High-z Spatially Resolved Star Formation with HST

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Multiwavelength Views of the ISM in High-Redshift Galaxies
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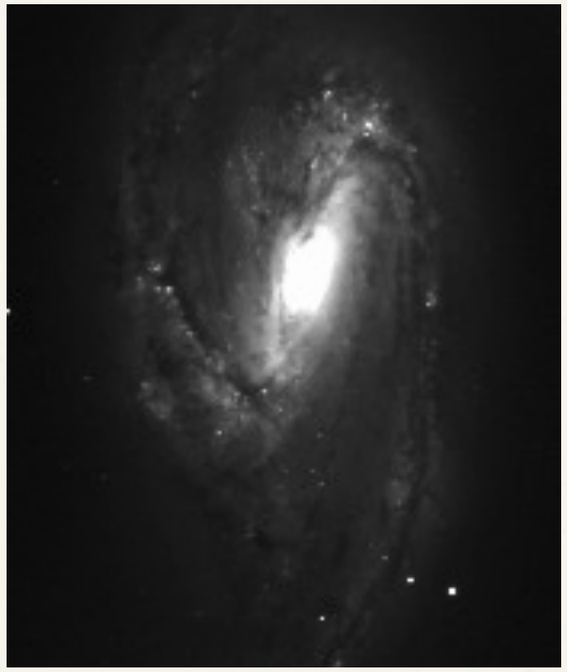
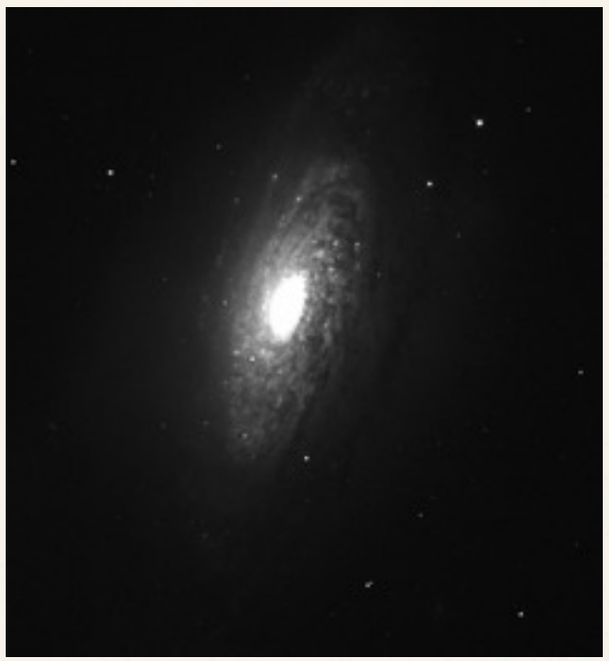
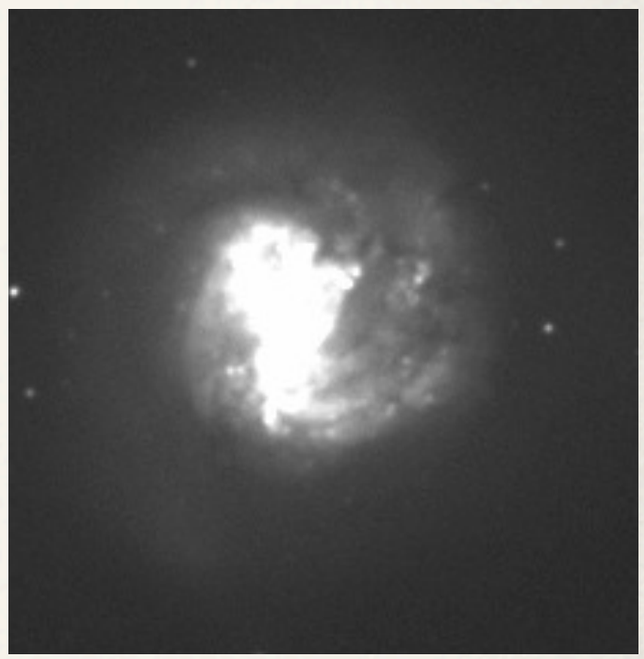
How do galaxies grow?

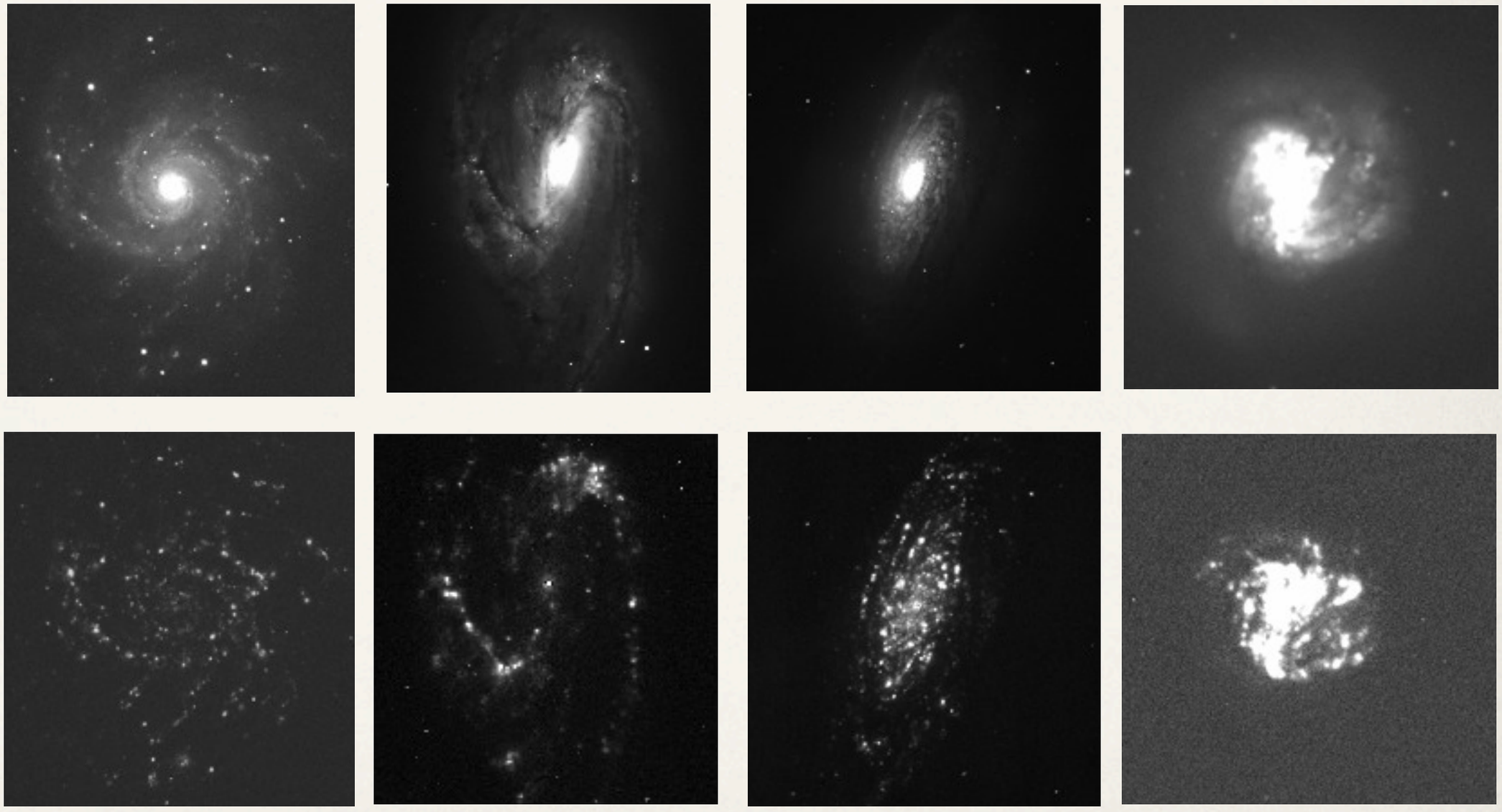
Stars

SINGS: Kennicutt+ 2005

How do galaxies grow?

