Identification of High-z Mergers through Resolved Mass Distributions

Accepted yesterday to ApJ! Check astro-ph next week.

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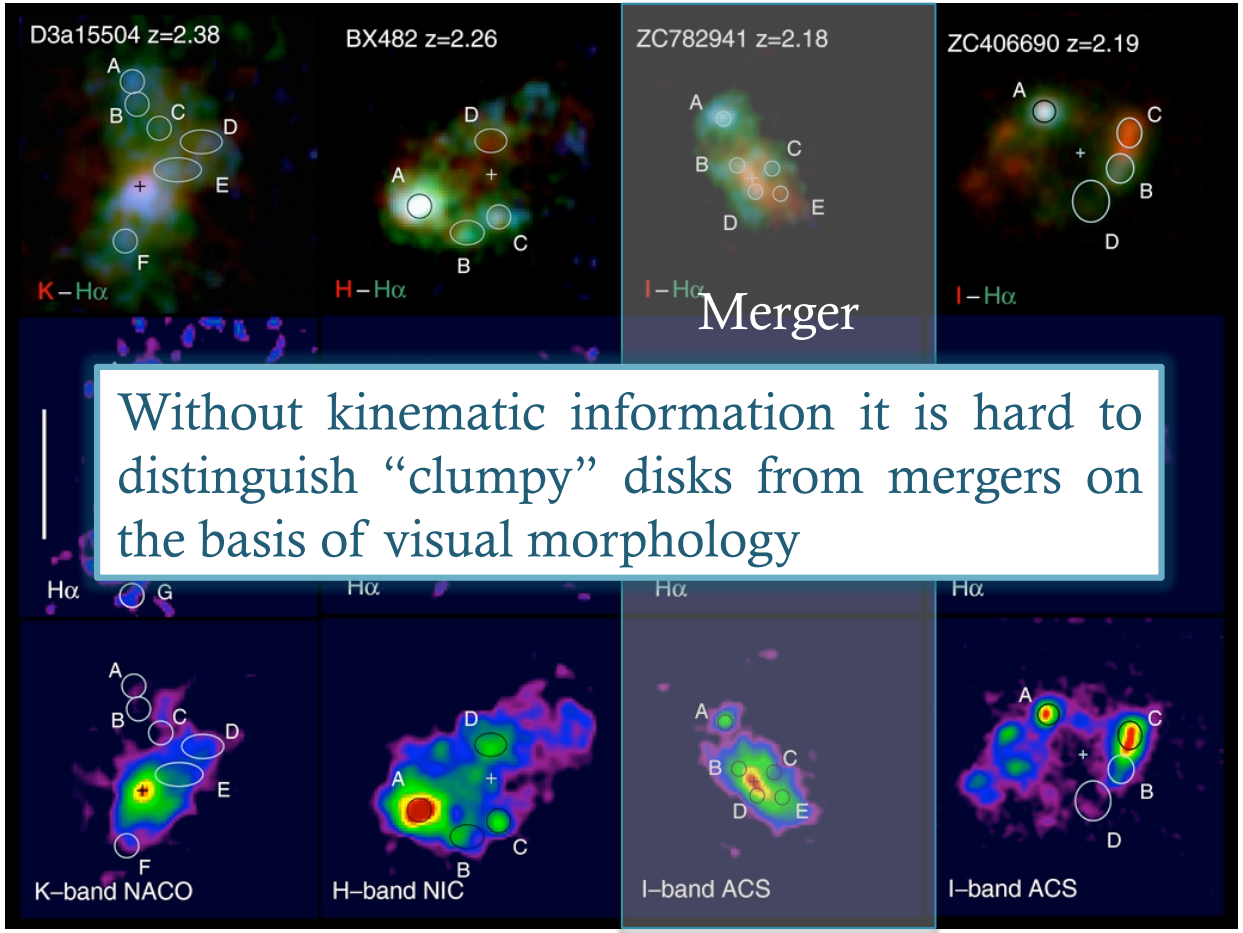
CLASSIFYING MERGERS AT Z~2

