Strategies to Observe First Light with JWST

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Outline:

(1) Strategies to Observe First Light with JWST:

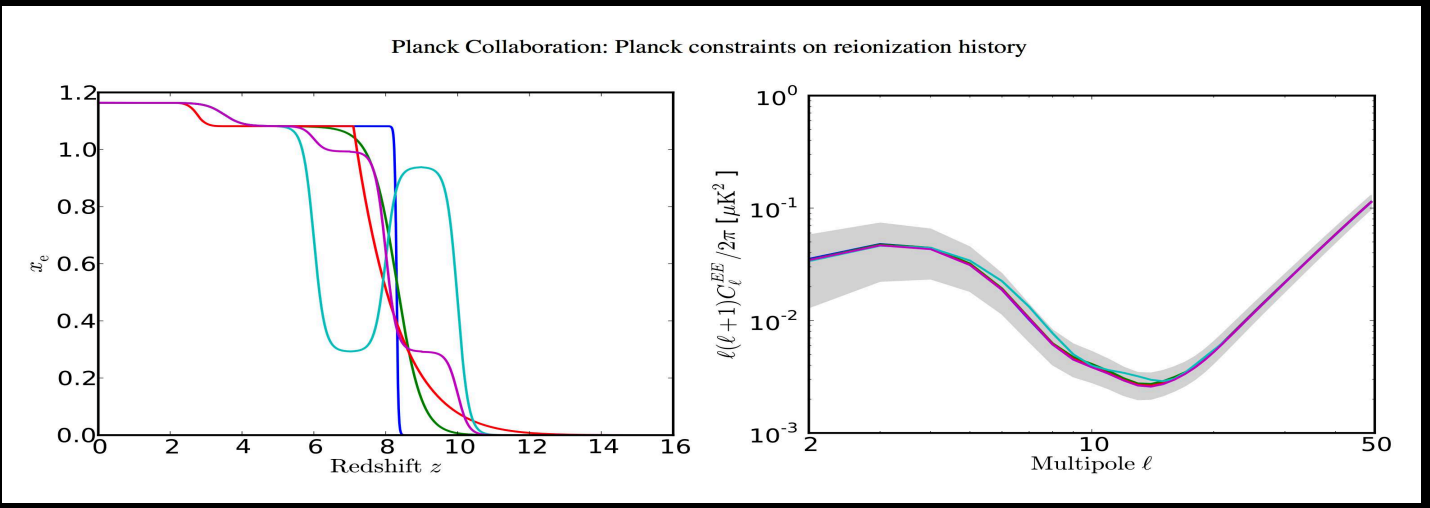
- Random medium-deep fields compared to the best lensing targets

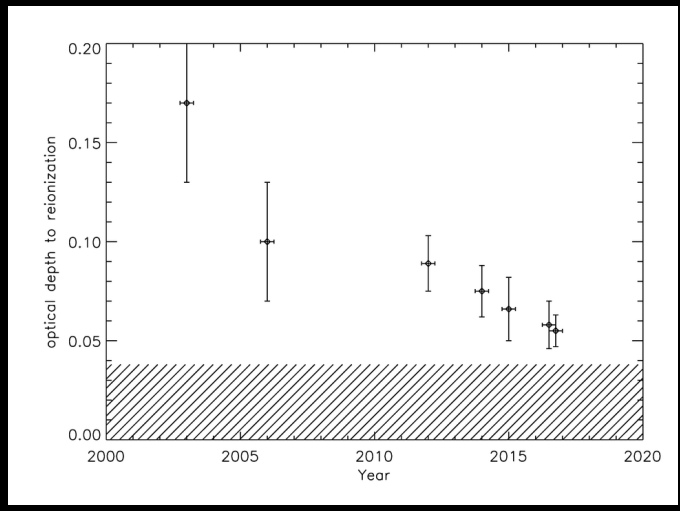
(2) Summary and Conclusions.

Talk at the JWST GTO Workshop, May 17, 2016; National Research Council, Victoria (BC, Canada).

http://www.asu.edu/clas/hst/www/jwst/jwsttalks/windhorst_firstlight16.pdf

Implications of Planck 2016 results for JWST First Light:





WFC3 $z \lesssim 7$–9 $\longleftarrow\ \longrightarrow$ JWST $z \simeq 8$–25

(Courtesy: Dr. Bill Jones).