Stars

Star Formation

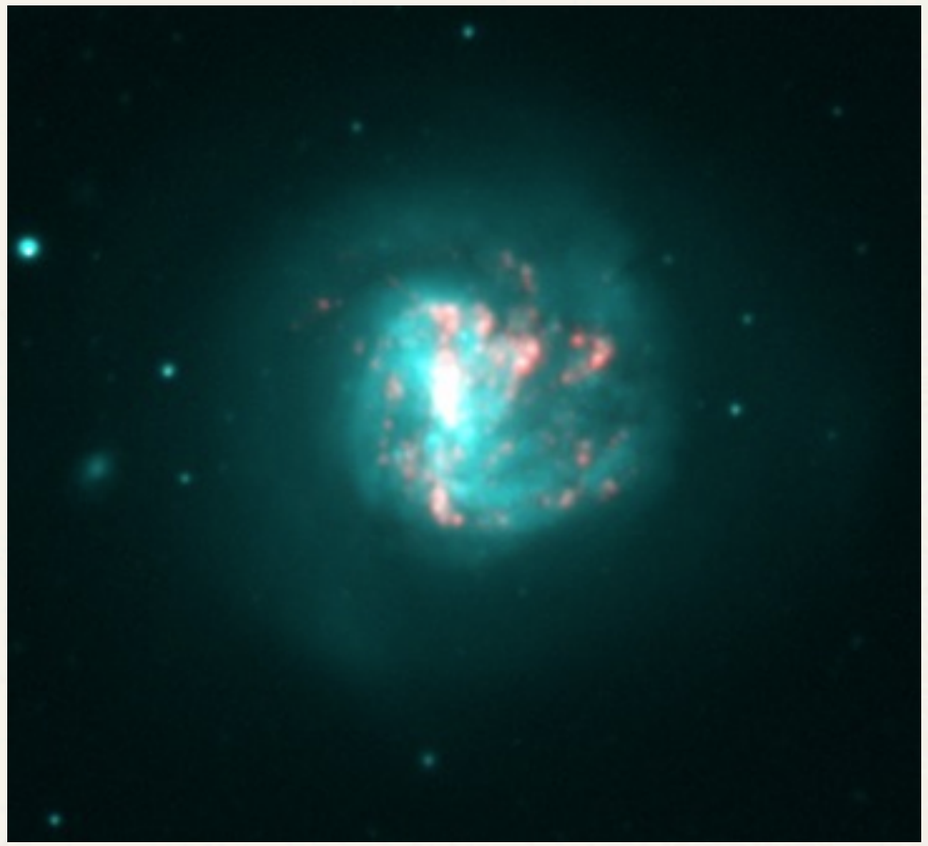


SINGS: Kennicutt+ 2005

How do galaxies grow?

Spatial Distribution of Stars vs. Star formation

Extended Star Formation

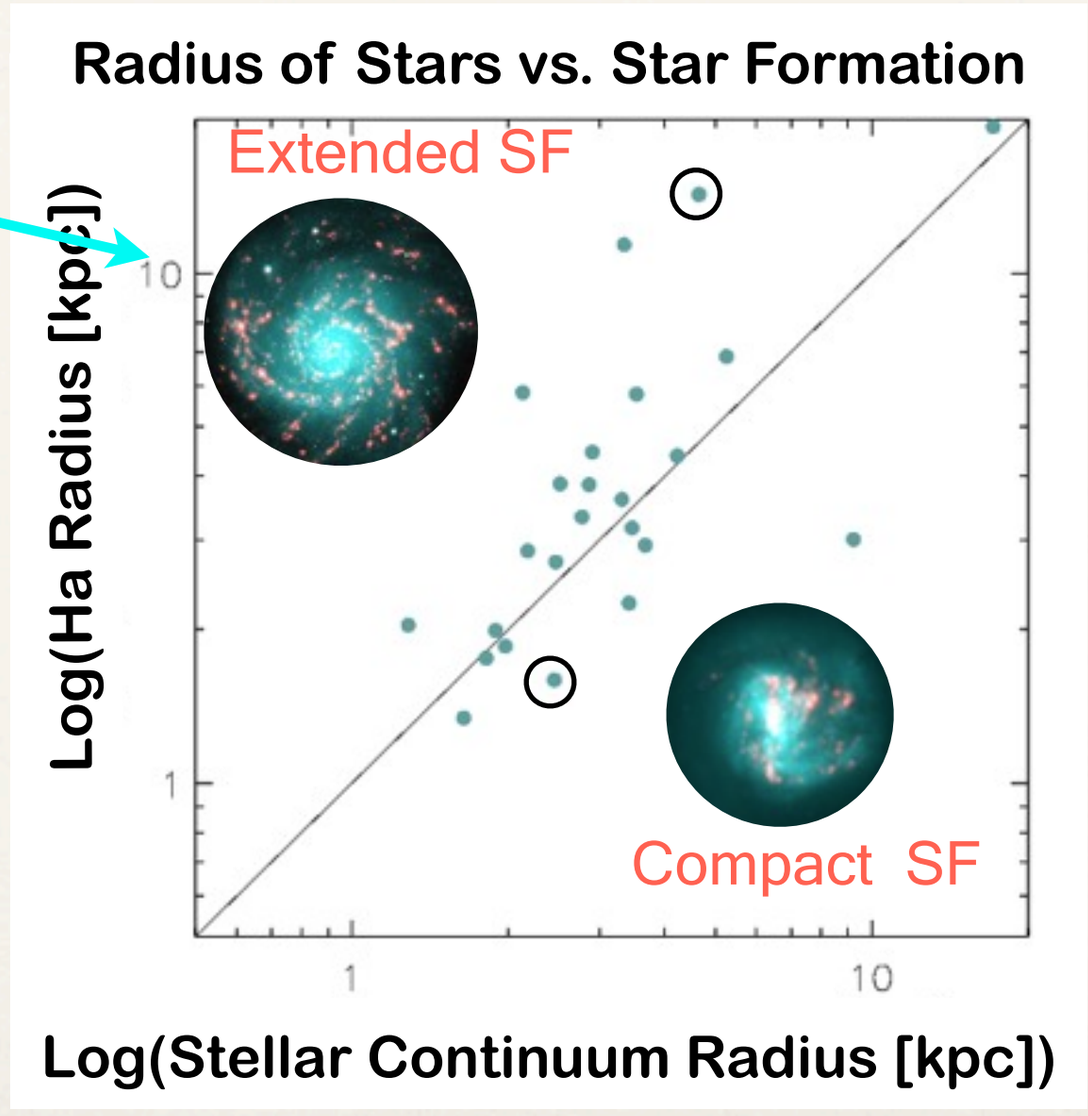


Compact Star Formation

SINGS: Kennicutt+ 2005

Where are local galaxies growing?