Star-forming clumps affect optical, NIR, ionized and molecular gas morphologies

NIR+Halpha

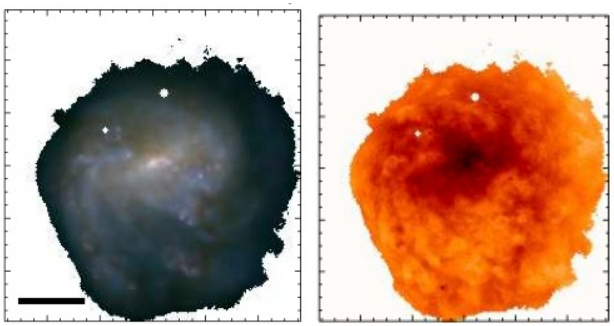


Genzel et al. 2011

FIND A PROXY FOR KINEMATICS

z~0

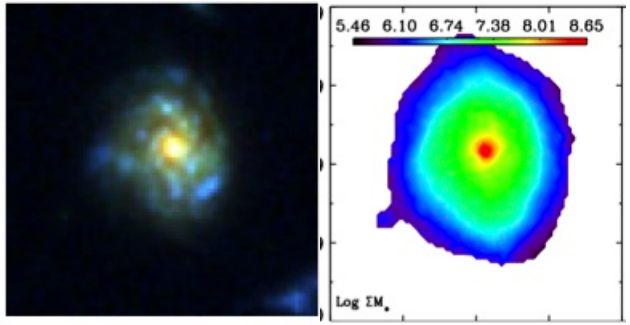
Stellar Mass



Zibetti et al. 2009

z~1

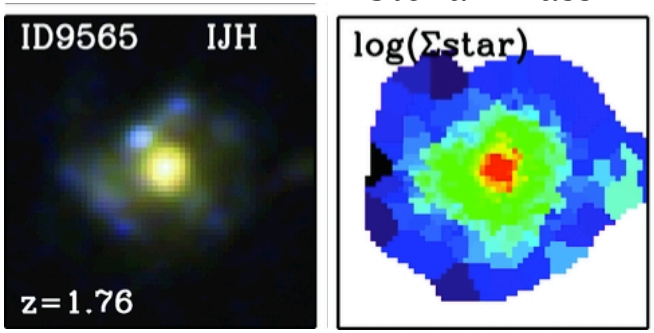
Stellar Mass



Hemmati et al. 2014
See Shoubaneh's talk
on Tuesday

z~2

Stellar Mass



Wuyts et al. 2012

Clumps display lower contrast in mass maps than in optical images
Can we use the distribution of mass as a kinematic proxy?

CALIBRATION ON SIMULATIONS

MIRAGE Simulations: Merging and Isolated high redshift Adaptive mesh refinement Galaxies

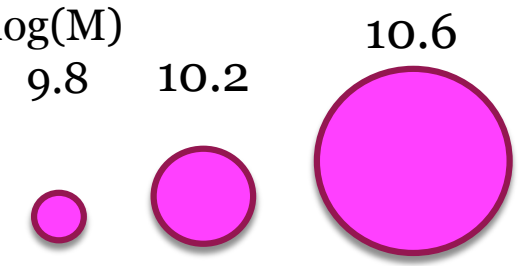
(Perret et al. 2014)

THE MIRAGE SIMULATIONS

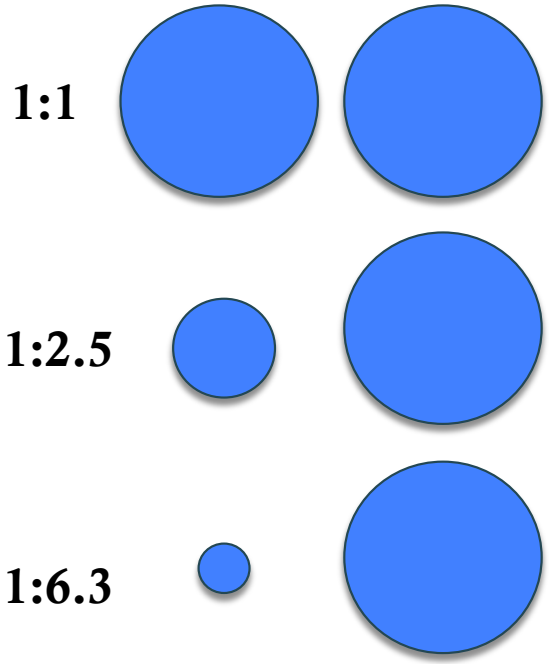
RAMSES AMR simulations

1. gas rich, $\mathbf{f_{gas}=0.65}$ (Daddi+10, Tacconi+10)
2. Moderate stellar feedback
3. Reproduce **clumpy structure** also in isolated disks

