

Detecting population III galaxies with HST and JWST

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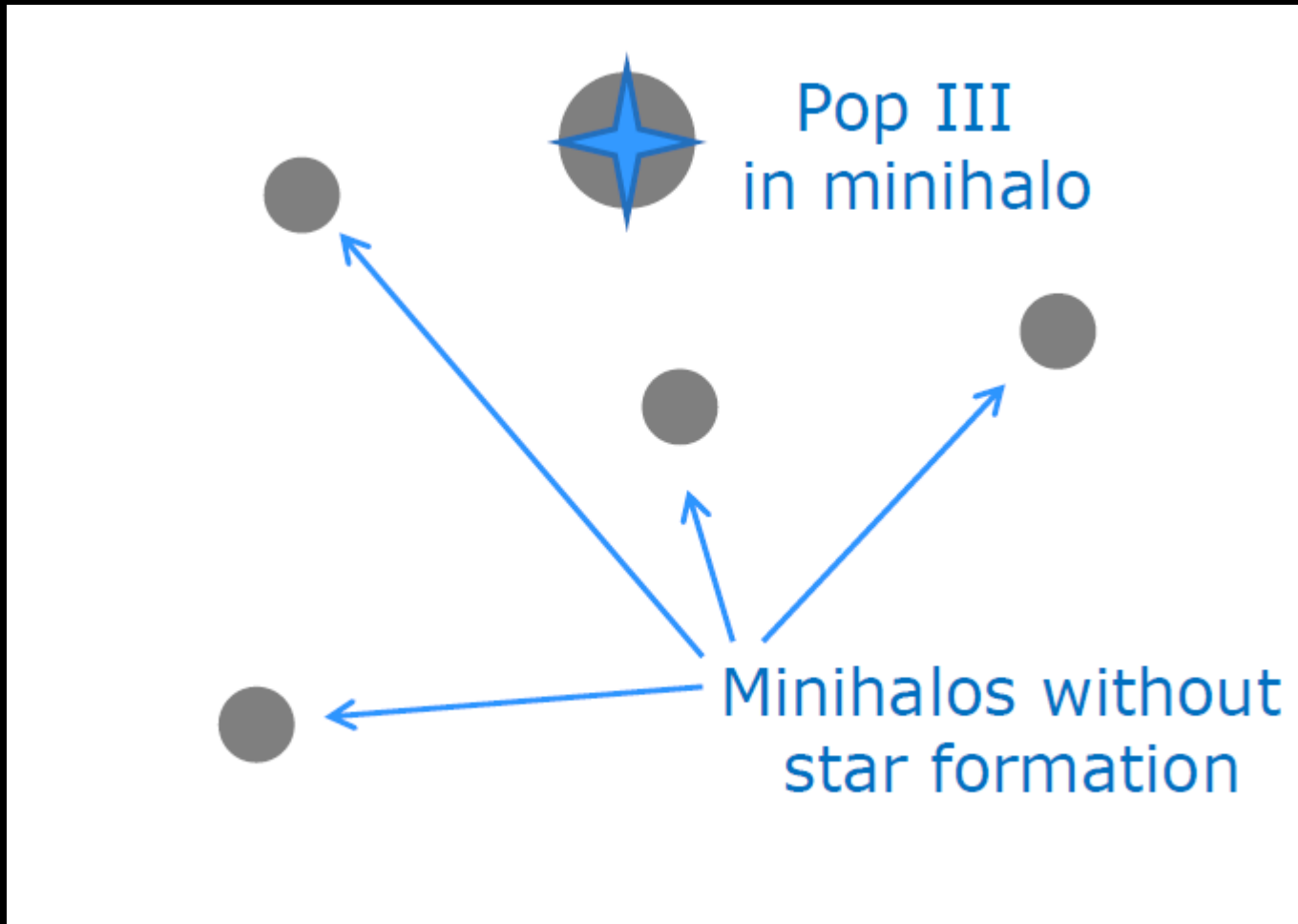


Akio Inoue, Michele Trenti, Daniel Schaerer, Adi Zitrin,
C.-E. Rydberg, Lucia Guaita, Tom Broadhurst, Tina Ström,
Göran Östlin, Florent Duval, Peter Lundqvist, Pat Scott