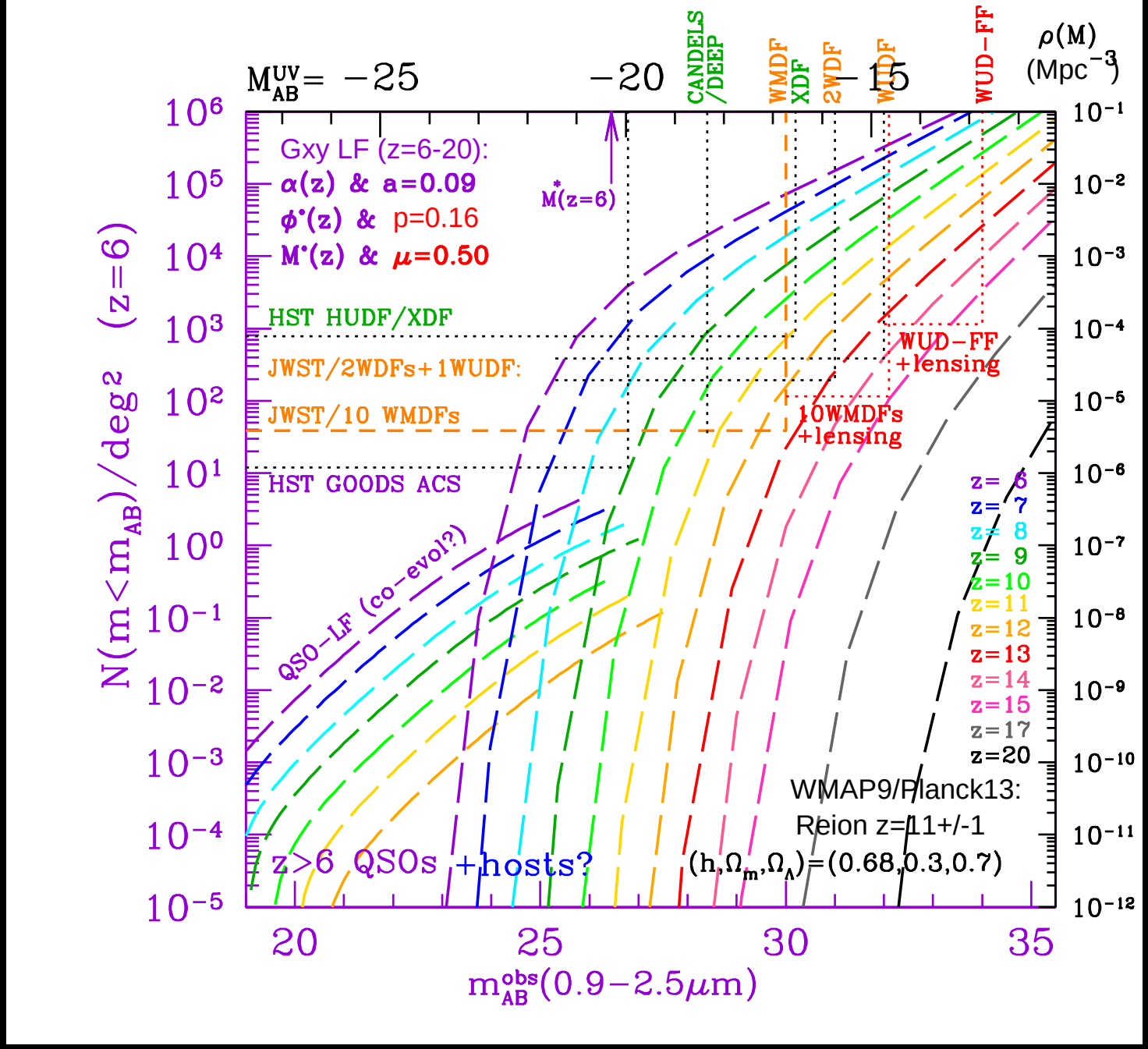
Planck 2016 data provided better foreground removal (Planck 2016 papers XLVIII & XLVII; astro-ph/1605.02985 & astro-ph/1605.03507):

Reionization appears to have occurred between these extremes:

(1) Instantaneous: $z \sim 8.3 \pm 0.5$ (optical depth $\tau \simeq 0.055 \pm 0.009$; 0.058 ± 0.012)

(2) or Inhomogeneous & drawn out: starting at $z \gtrsim 12$?, peaking at $z \sim 8$, ending at $z \simeq 6$–7. The differences between both are now very small.