3 isolated disks

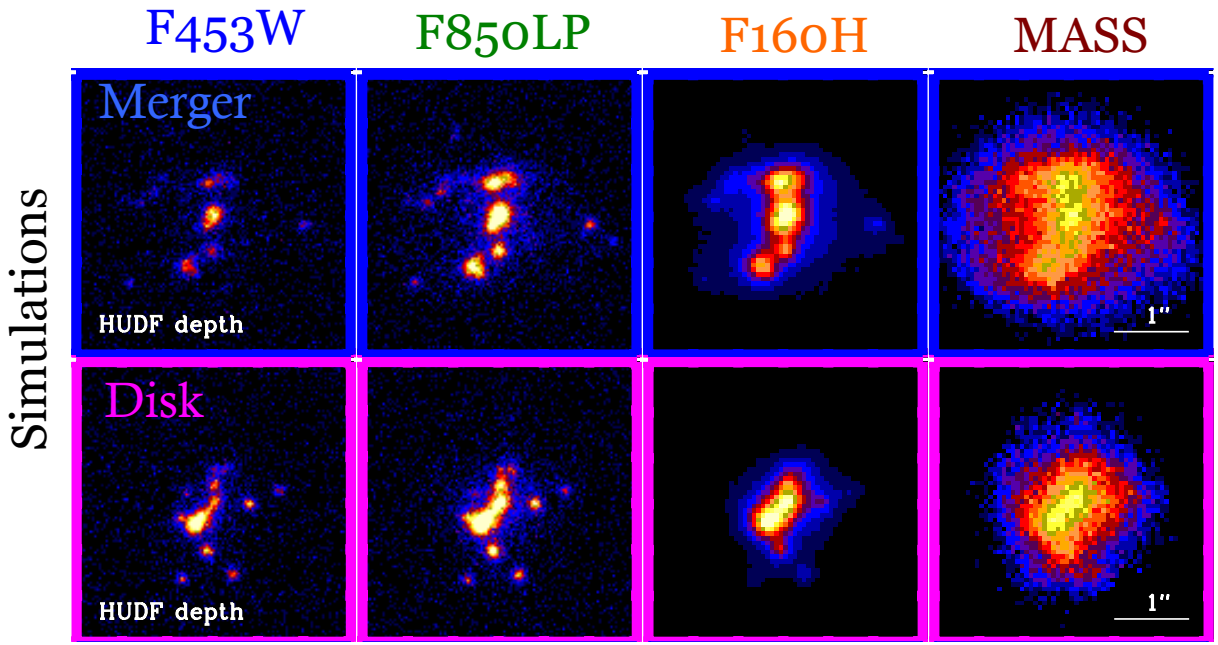


combined in min/maj mergers

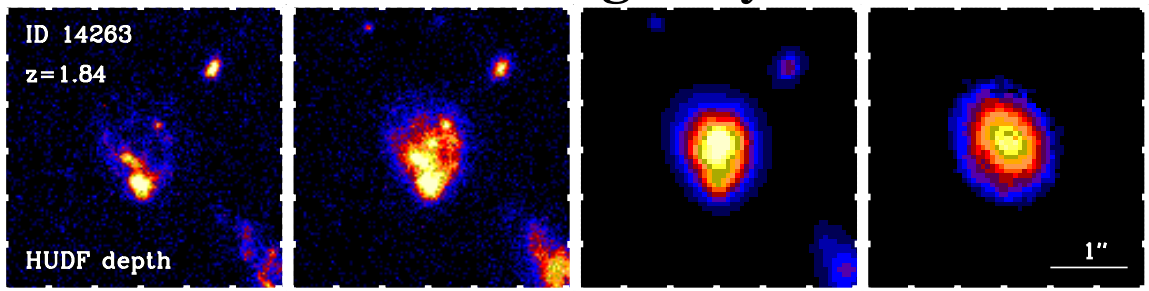


POST-PROCESSING OF THE SIMULATIONS

Mock HUDF images (Starburst99) and mass maps



Real z~2 galaxy



Caveats:

- no cosmological context
- no dust included in sims
- possibly lower f_{gas} than real galaxies