Outline

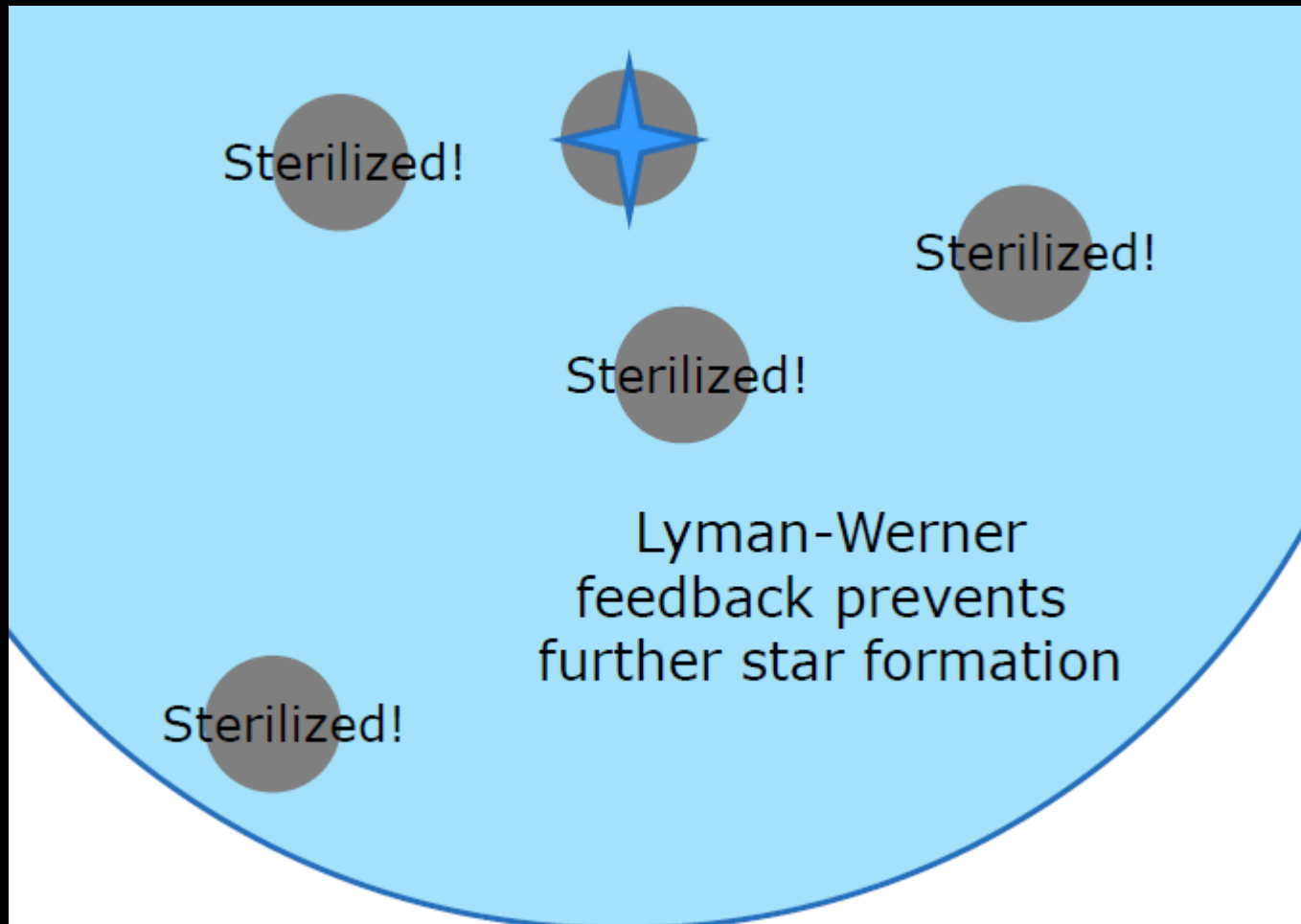
- Pop III galaxies – what, when, where?
- JWST/HST detection limits
- Hunting for pop III galaxies behind lensing clusters
- Spectral signatures of pop III galaxies

How to form a Pop III galaxy



E.g. Stiavelli & Trenti (2010)

How to form a Pop III galaxy



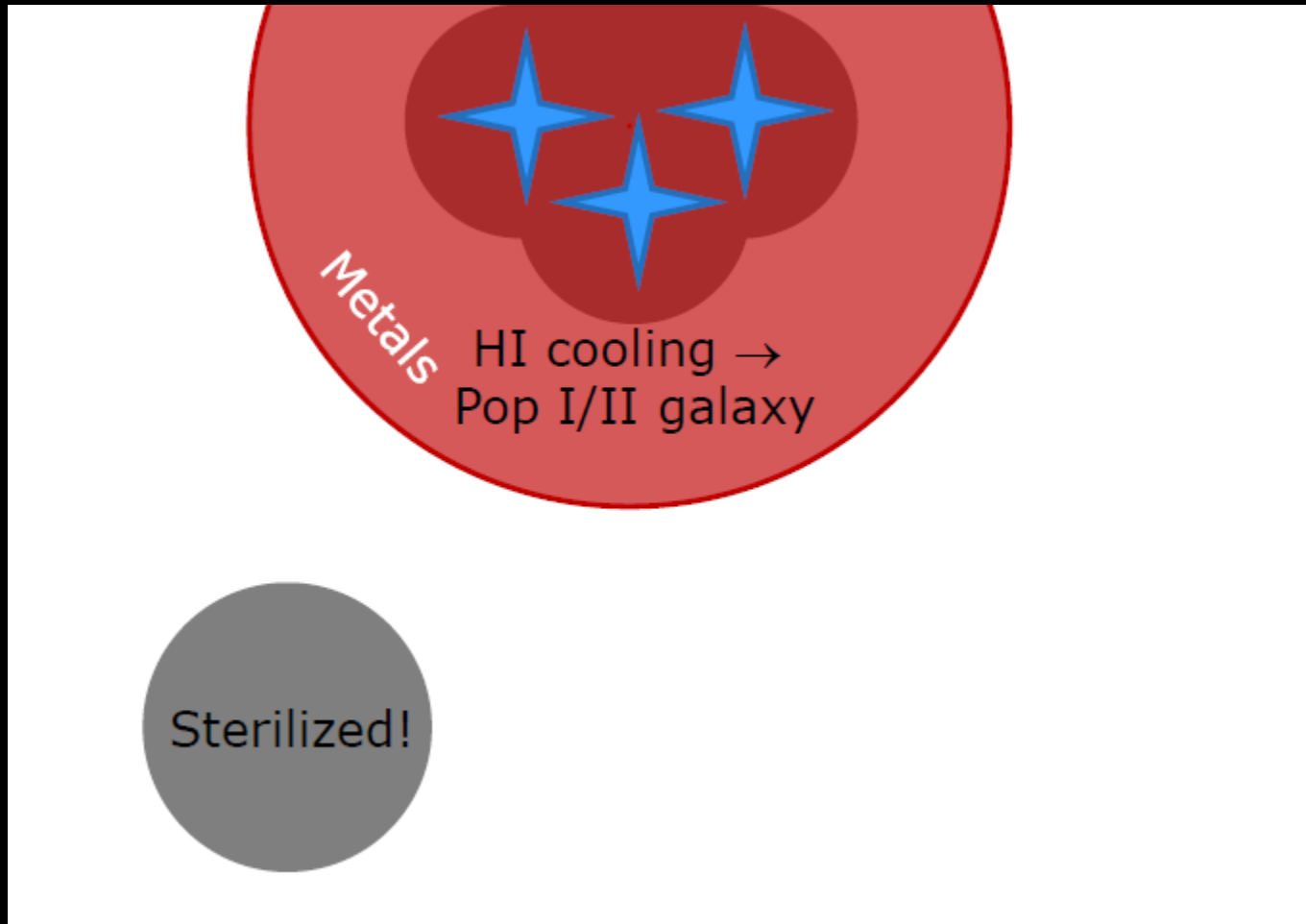
E.g. Stiavelli & Trenti (2010)