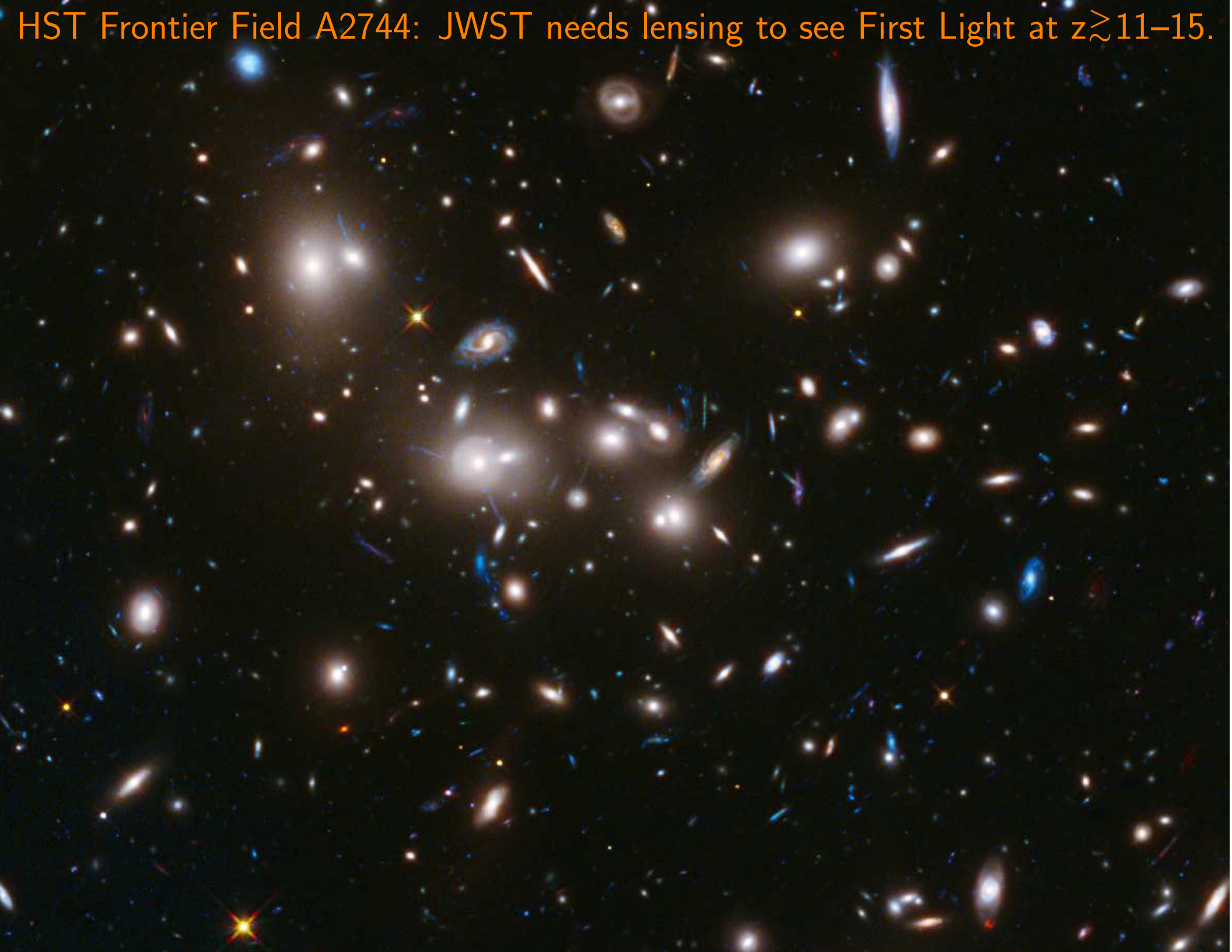
- Since Planck 2016's polarization τ has come down considerably ($\tau \simeq 0.055$–0.058), how many reionizers will JWST actually see at $z \simeq 10$–15?



