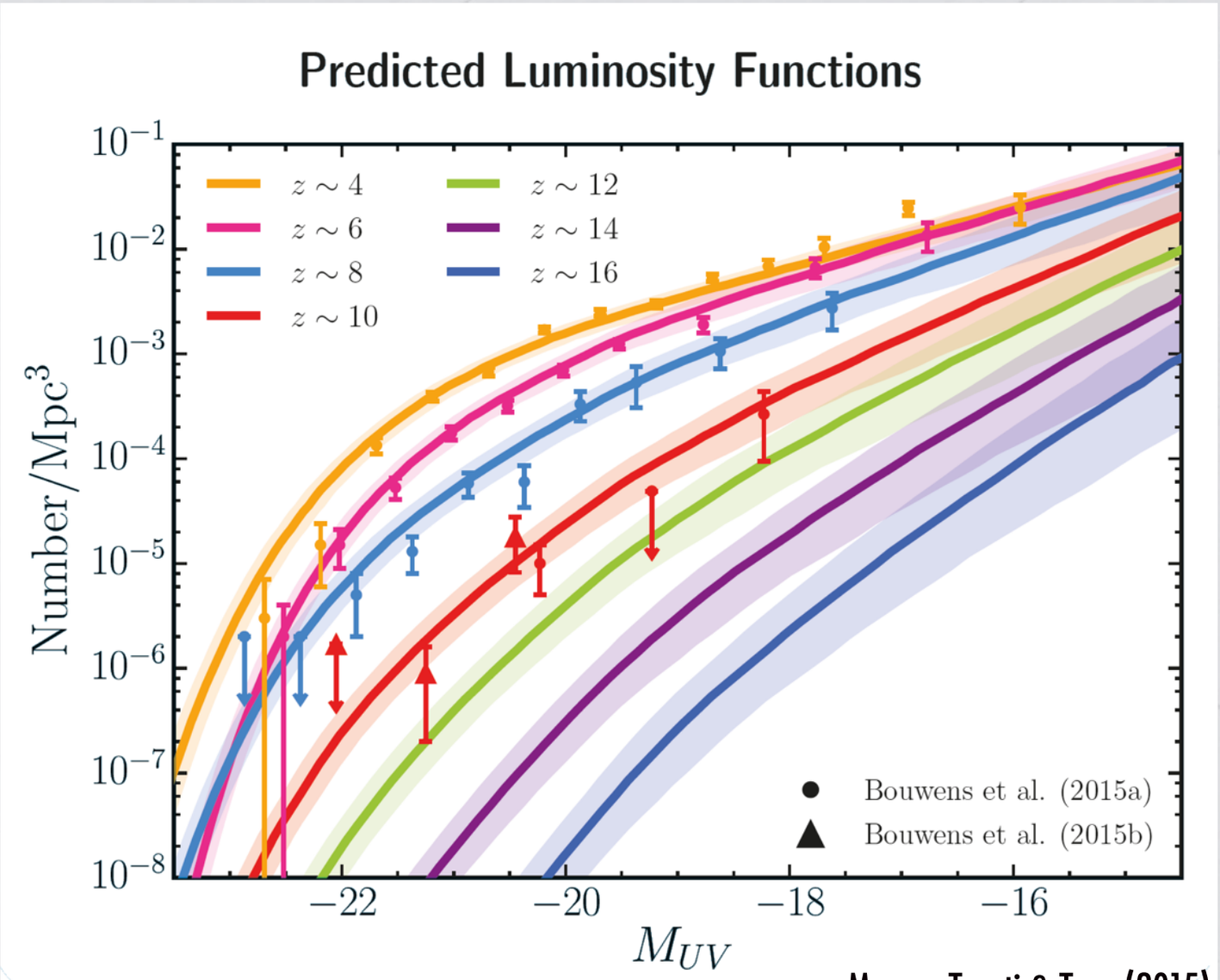
LF evolution from DM halo assembly

★ UV luminosity function predicted by basic modeling

★ Rapid evolution driven by DM halo assembly

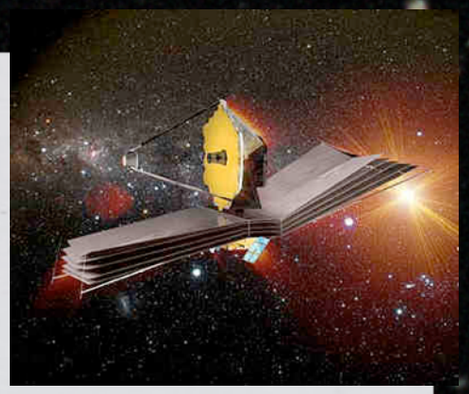
★ Halo mass for z>7 HST observations: ~10^{11} M_{sun}