How to form a Pop III galaxy



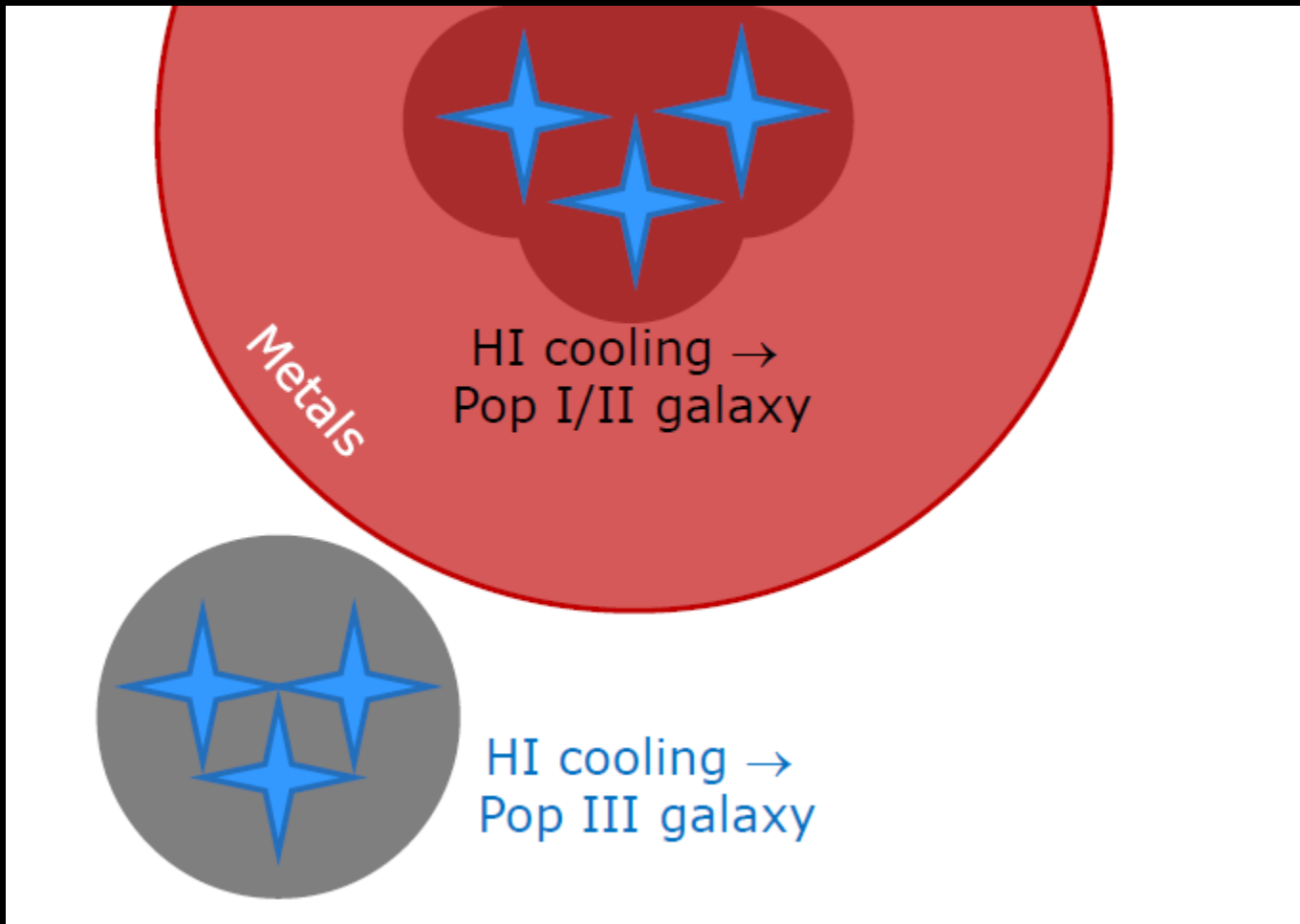
E.g. Stiavelli & Trenti (2010)