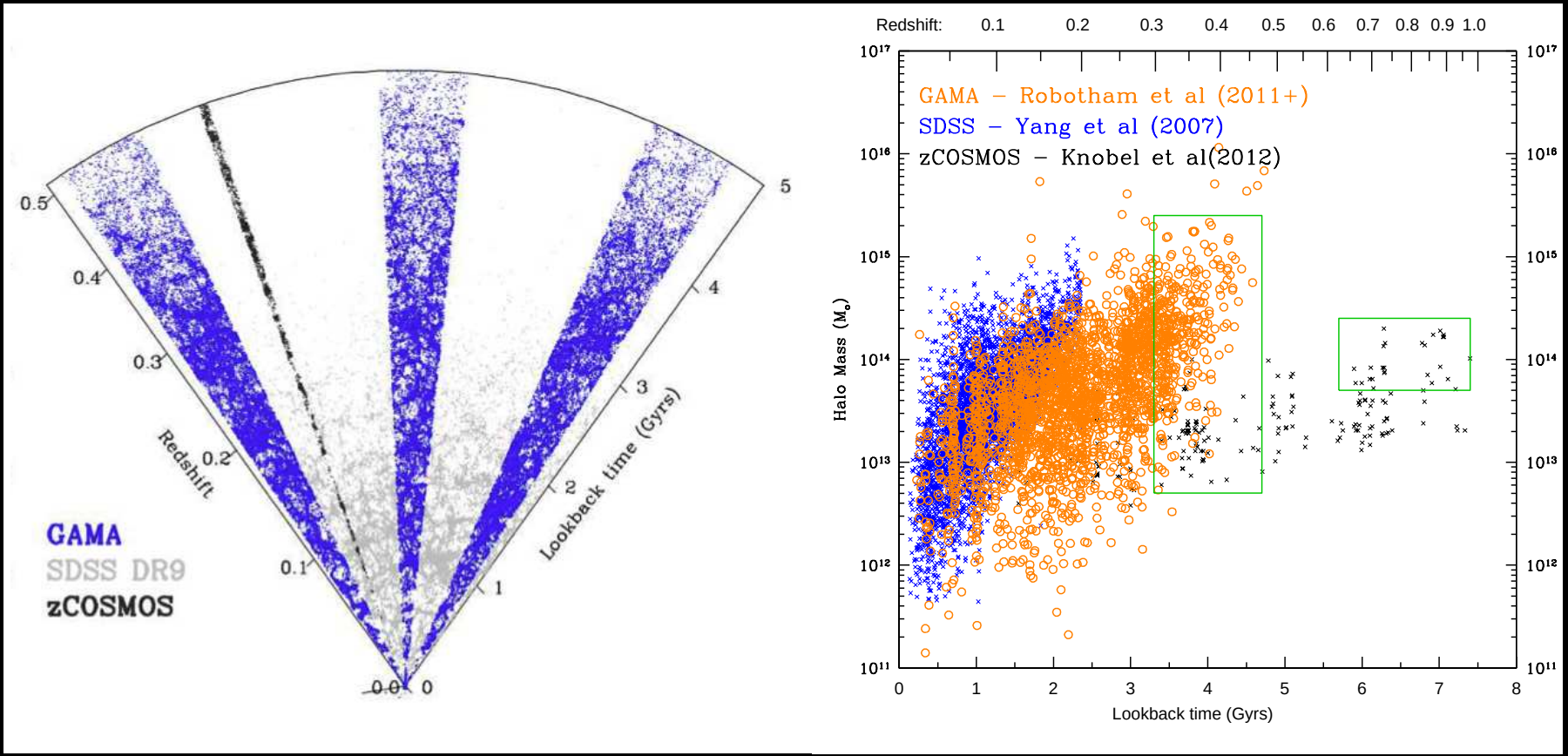
Schechter LF ($z\lesssim6\lesssim20$) with best-fit $\alpha(z)$, Φ^* (z), M^* (z) & μ=0.50.

Area/Sensitivity for: HUDF/XDF, **10 WMDFs**, 2 WDFs, & 1 WUDF.

- May need lensing targets for JWST to see $z\gtrsim13$ objects.


HST Frontier Field A2744: JWST needs lensing to see First Light at z≳11–15.

(3b) Gravitational Lensing to see First Light population at $z \gtrsim 10$.



Use the best available lenses: Rich clusters and (compact) galaxy groups.

[Left] Redshift surveys: SDSS $z \lesssim 0.25$ (Yang$^+$ 2007), GAMA $z \lesssim 0.45$ (Robotham$^+$ 2011), and zCOSMOS $z \lesssim 1.0$ (Knobel$^+$ 2012).