Old Bulge
SF Disk



Points are
SINGS sample

Central
Starburst

Munoz-Mateos+ 2009

Measuring the Spatial distribution of Star Formation at High Redshift

Measuring the Spatial distribution of Star Formation at high z

- Rest-frame UV (Observed Optical)

  ✓ Large sample

  X Dust extinction

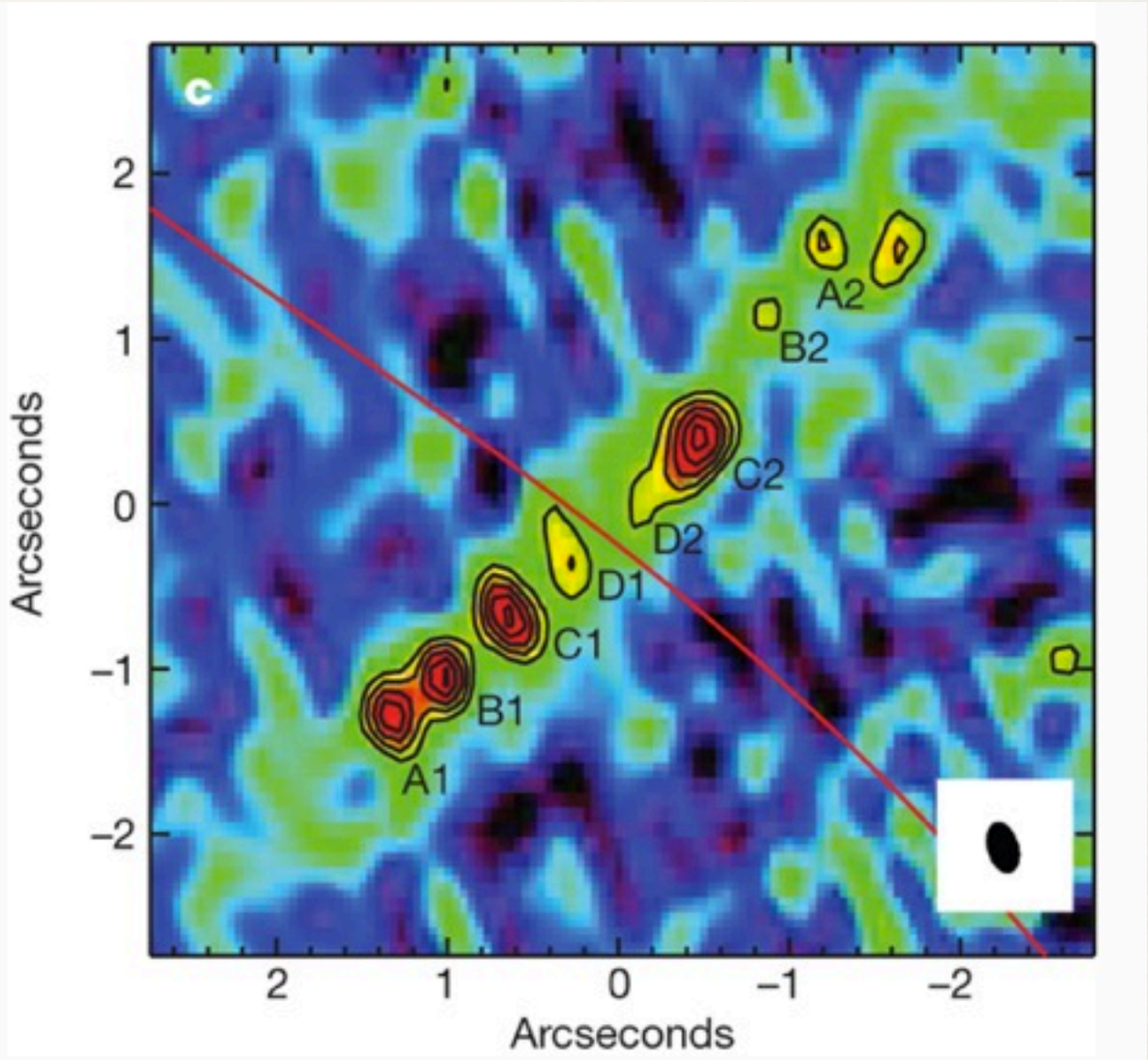
e.g. Ferguson+ 2004

Measuring the Spatial distribution of Star Formation at high z

- Rest-frame UV (Observed Optical)
- Rest-frame FIR (Observed mm/sub-mm)

✓ Traces obscured star formation

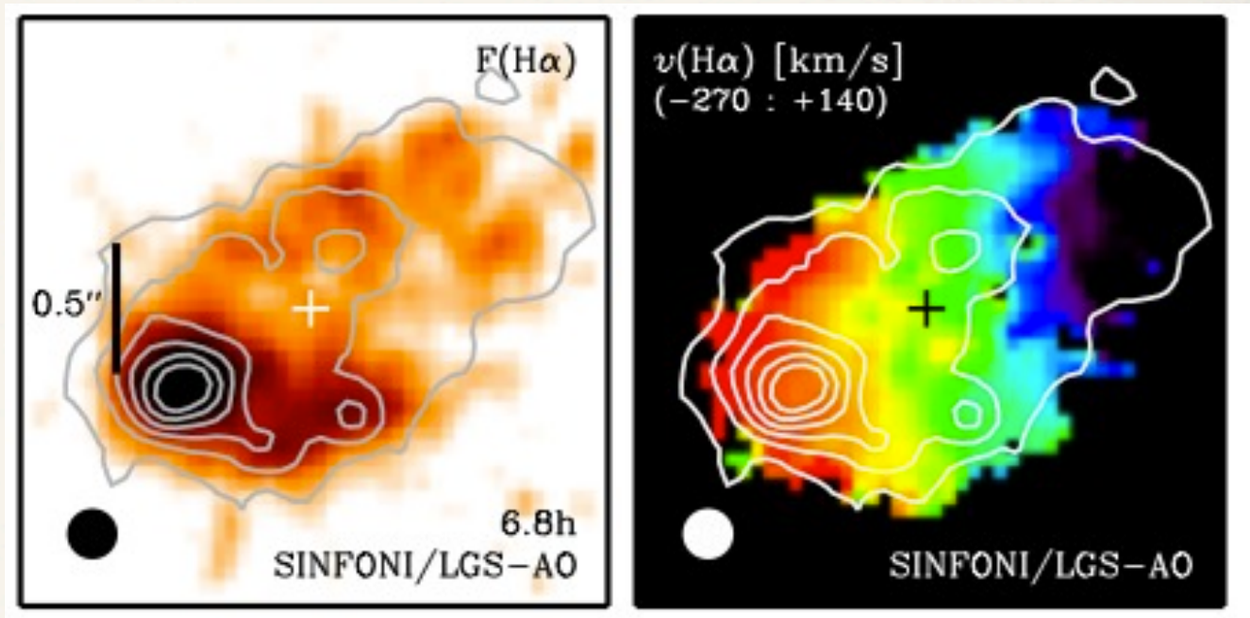
X Bright objects, small sample



Swinbank 2010

Measuring the Spatial distribution of Star Formation at high z

- Rest-frame UV (Observed Optical)
- Rest-frame FIR (Observed mm/sub-mm)
- Ha line emission (Observed NIR)
  - Ground-based IFU Spectroscopy (SINFONI)
    - ✓ Spatial and kinematic info
    - X Bright objects, small sample



Forster-Schreiber+ 2010

Measuring the Spatial distribution of Star Formation at high z

- Rest-frame UV
  (Observed Optical)