How to form a Pop III galaxy



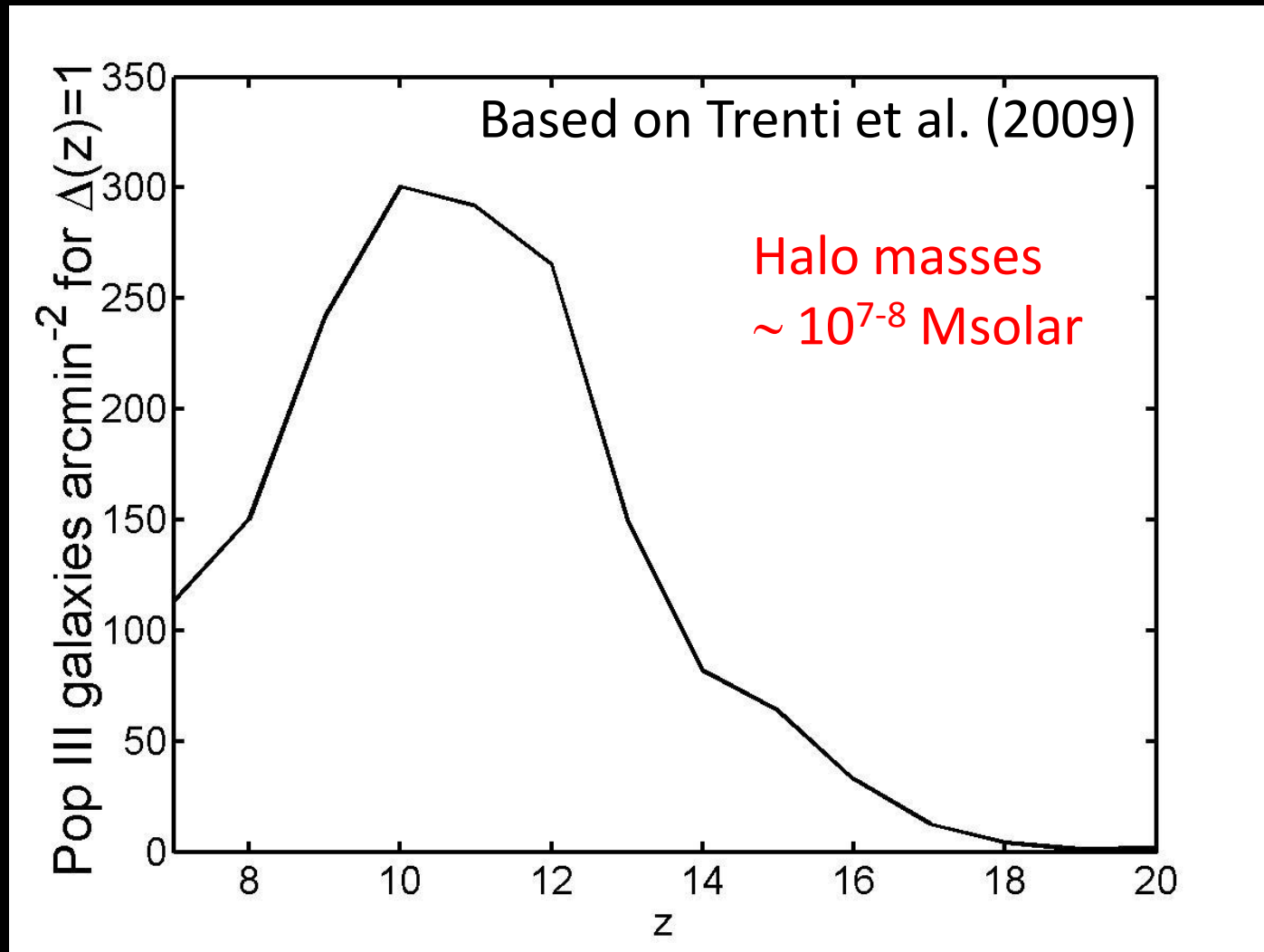
E.g. Stiavelli & Trenti (2010)

How to form a Pop III galaxy



E.g. Stiavelli & Trenti (2010)

The formation history of pop III galaxies



Zackrisson et al. (2012, arXiv:1204.0517)



The
ggdrasil code

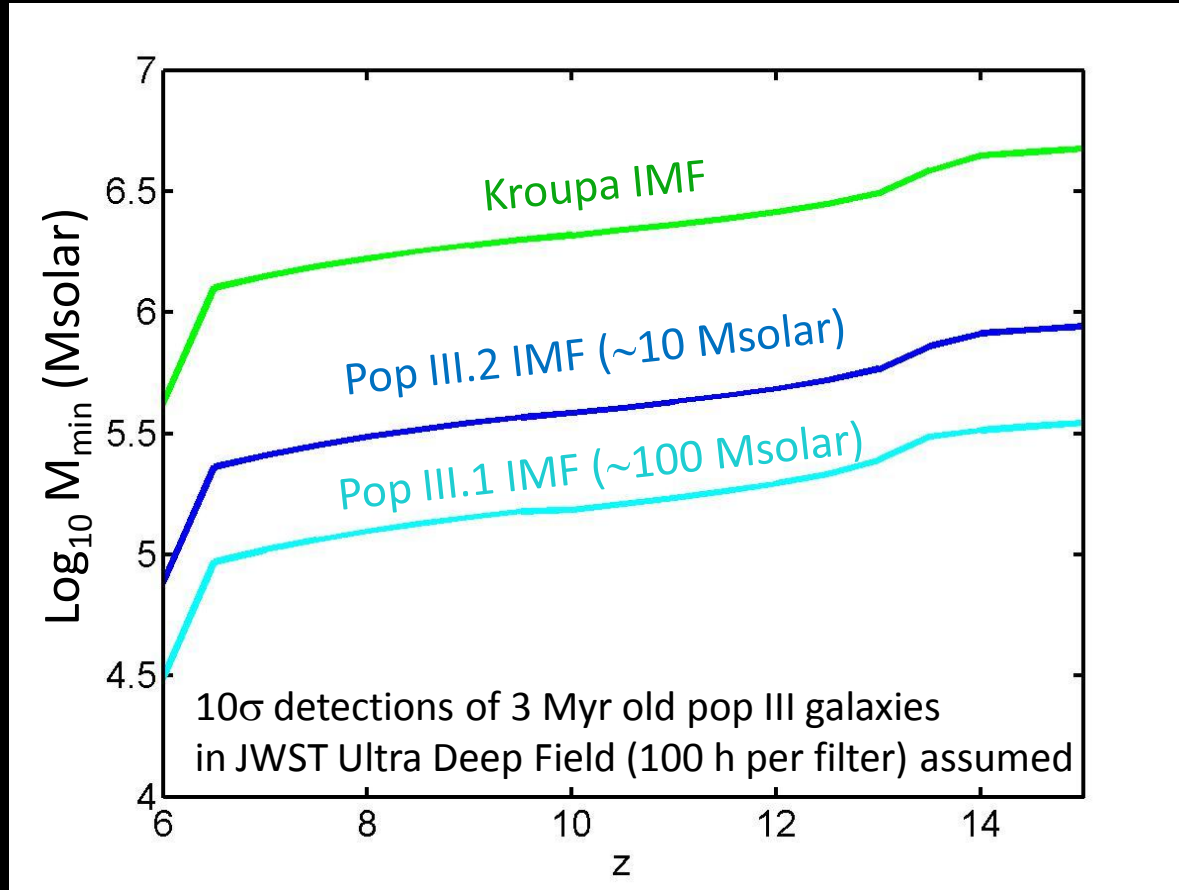
- Pop I, II, III stars + dark stars
- Nebular emission (Cloudy)
- Dust
- HST/JWST fluxes @ $z=0-15$