↓

Flux maps in real galaxies likely to be clumpier than simulations

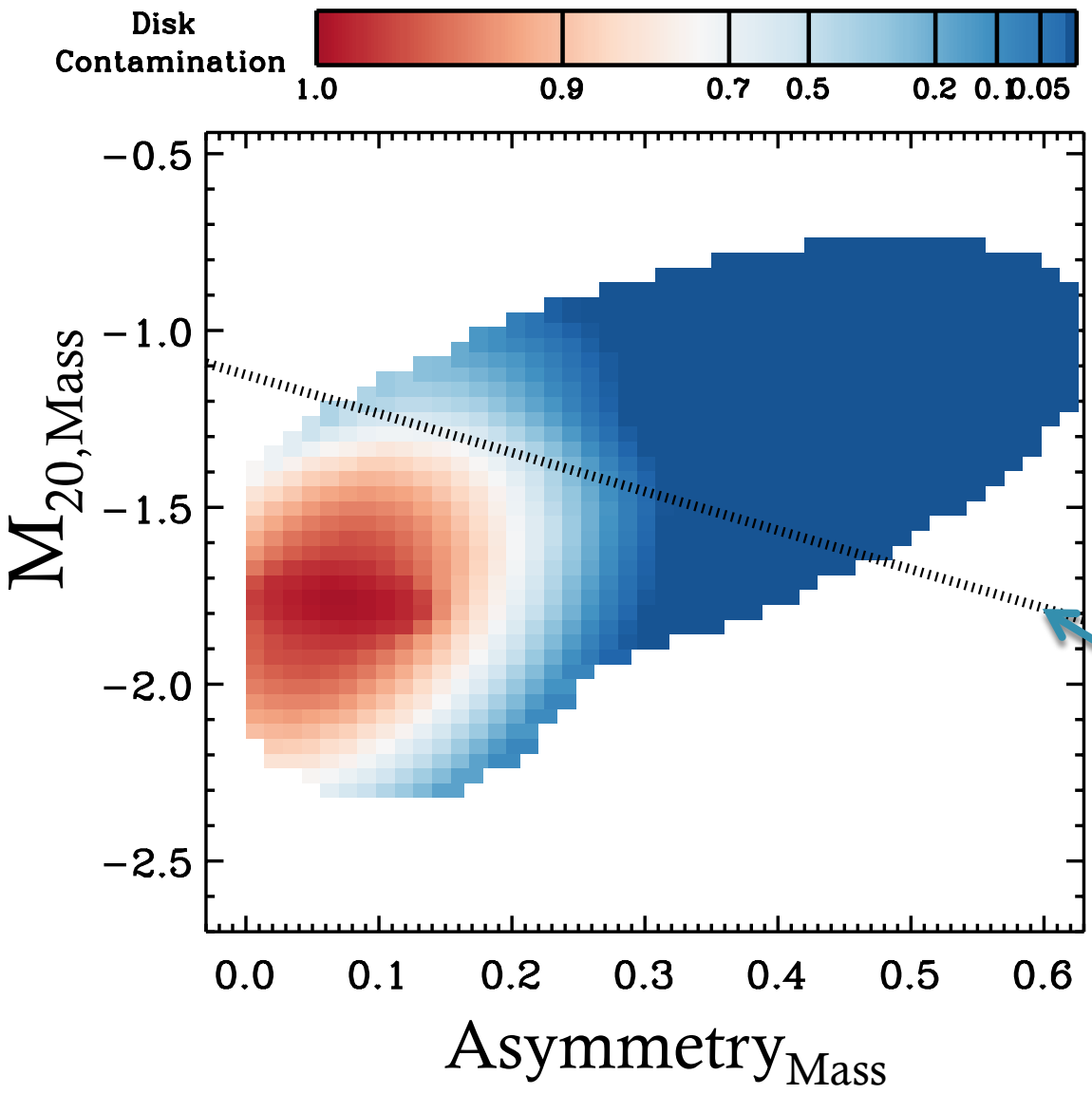
POST-PROCESSING OF THE SIMULATIONS

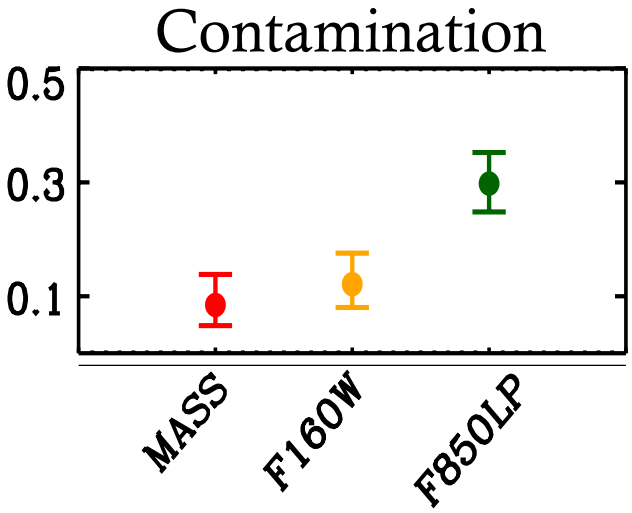
We measured canonical non-parametric structural indicators on the MIRAGE:

- mock images
- mass maps.

Consider only two from now on: **M_{20}** and **Asymmetry**
(They are least affected by noise.)

CALIBRATION OF THE CLASSIFICATION





Operational dividing line between mergers and normal galaxies based on simulations

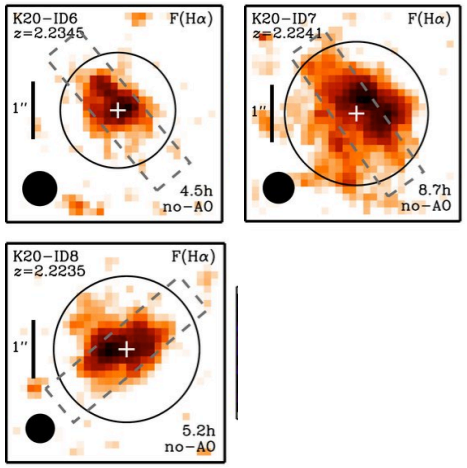
… Now the Real Data

Stellar mass maps obtained by "standard" approach

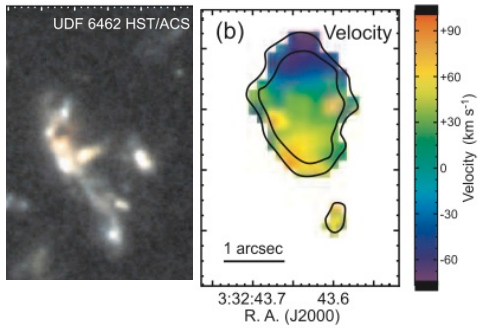
- Matched resolution to H-band
- Homogenized S/N (ADAPTSMOOTH, Zibetti et al 2009)
- Pixel-by-pixel SED fitting (LePHARE)