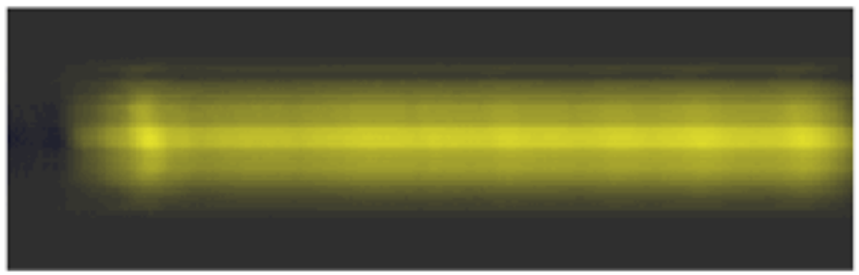
- Rest-frame FIR
  (Observed mm/su

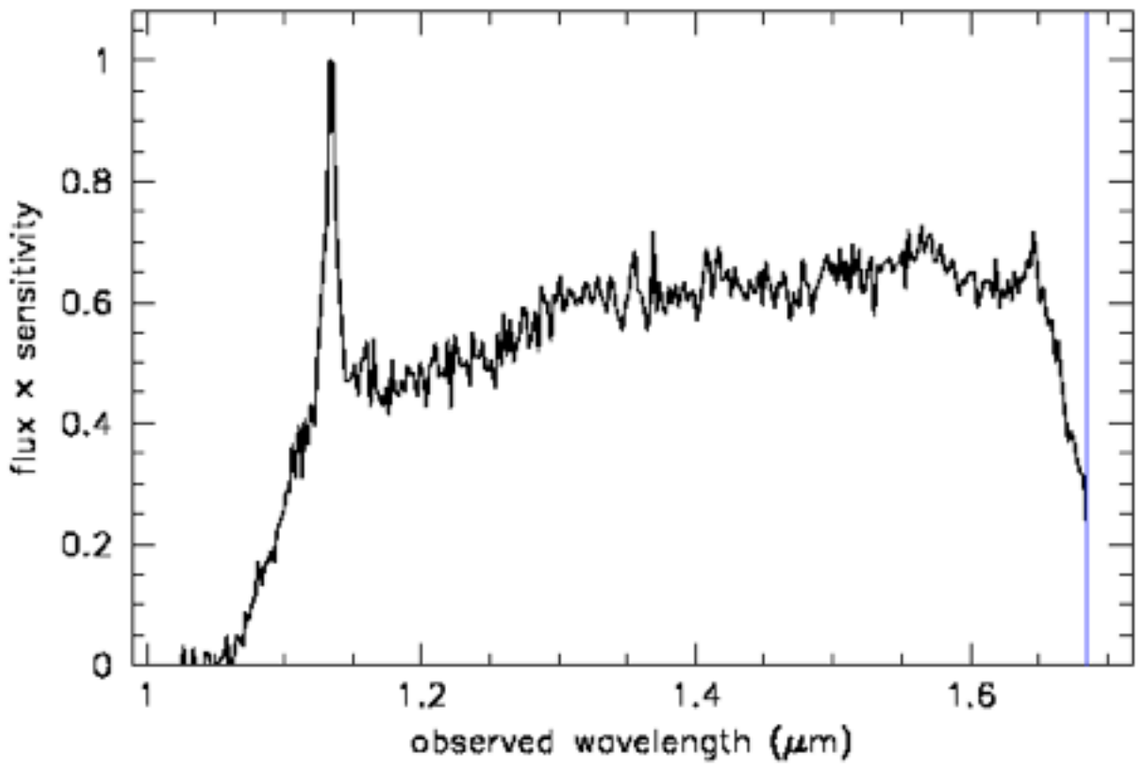
- Ha line emis
  (Observed N

=> NIR
=> spatially-resolved spectroscopy
=> from space

Measuring the Spatial distribution of Star Formation

3dHST





Hubble Space Telescope: WFC3 Grism

H < 23

Spatial Resolution: 0.1” (0.8kpc @ z~1)

Spectral Resolution: R=130 ~2300 km/s

Measuring the Spatial distribution of Star Formation

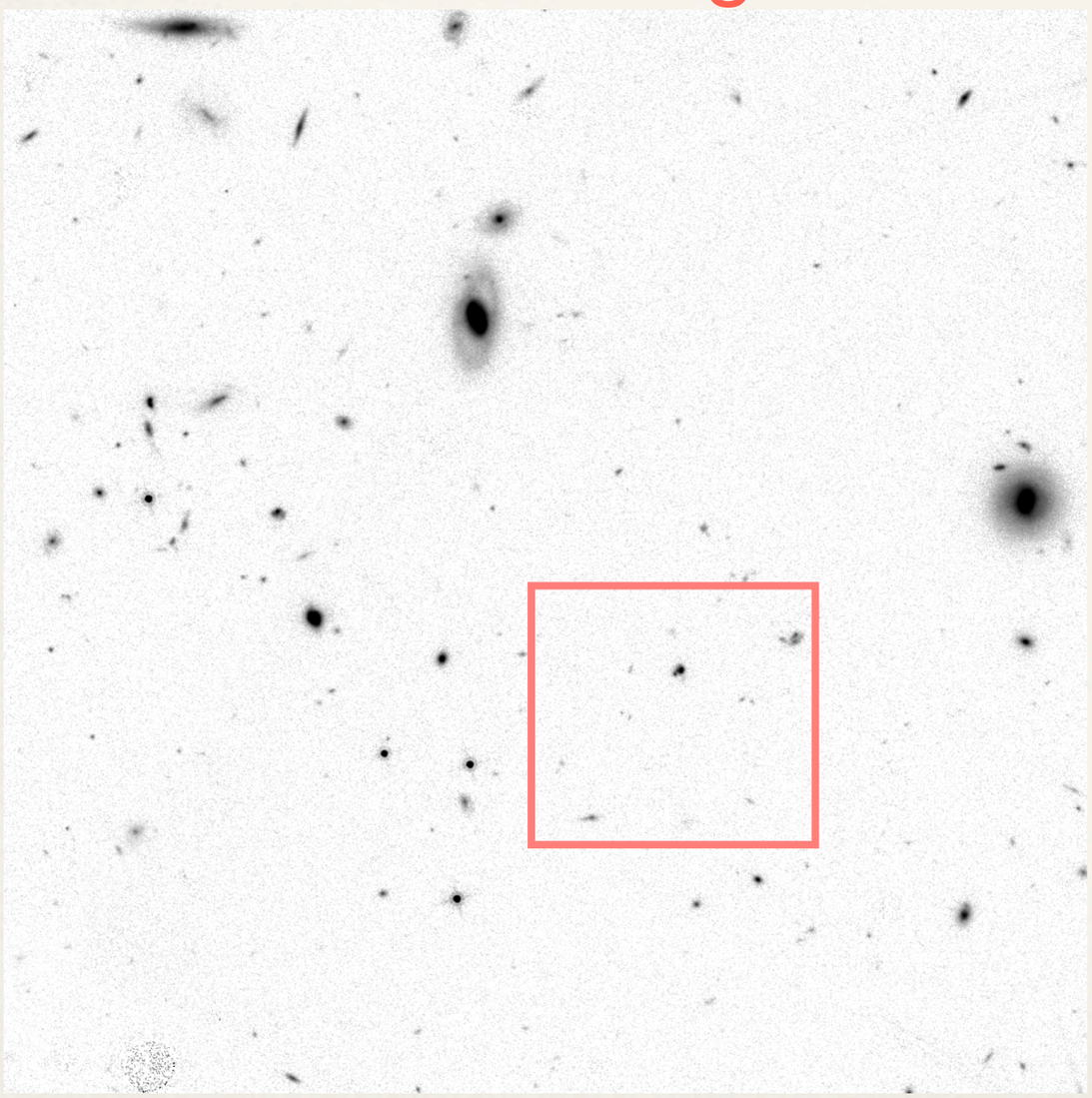
3dHST Specs

- NIR Slitless Spectroscopic Survey
- HST WFC3 248 orbits
- Rest-frame Optical spectra of ~5,000 galaxies z~0.7-3
- Spatially resolved spectra
- Emission line star-formation diagnostics
- Magnitude limit: H < 23 => @ z ~ 1, Mass > 2x10$^{10} M_{\odot}$, L > 6x10$^{9} L_{\odot}$
- SFR > 0.8 $M_{\odot}/yr$