A spectral synthesis model for the first galaxies

Model grids available at: www.astro.su.se/~ez

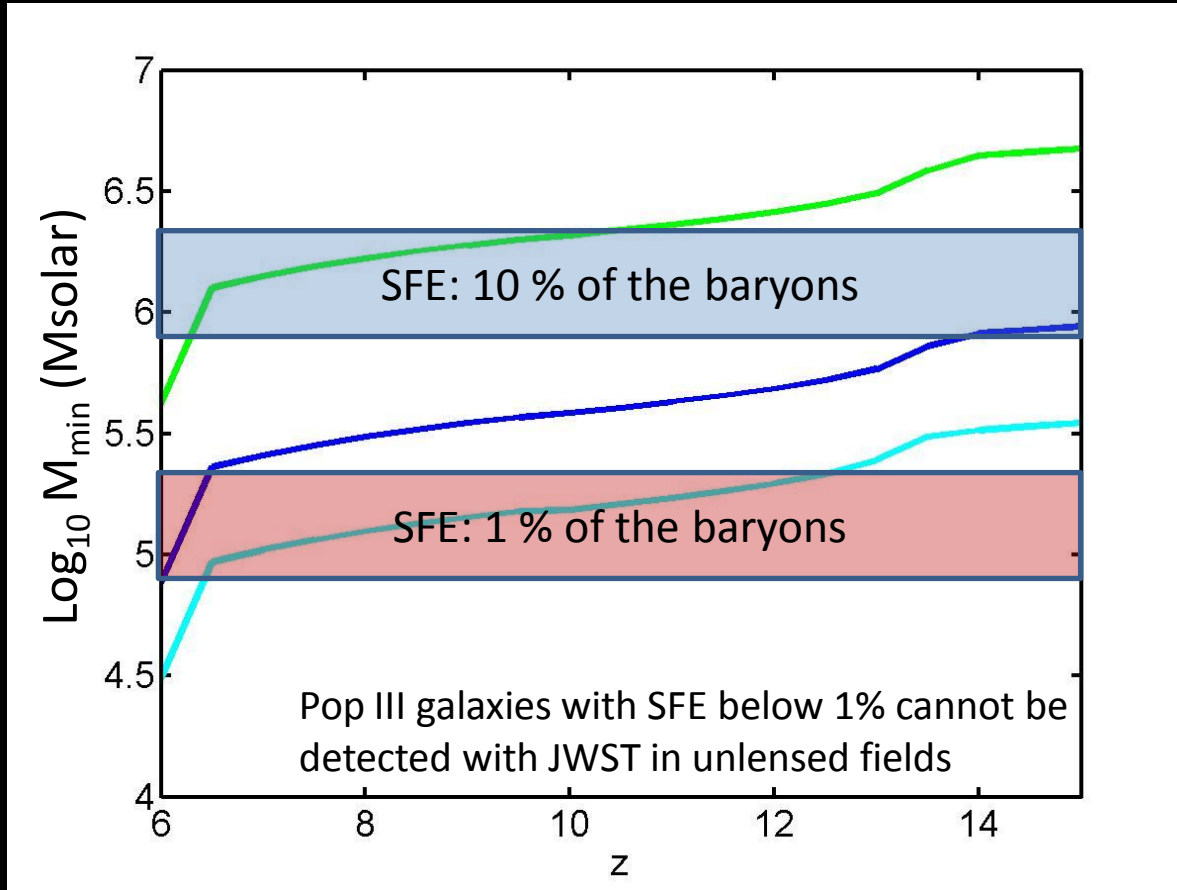
Zackrisson et al. 2011, ApJ, 740, 13

JWST detection limits



Zackrisson et al. 2011, ApJ, 740, 13

JWST detection limits



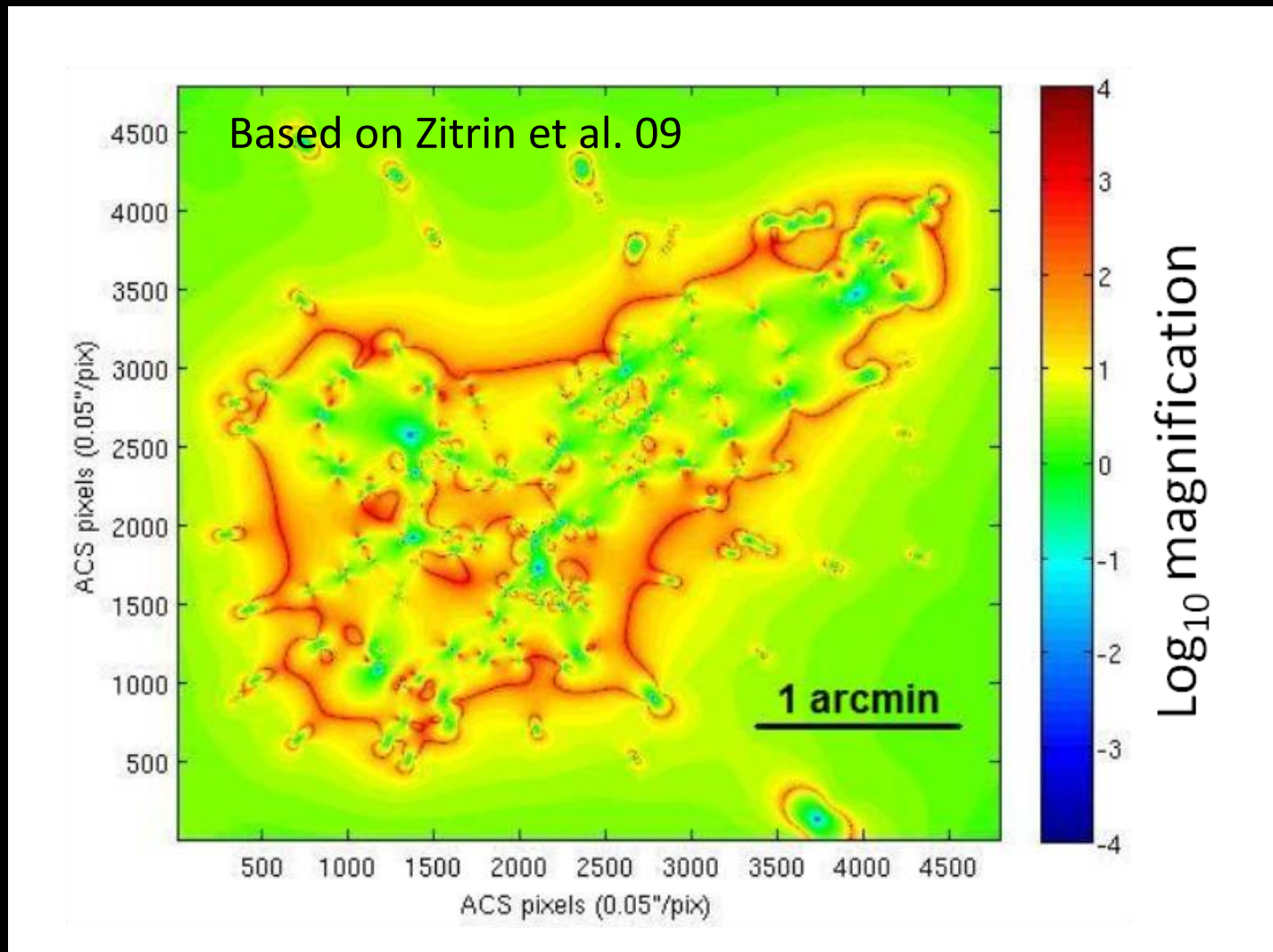
Zackrisson et al. 2011, ApJ, 740, 13

Lensed pop III galaxies

- Cluster lensing can push these JWST limits to $\sim 0.1\%$
- The ongoing HST/CLASH survey \rightarrow Multiband photometry in 17 filters for 25 low- z galaxy clusters (Postman et al. 12)
- With HST/CLASH, you get a pop III galaxy detection threshold similar to a JWST, 100 hour Ultra Deep Field!

Zackrisson et al. (2012, arXiv1204.0517)