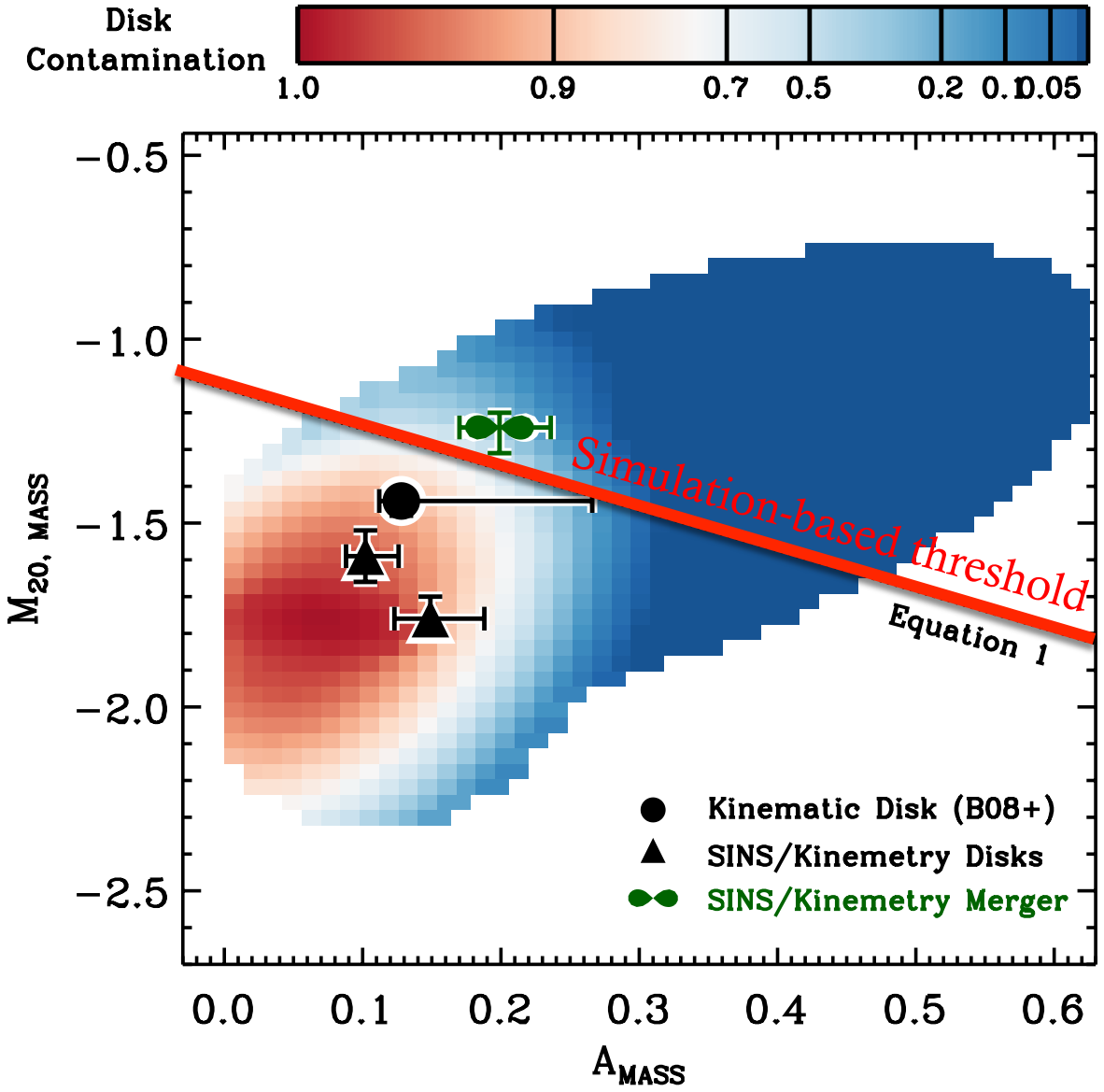
TESTS ON GALAXIES WITH KINEMATICS

SINS galaxies w. kinemetry
Forster-Schreiber+09

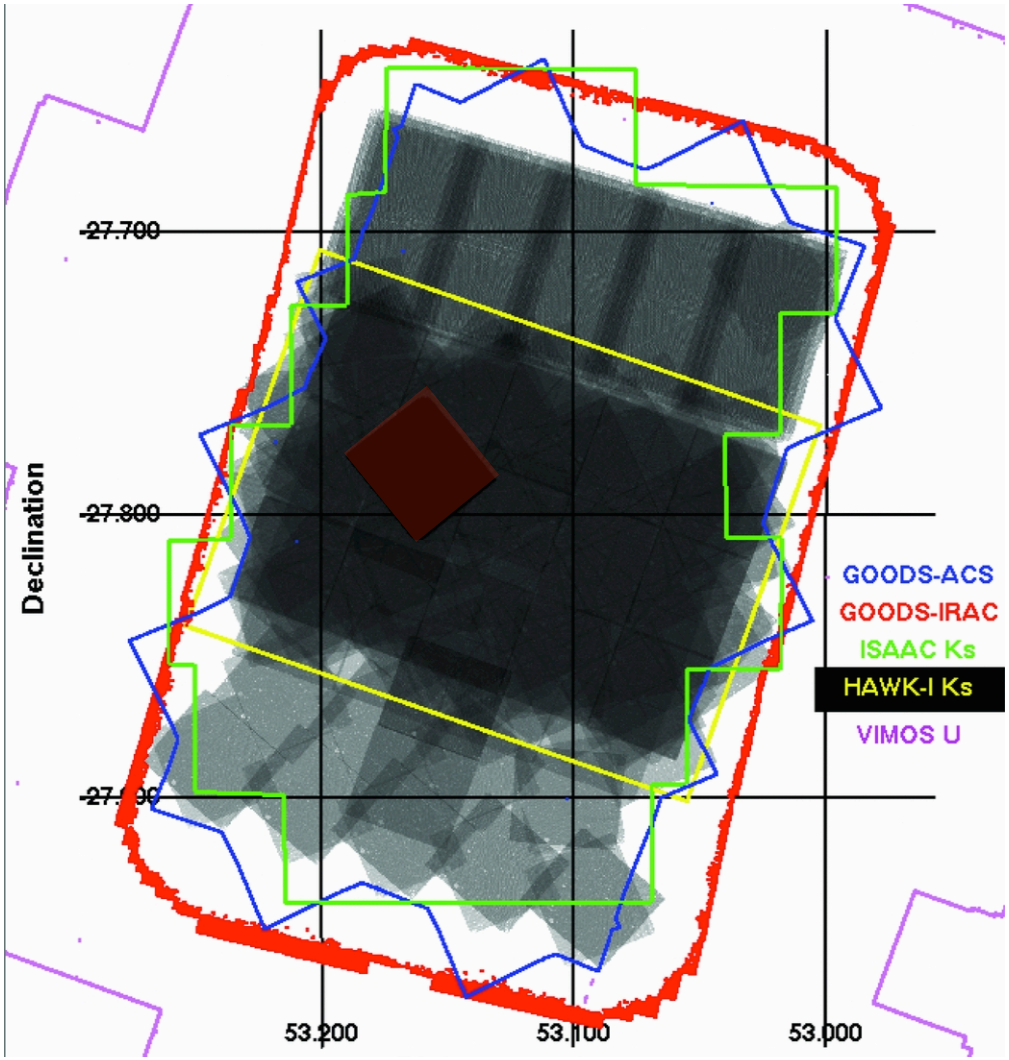