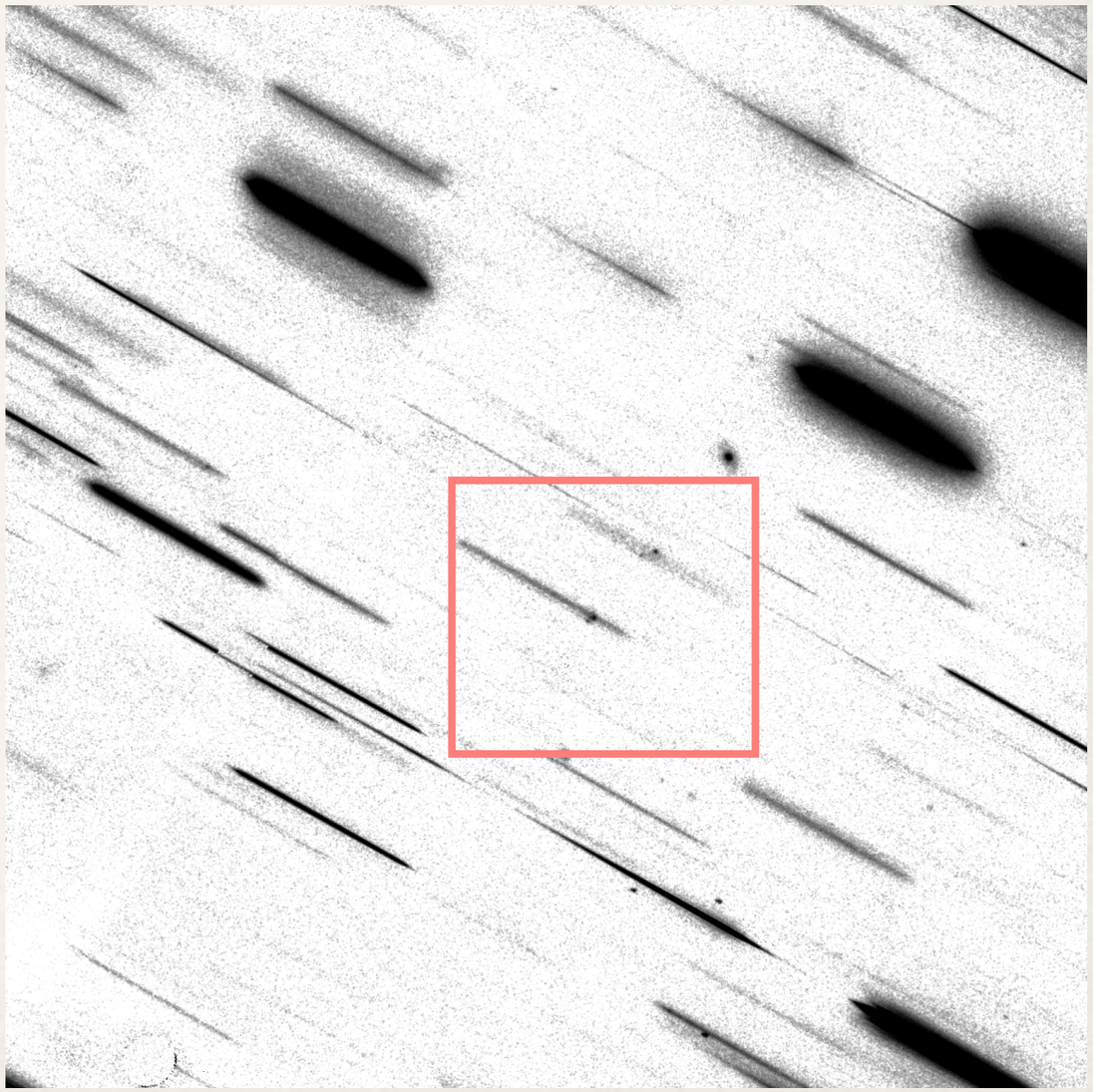
3dHST

Part of One of 150 Pointings

Direct Image



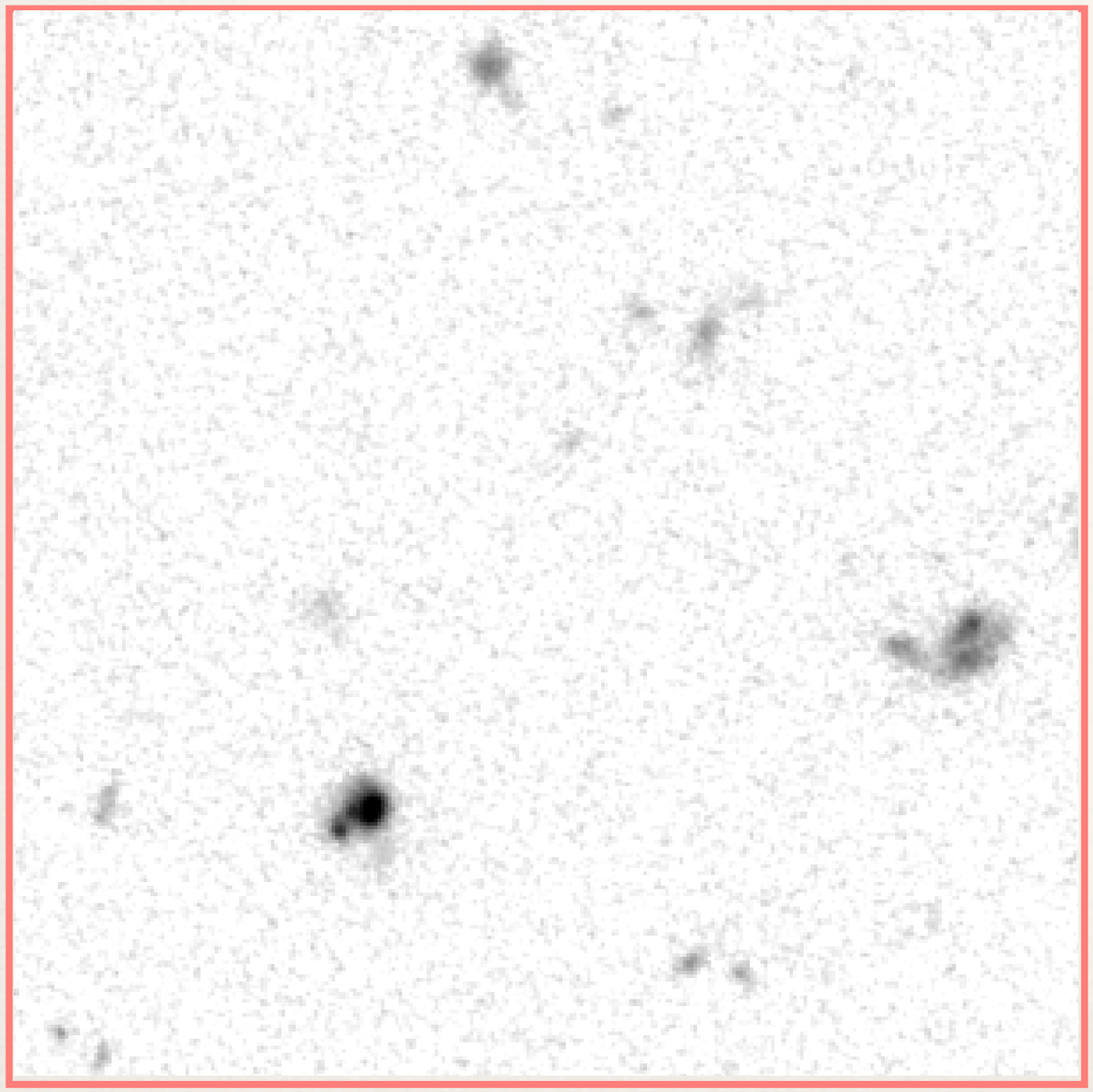
Grism Image



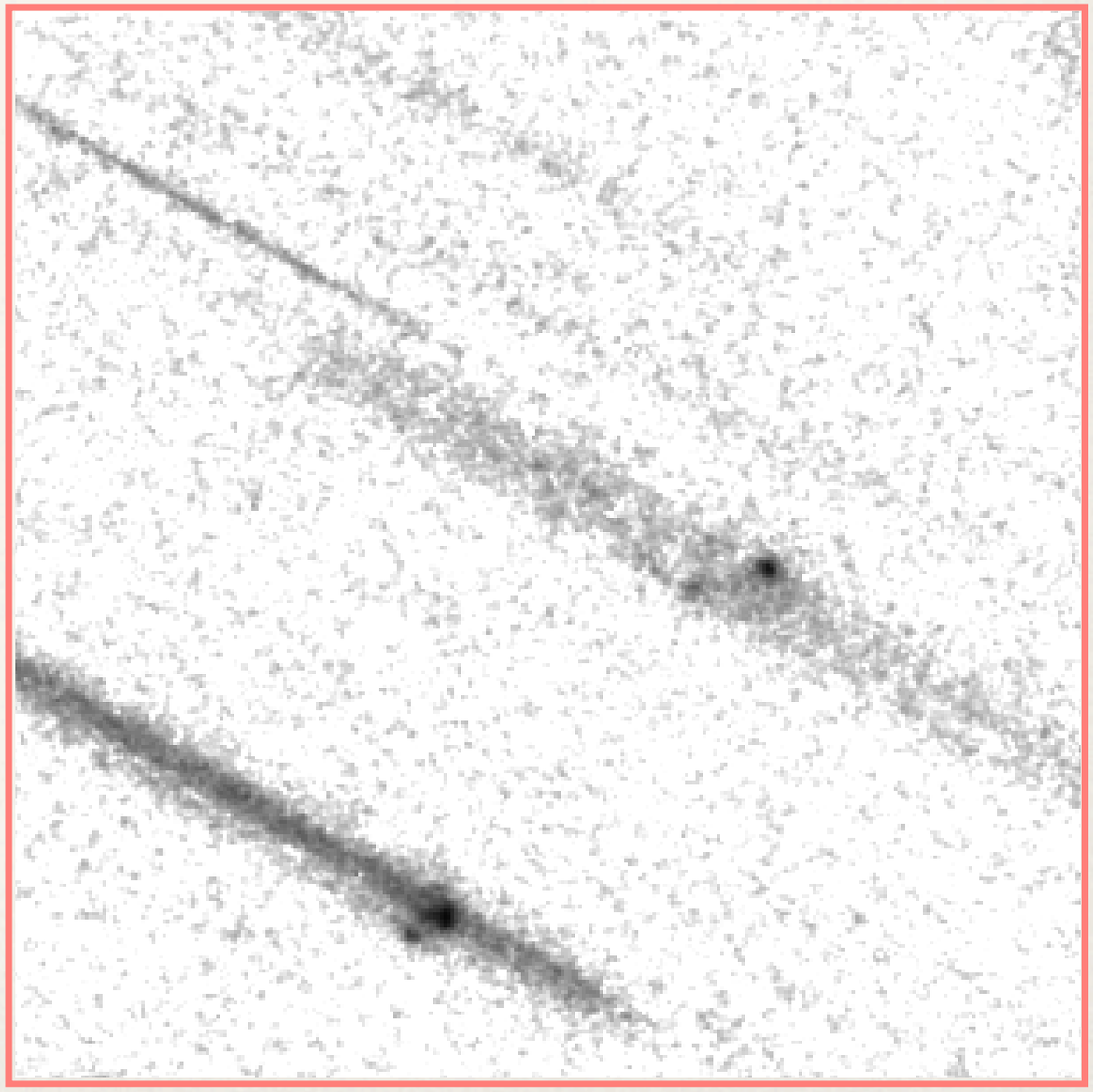
3dHST

Spatially Resolved Emission Lines

Direct Image



Grism Image

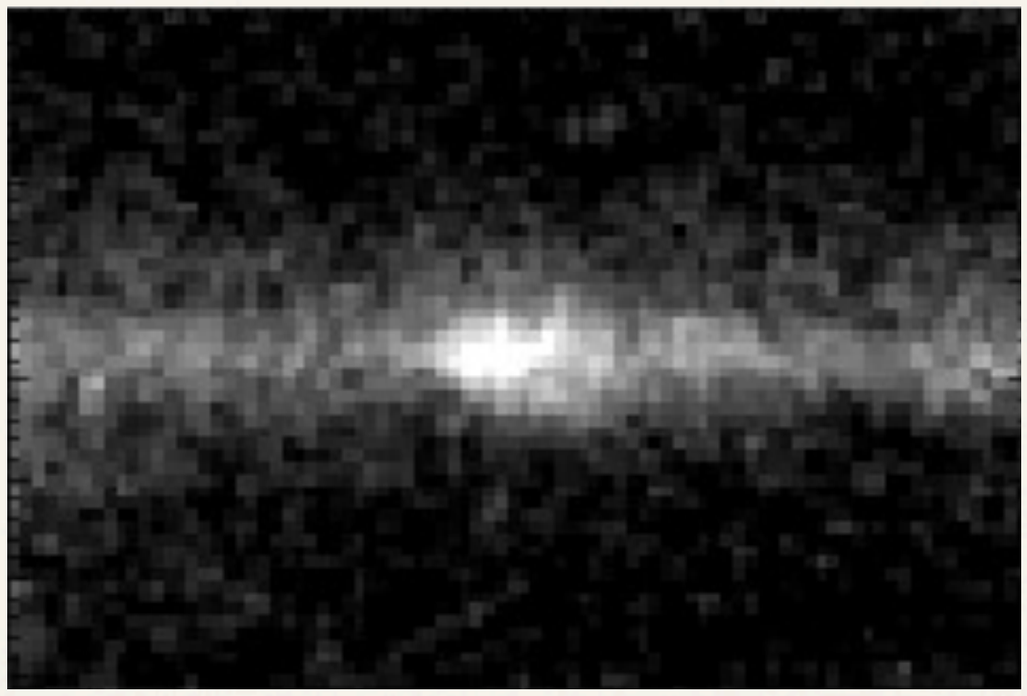