Magnification map of J0717.5+3745



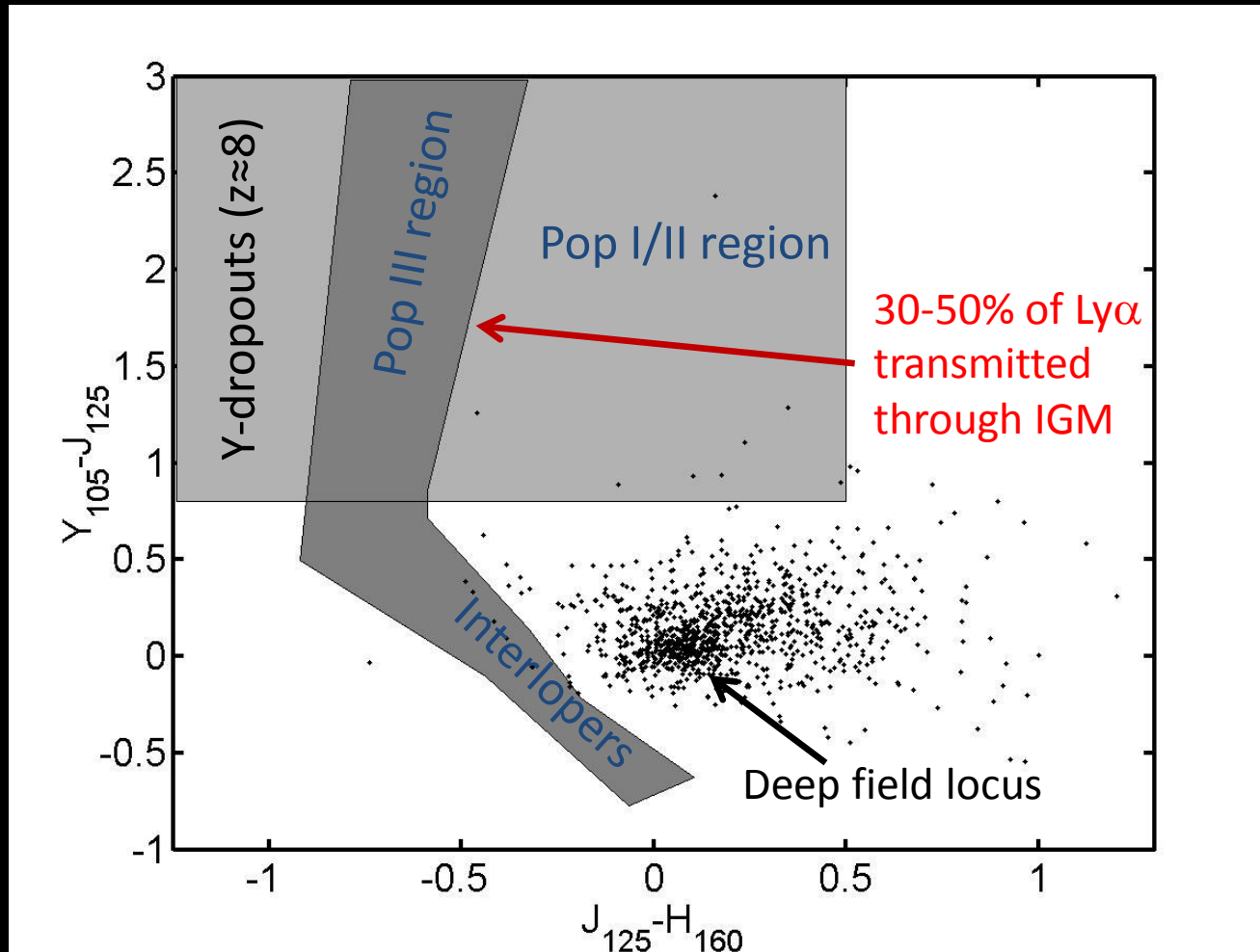
Zackrisson et al. (2012, arXiv:1204.0517)

Identifying pop III galaxies at $z > 6$

Photometric signatures

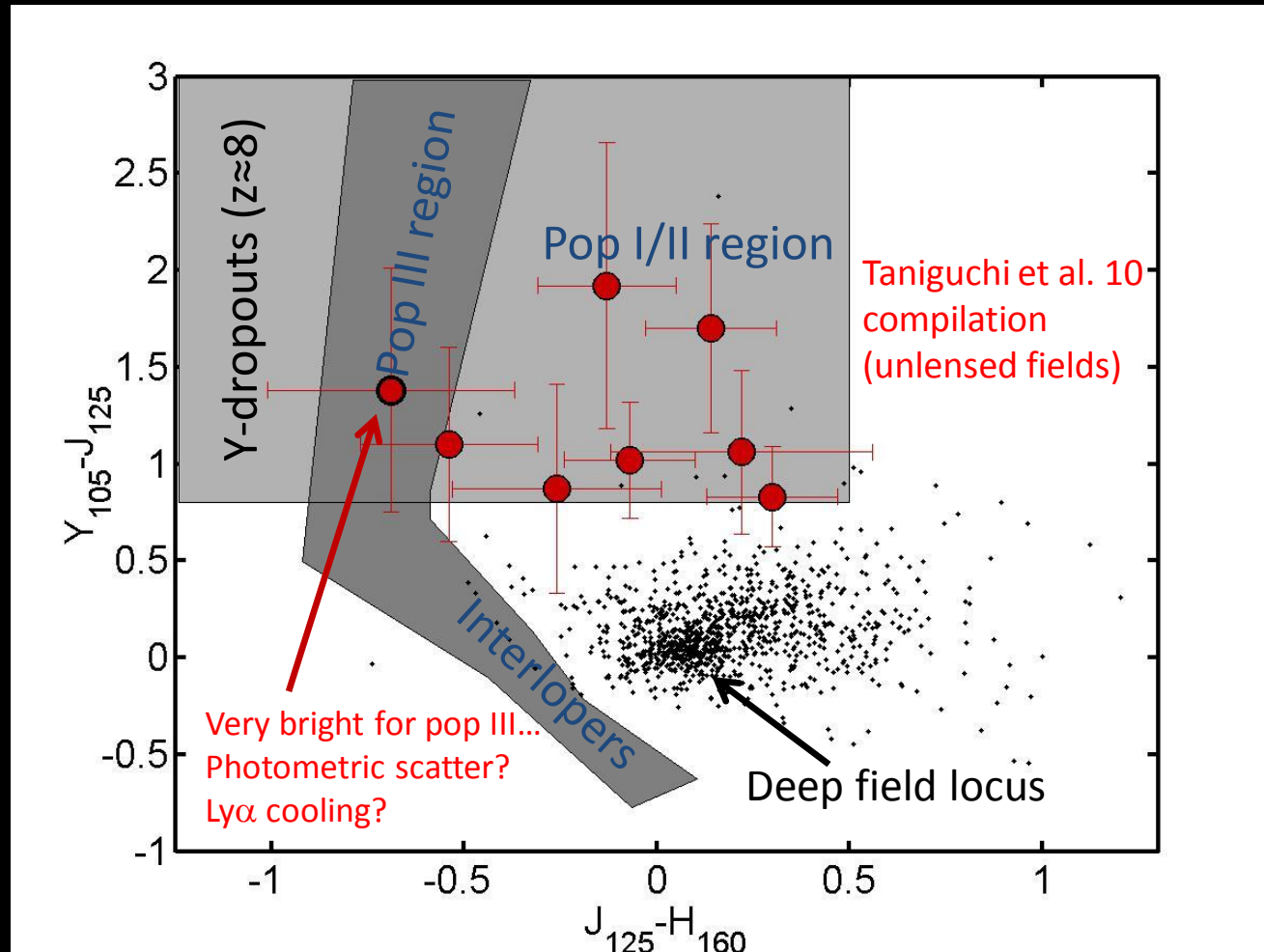
- Very blue UV slope (e.g. Raiter et al. 10)
 - Good: In principle sensitive to the pop III IMF
 - Bad: Requires very high LyC escape fraction ($>90\%$)
 - Extremely faint object + very difficult to measure
- Metal-free nebular spectrum (Inoue 11, Zackrisson 11a)
 - Good: Lack of [OIII] @ 5007 \AA → strange JWST colours
 - Bad: Not sensitive to the pop III IMF
- Very strong Ly α (e.g. Schaerer 02, Zackrisson 11b)
 - Good: Sensitive to the pop III IMF + detectable with HST
 - Bad: IGM absorption & non-pop III contributions (AGN, cooling)