★ LF approaching power law at z>10 (up to typical JWST survey area)

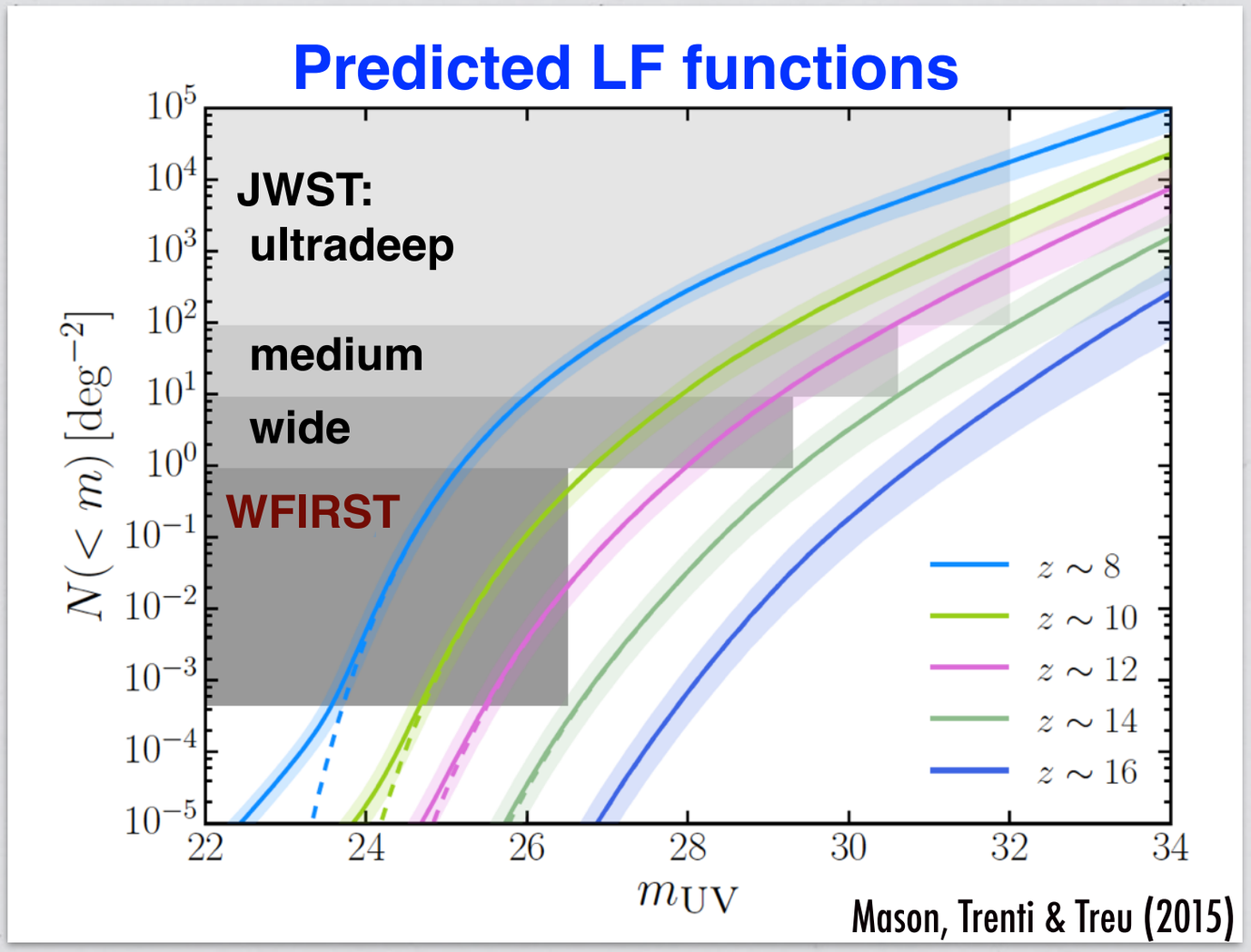


Mason, Trenti & Treu (2015)

Extending the frontier



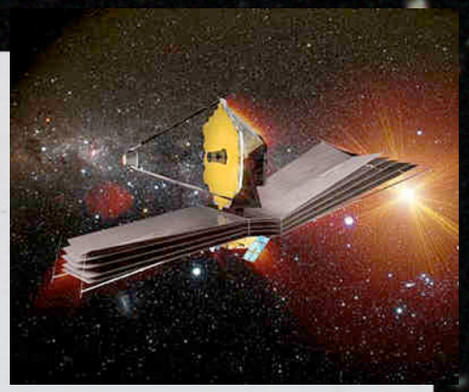
★ JWST imaging will explore the z>10 Universe



Redshift frontier is reached by wide area surveys:

Opportunity for BoRG-like JWST parallels!