Analysis

Measuring the Spatial distribution of Star Formation

3dHST

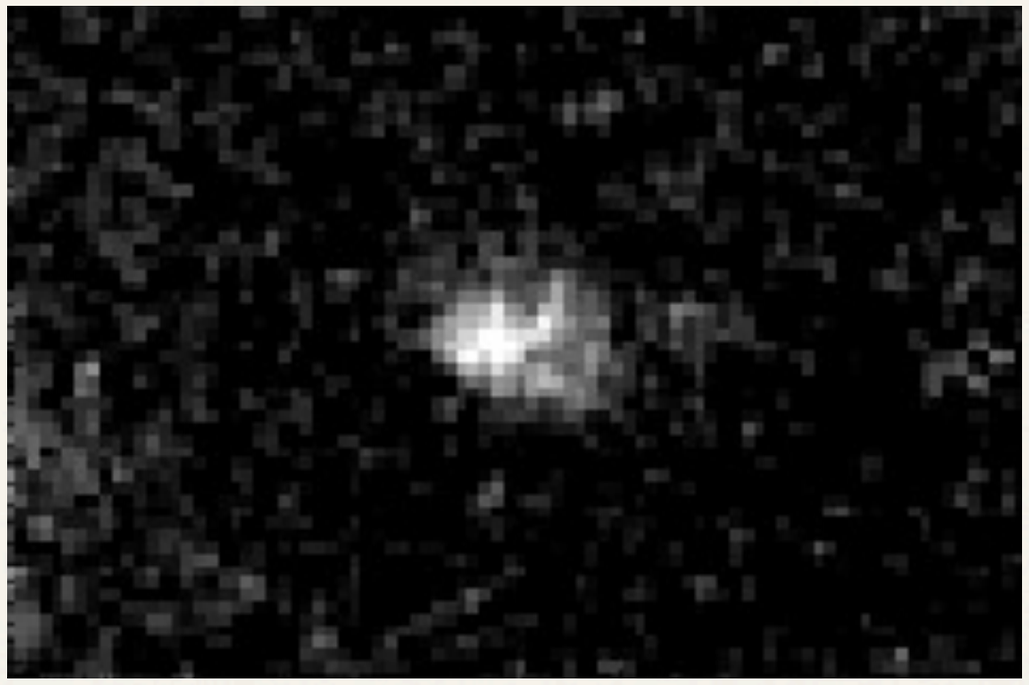
Make Ha Map



Measuring the Spatial distribution of Star Formation

3dHST

Make Ha Map

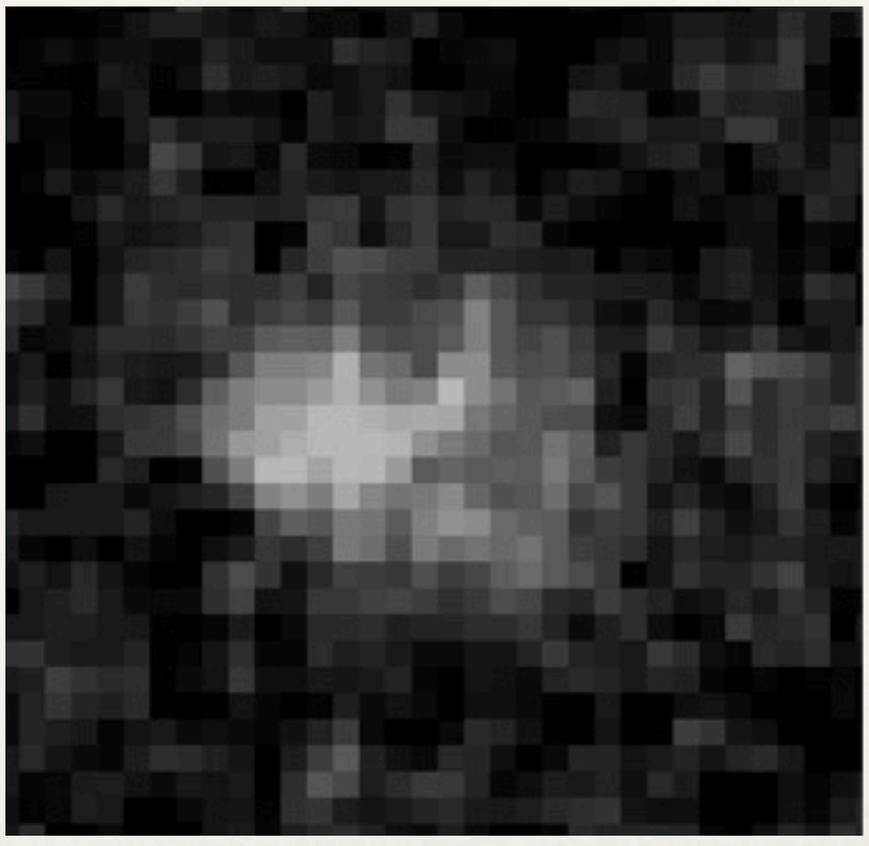


Measuring the Spatial distribution of Star Formation