The colour signatures of strong Ly α



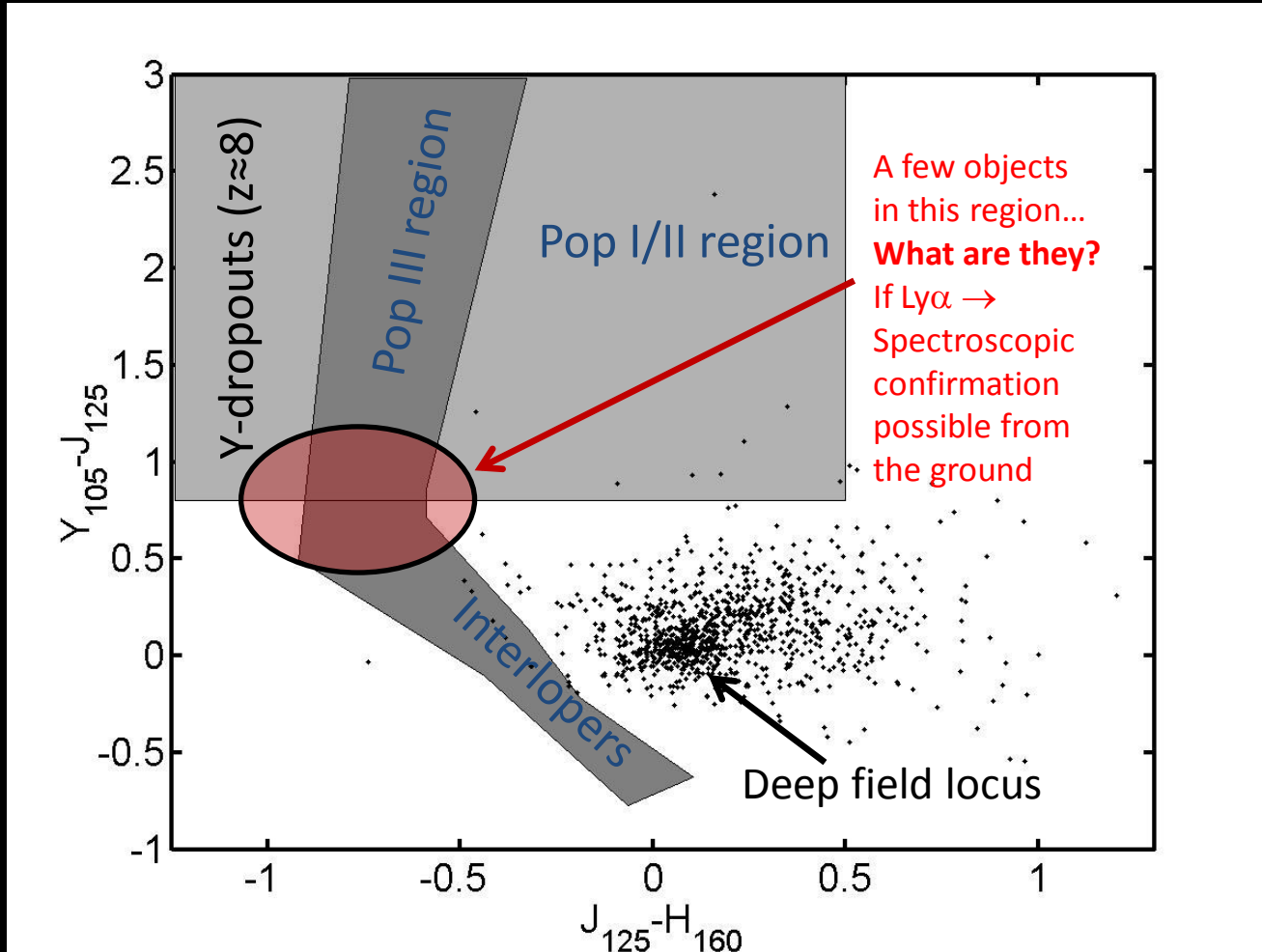
Zackrisson et al. 2011b, MNRAS 418, L104

The colour signatures of strong Ly α



Zackrisson et al. 2011b, MNRAS 418, L104

Lensed pop III galaxy candidates in CLASH?



Summary

- The *Yggdrasil* model → spectral signatures of pop III galaxies (www.astro.su.se/~ez)
- Search strategy: HST + lensing clusters → Detection threshold similar to a JWST Ultra Deep Field
- Search for pop III galaxies at $z > 6$ in CLASH underway