- GAMA: 22,000 groups $z \lesssim 0.45$; 2400 with $N_{spec} \gtrsim 5$ (Robotham$^+$ 11).
- $\lesssim 10\%$ of GAMA groups compact for lensing (Wyithe et al.).
- Large group sample to identify optimal lens-candidates for $z \gtrsim 6$ sources.

Conclusions re. JWST Medium-Deep Survey for First Light

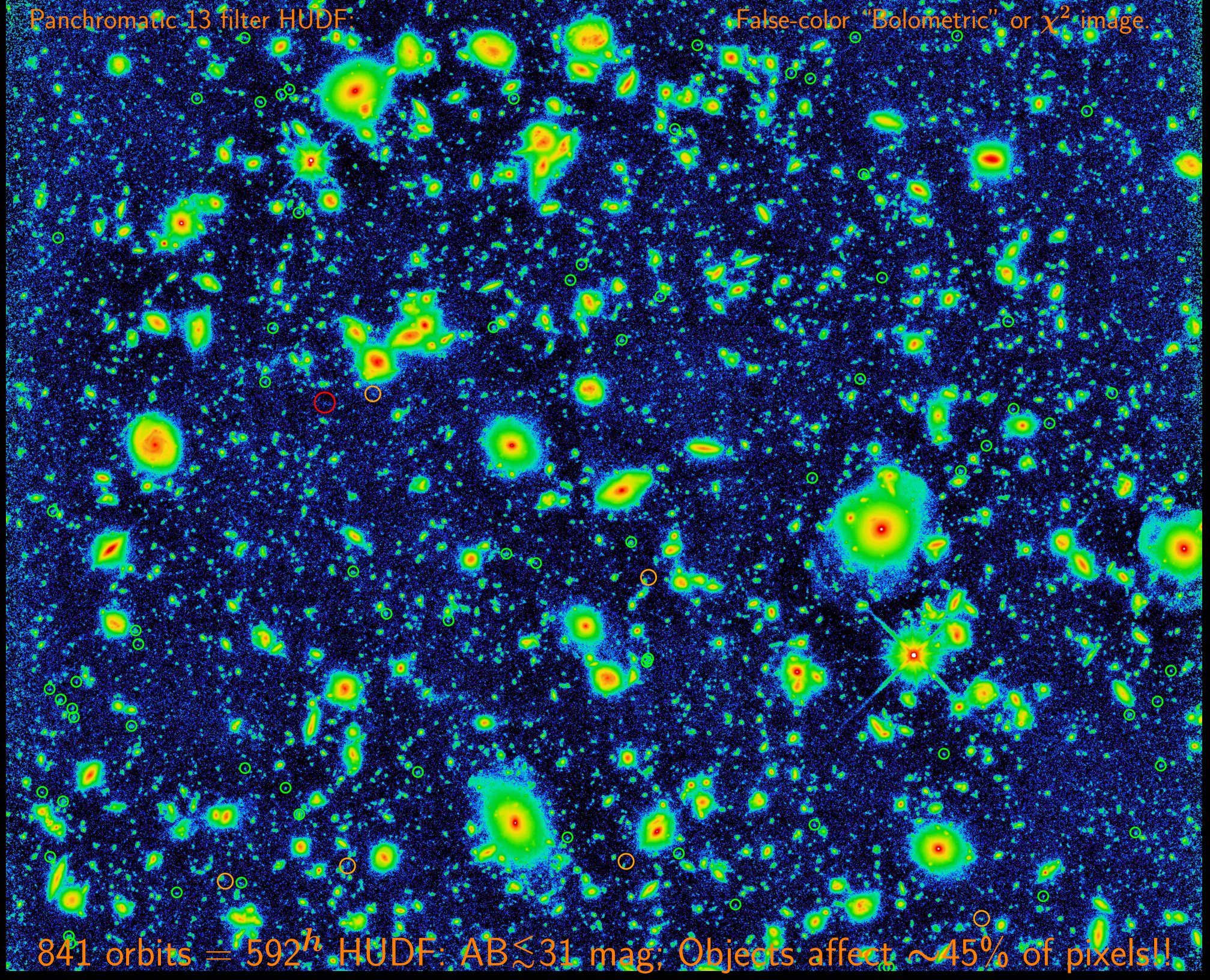
(1) This IDS GTO team will do a mix of Medium-Deep and Cluster/Group Fields:

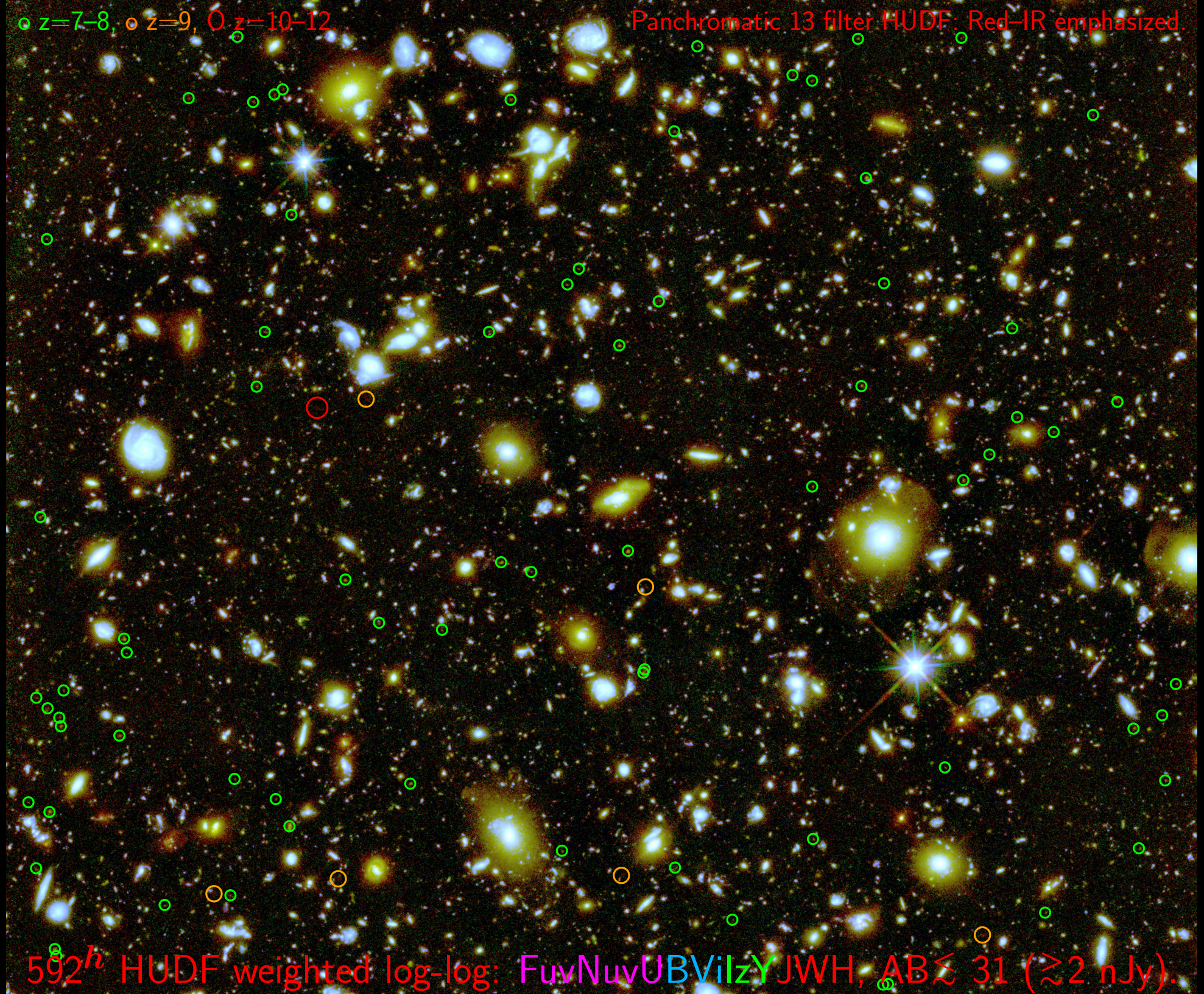
- About $\sim$16$\times$4-5 hr Webb Medium-Deep Fields to AB$\lesssim$29 mag.