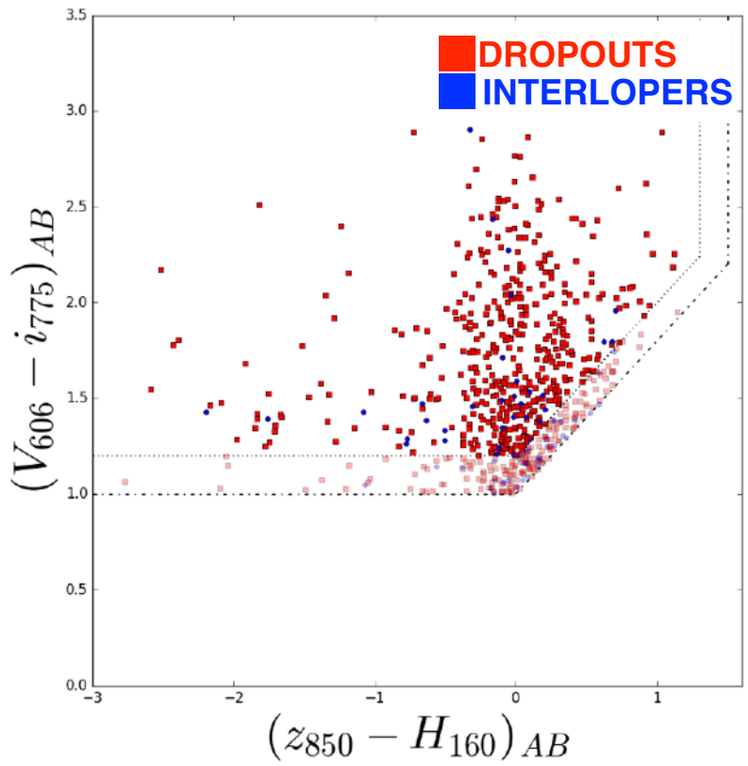
Needles in haystacks



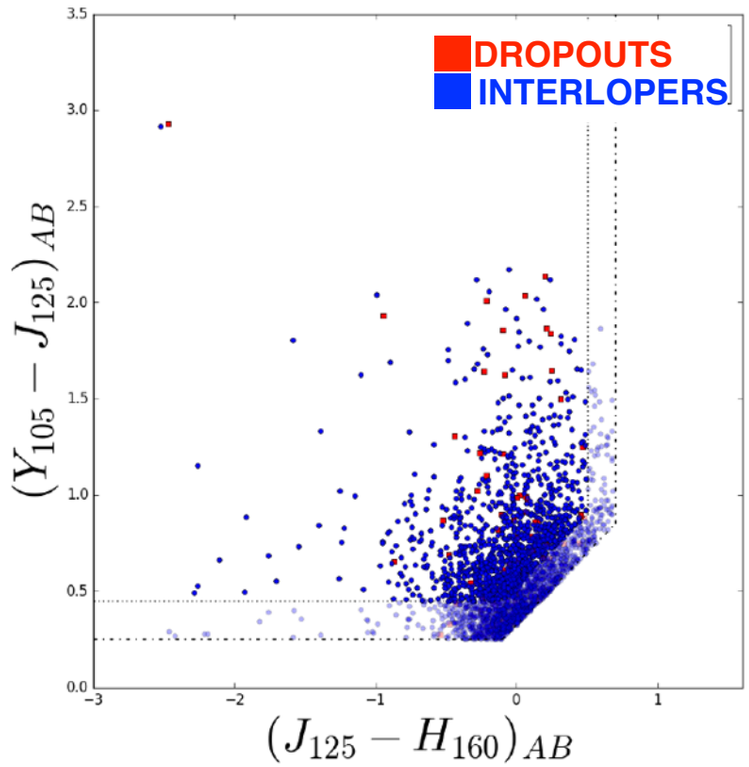
★ z>10 galaxies will be extremely rare

★ Interlopers likely to remain abundant

z~5



z~8

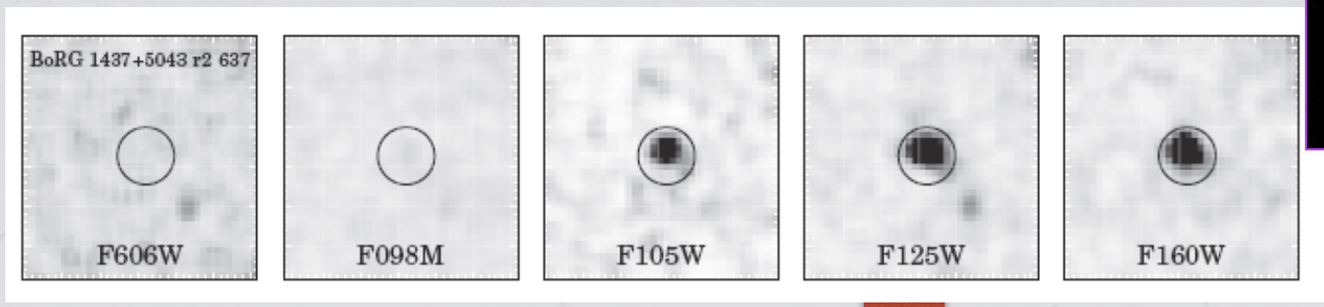


z>10

Vulcani, MT et al. (submitted)

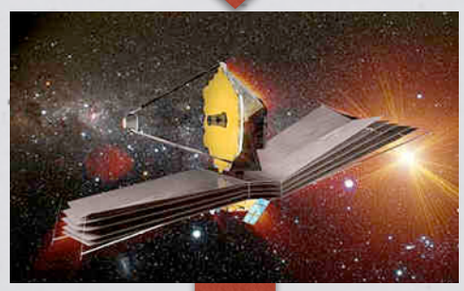
JWST photo-z surveys need careful design,
but IR capabilities will help

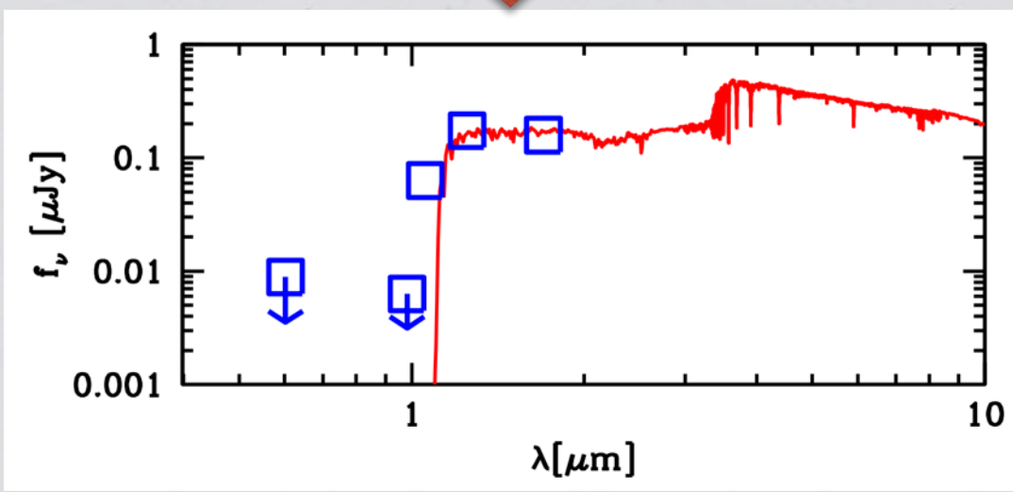
High-z stellar populations from JWST

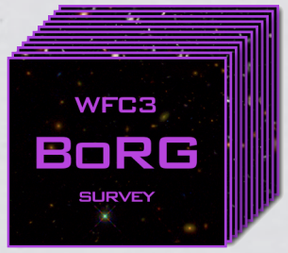


★~3h NIRSpec: Medium-res **continuum spectrum** at restframe optical for z~8-10 BoRG galaxies [G395M, R=1000]

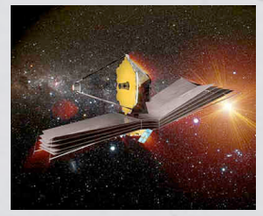
★Opportunity to identify new targets with HST while waiting for JWST







Summary



- Hubble transformed our view of galaxy formation during the epoch of reionization

- Large-area random-pointing imaging (BoRG survey) ideal to identify the brightest galaxies

- JWST will not only find the brightest galaxies sources in the first 300 Myr, but also study in detail their stellar populations