Bournaud+08





APPLICATION TO HUDF GALAXIES



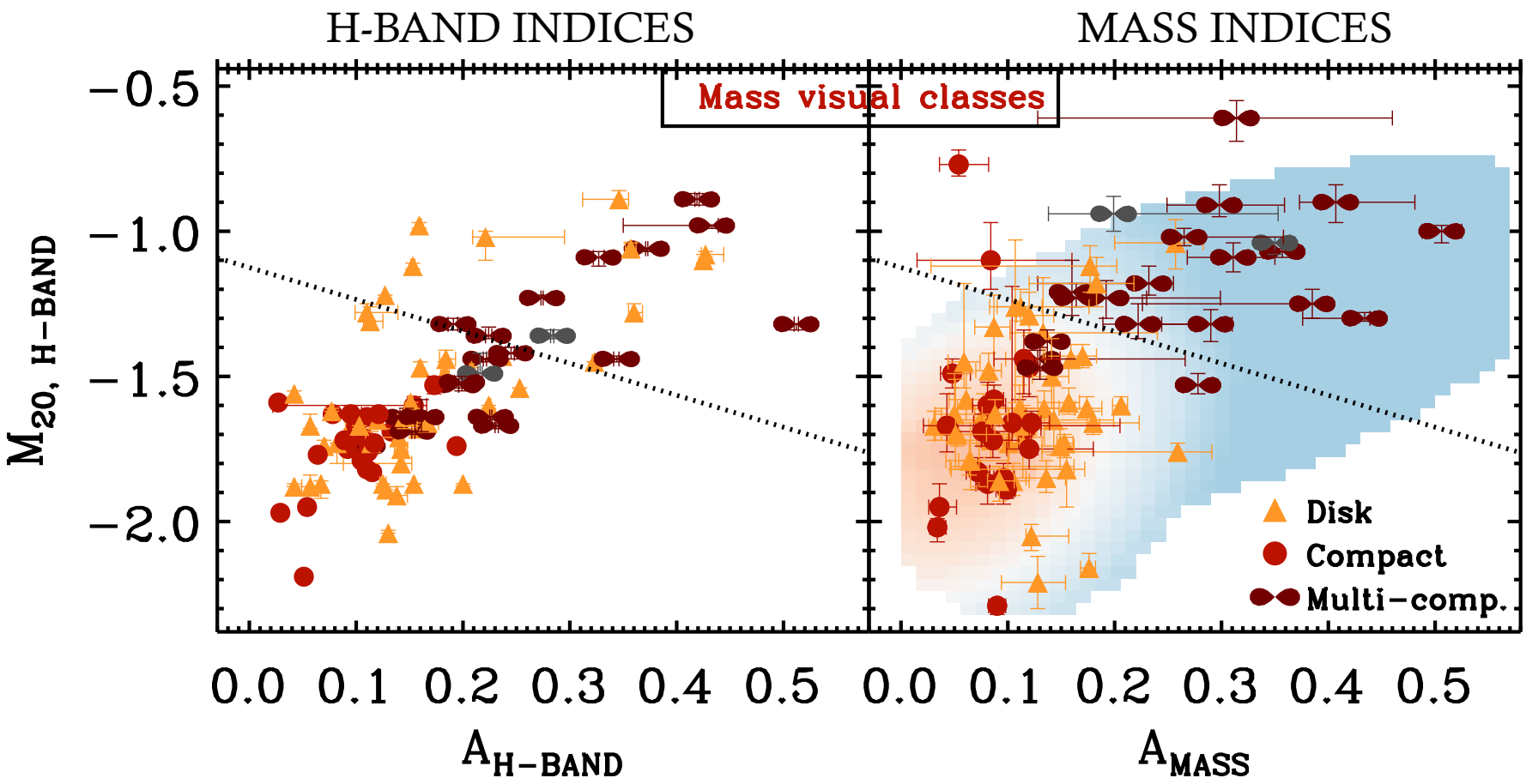
Test the classification at different depths