3dHST

Find Size

Ha Map

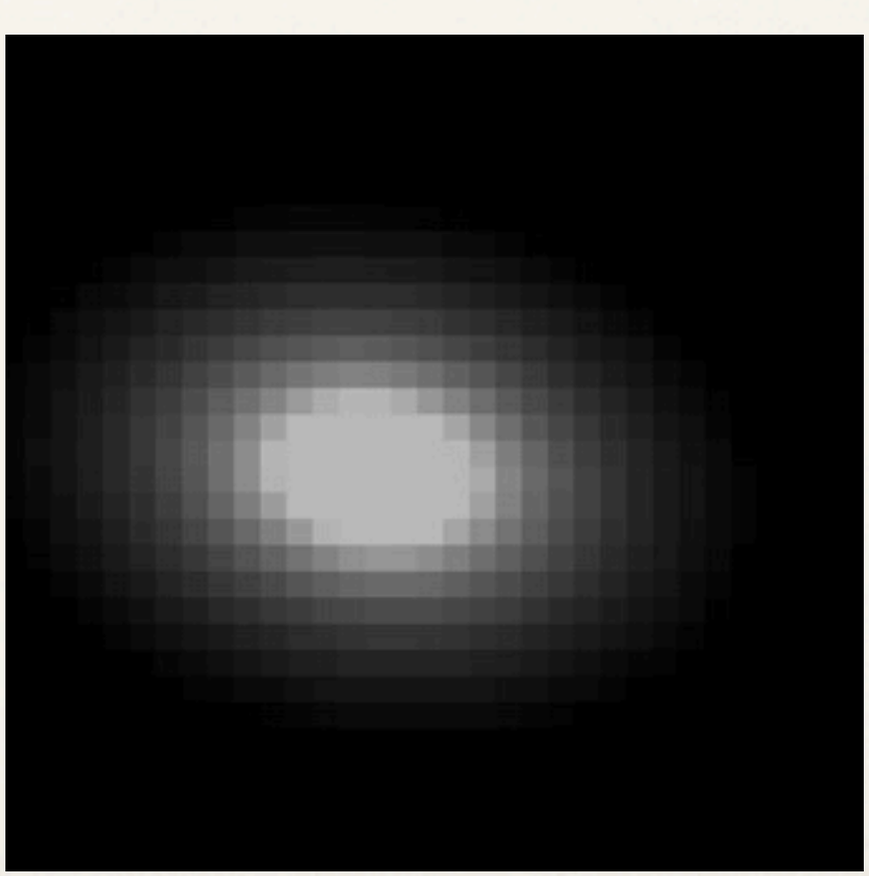


Measuring the Spatial distribution of Star Formation

3dHST

Find Size

Model

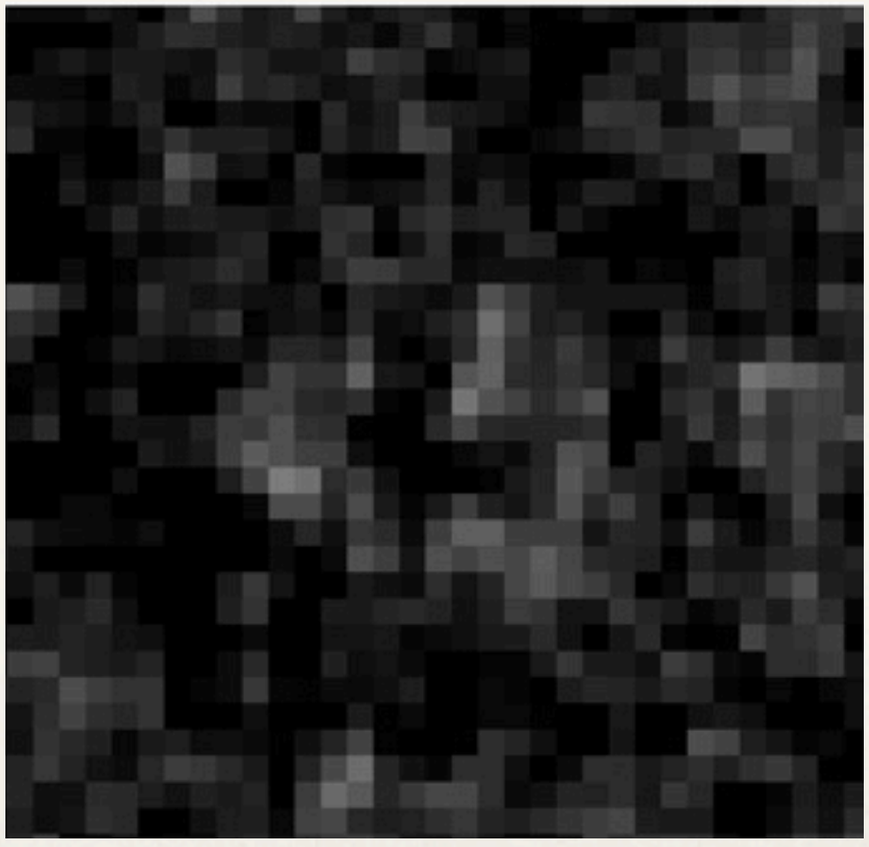


Measuring the Spatial distribution of Star Formation

3dHST

Find Size

Residual

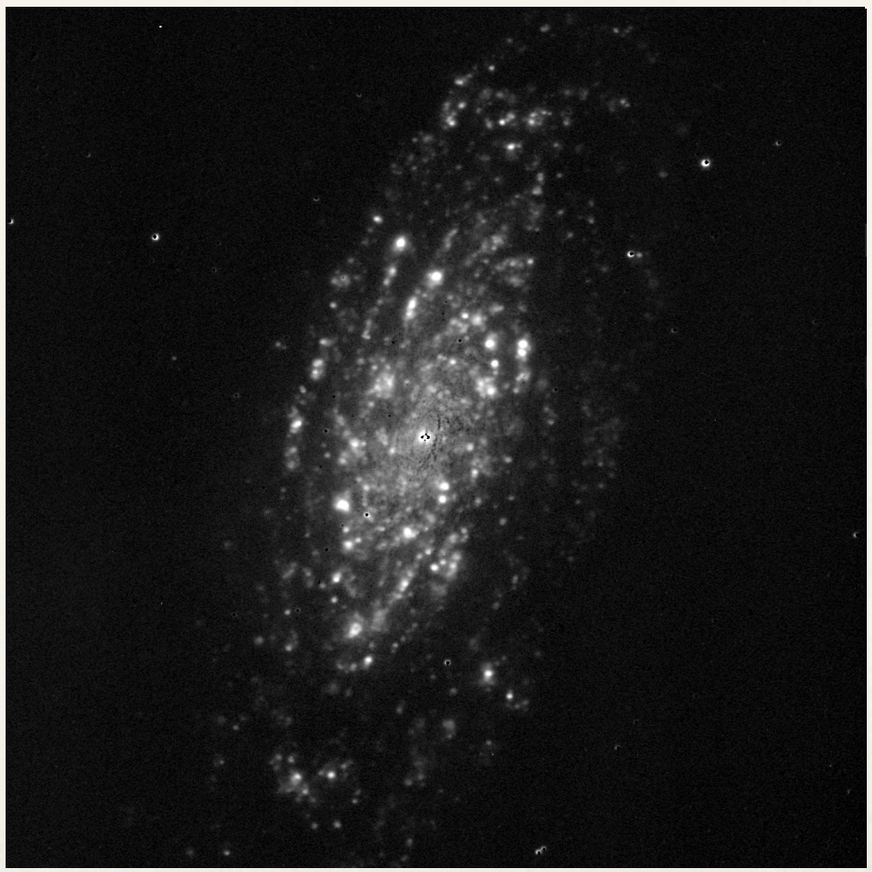