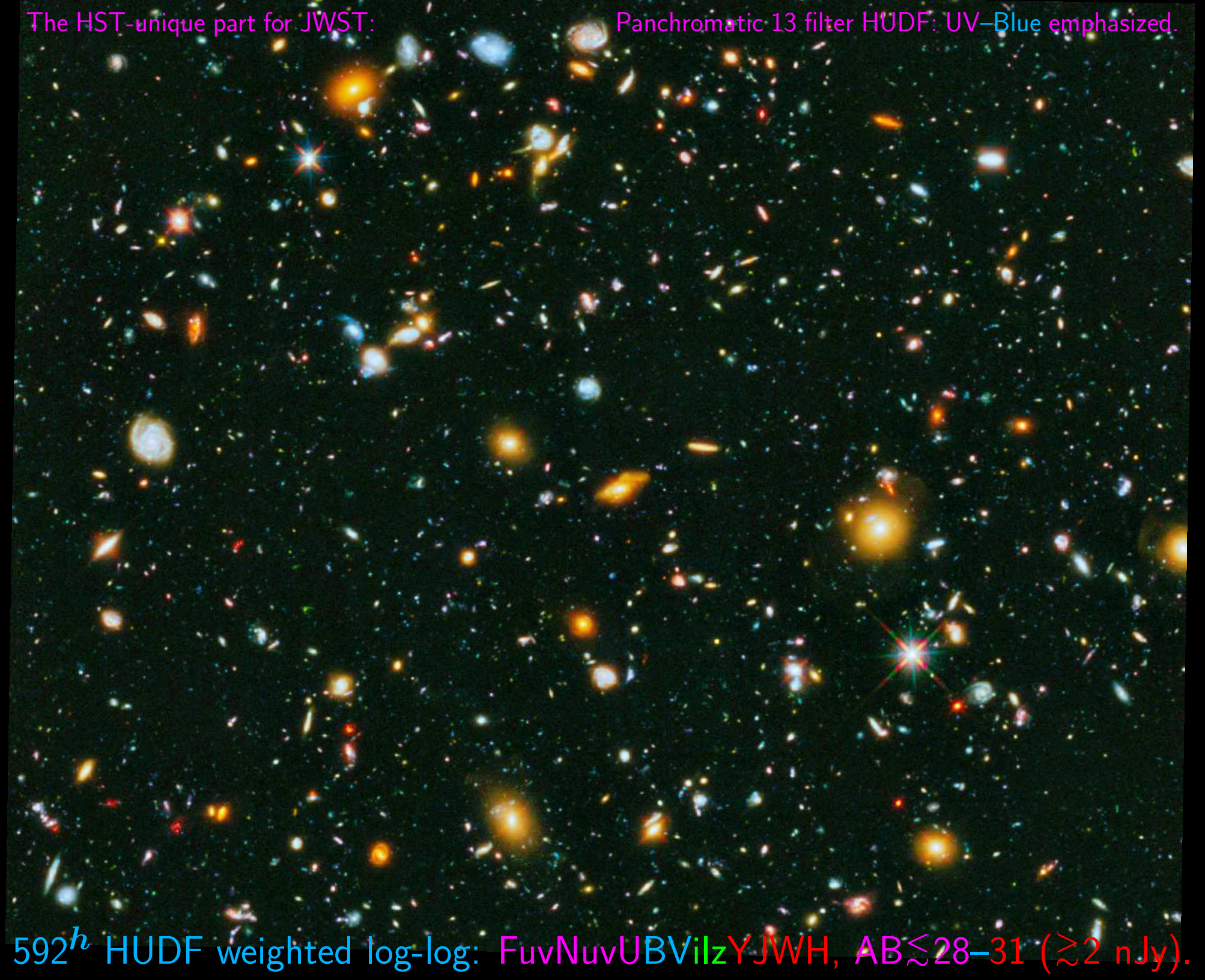
(2) Determine optimal combination of *random* Webb (Medium) Deep Fields, and fields targeting *the best lensing groups/clusters*.

- Lensing fields need to consider the brightness of — and low-level gradients in — IntraCluster Light (ICL) *and* low-level out-of-field (rogue-path) straylight, as well as best available cluster/group lensing maps.

SPARE CHARTS


Panchromatic 13 filter HUDF:
False-color "Bolometric" or χ^2 image
841 orbits $=592^h$ HUDF: AB$\lesssim$31 mag; Objects affect $\sim$45% of pixels!!


z=7–8, z=9, z=10–12
Panchromatic 13 filter HUDF: Red–IR emphasized.
592^h HUDF weighted log-log: FuvNuvUBViIzYJWH, AB≲ 31 (≳2 nJy).


The HST-unique part for JWST:
Panchromatic 13 filter HUDF: UV–Blue emphasized.
592^h HUDF weighted log-log: FuvNuvUBViIzYJWH, AB$\lesssim$28–31 ($\gtrsim$2 nJy).