optical	*NIR*
GOODS HUDF	CANDELS HUDF12

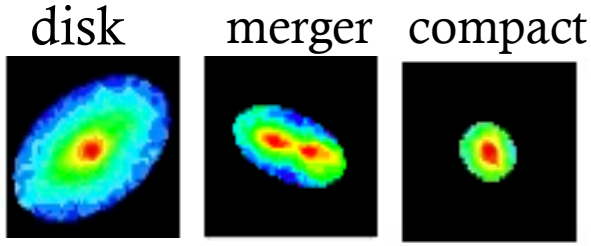
THE SAMPLE

- ~ 130 galaxies $1.5<z_{phot/spec}<3$
- H>24.5
- $R_{1/2}$> 5×PSF
- log(M)>9.4

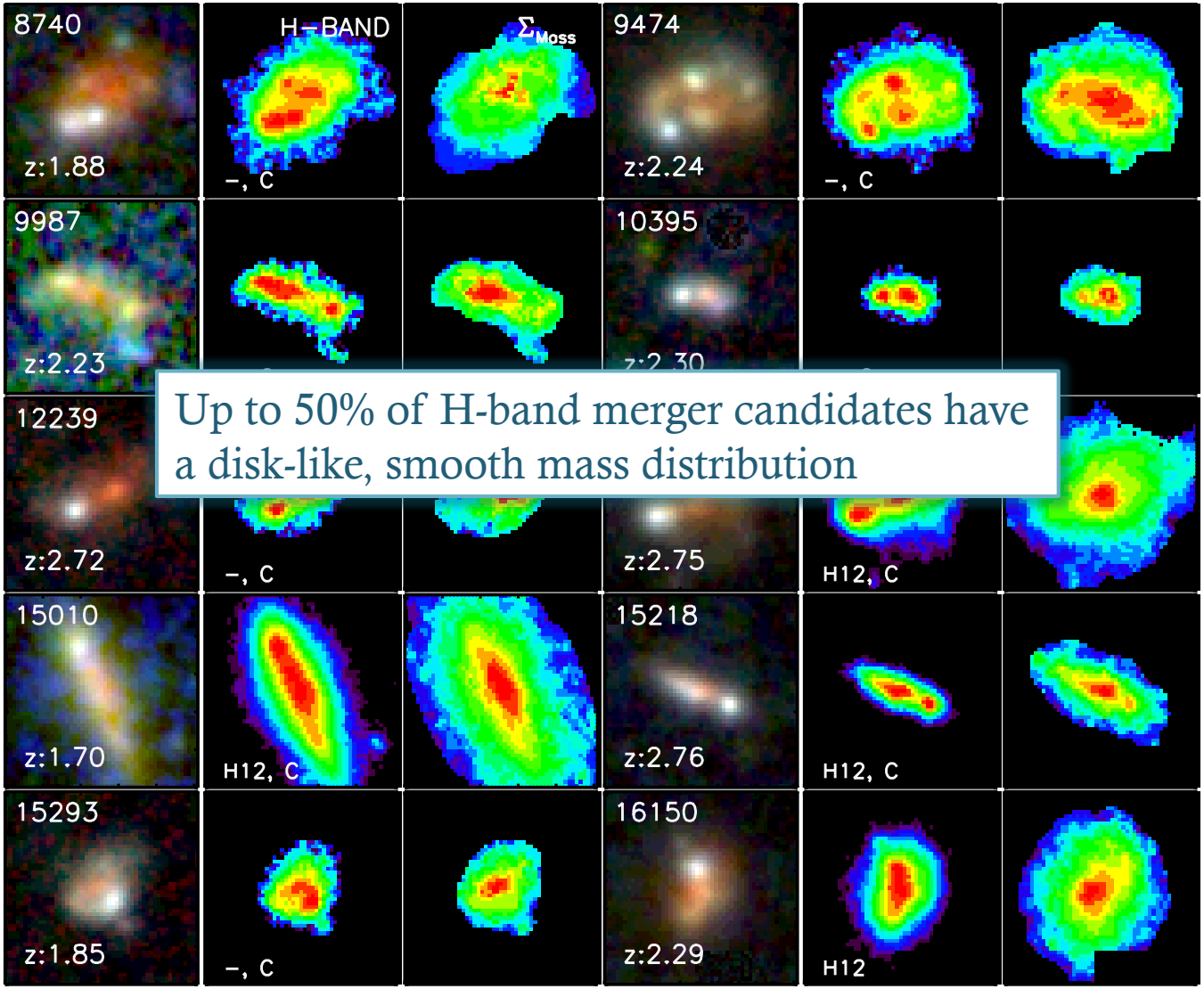
MASS VS. LIGHT



VISUAL CLASSIFICATION OF MASS MAPS

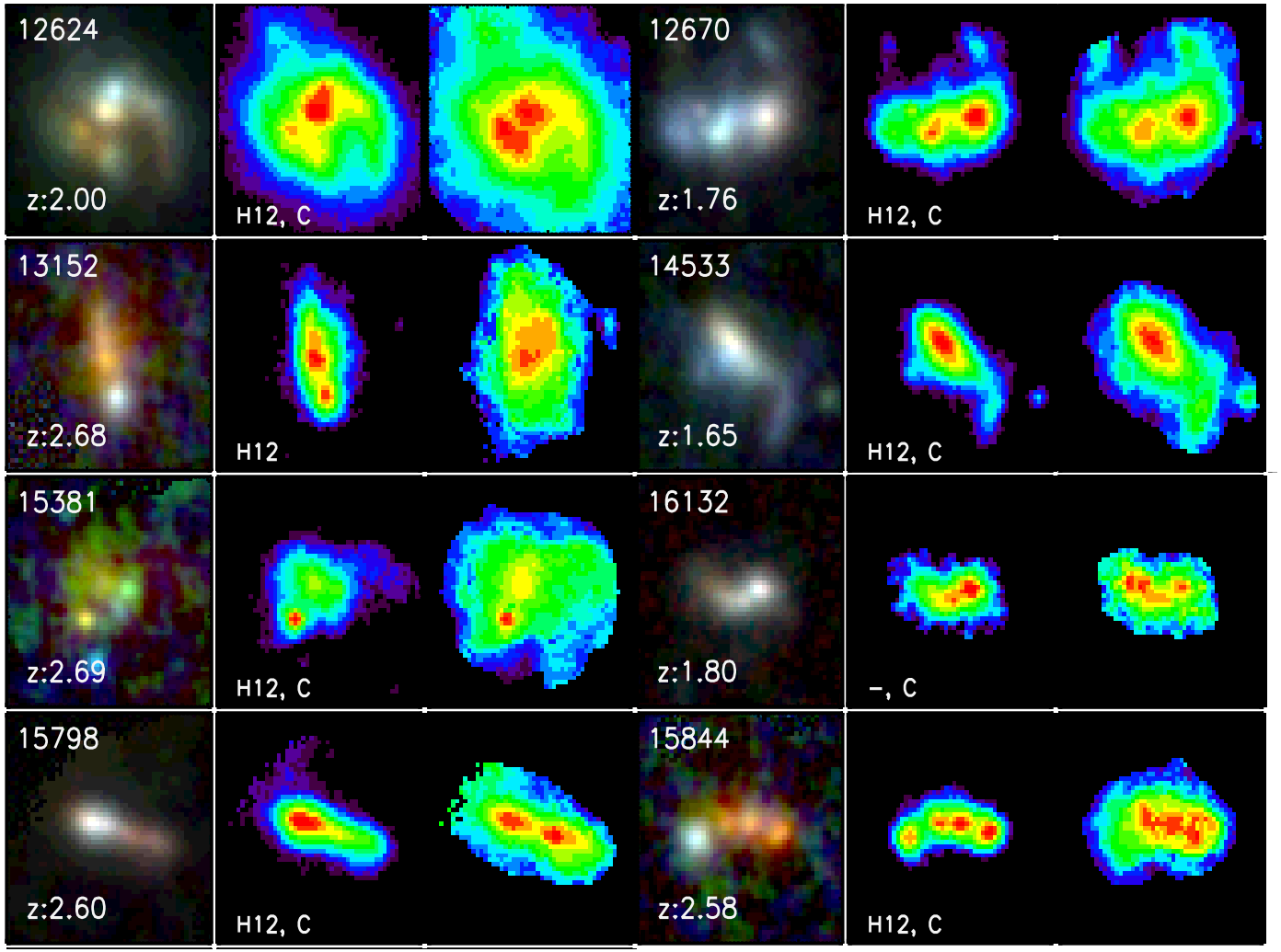


FALSELY IDENTIFIED MERGERS



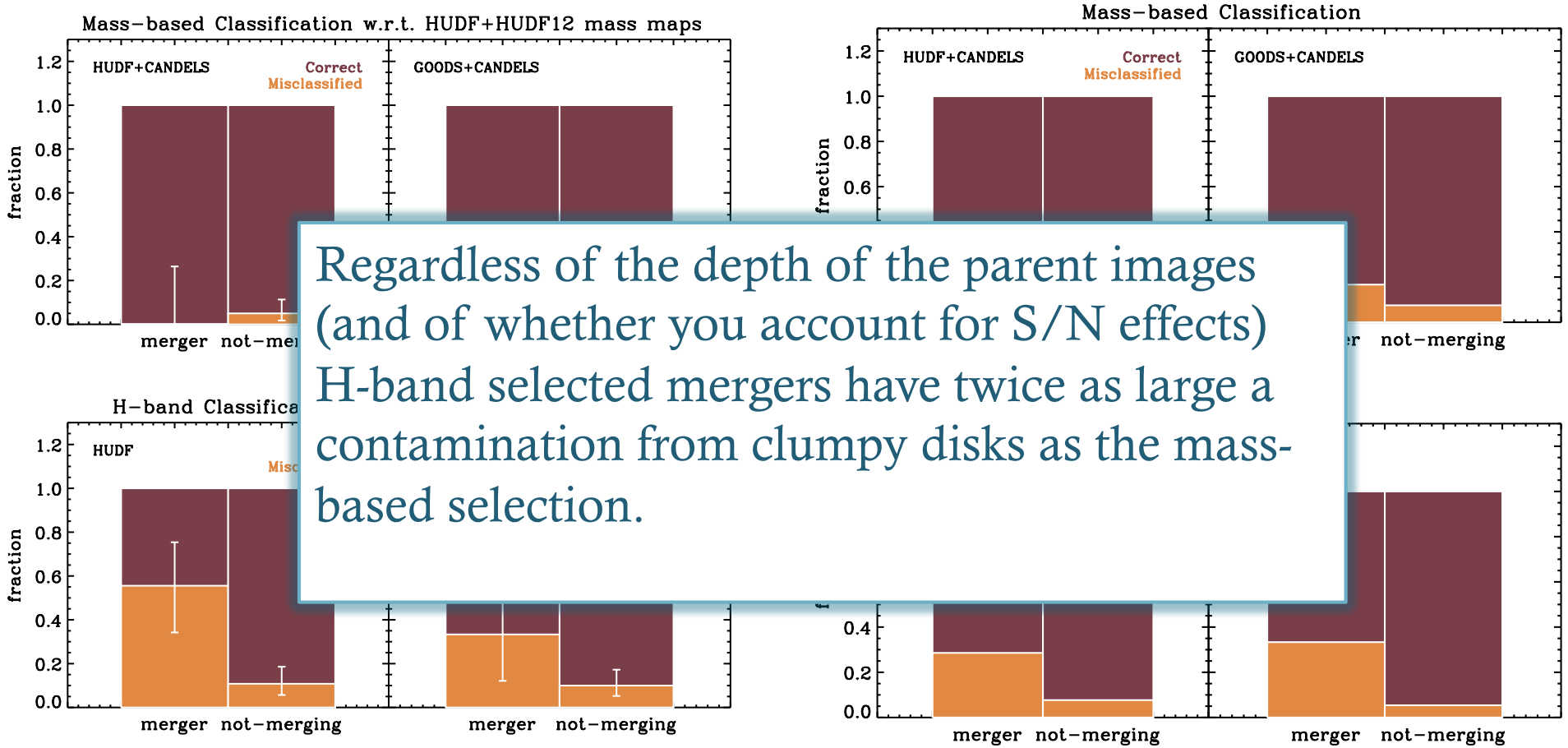
Up to 50% of H-band merger candidates have a disk-like, smooth mass distribution

Mass Selected Mergers



MASS VS. LIGHT

Check paper for details



Regardless of the depth of the parent images (and of whether you account for S/N effects) H-band selected mergers have twice as large a contamination from clumpy disks as the mass-based selection.

SUMMARY

- The identification of merger candidates based on asymmetries in the mass maps provides a useful alternative to a kinematic analysis

- Regardless of the imaging depth (e.g. CANDELS vs. HUDF), the mass-based classification always results in a lower contamination from clumpy disks than a H-band classification.

- Check the full paper for quantitative selection criteria for mass maps obtained from photometry at GOODS, CANDELS and HUDF depth