Measuring the Spatial distribution of Star Formation

Compare

Compare to Local Sample - SINGS

Ha Map



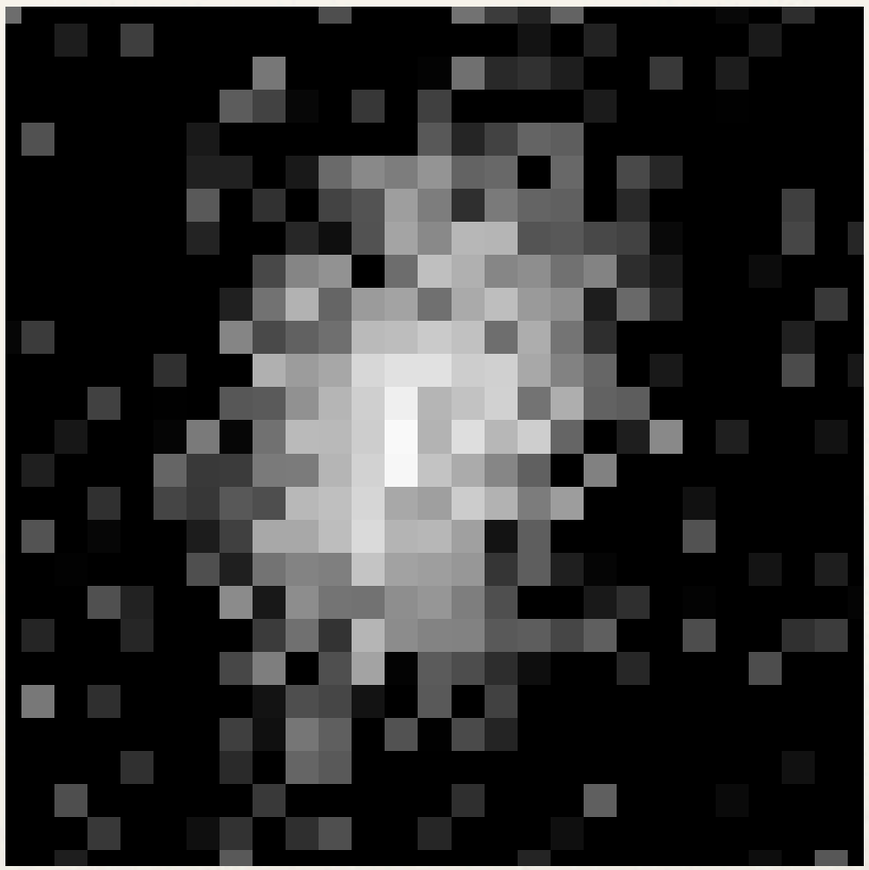
SINGS: Kennicutt+ 2005

Measuring the Spatial distribution of Star Formation

Compare to Local Sample - SINGS

Degrade to z~1

Ha Map



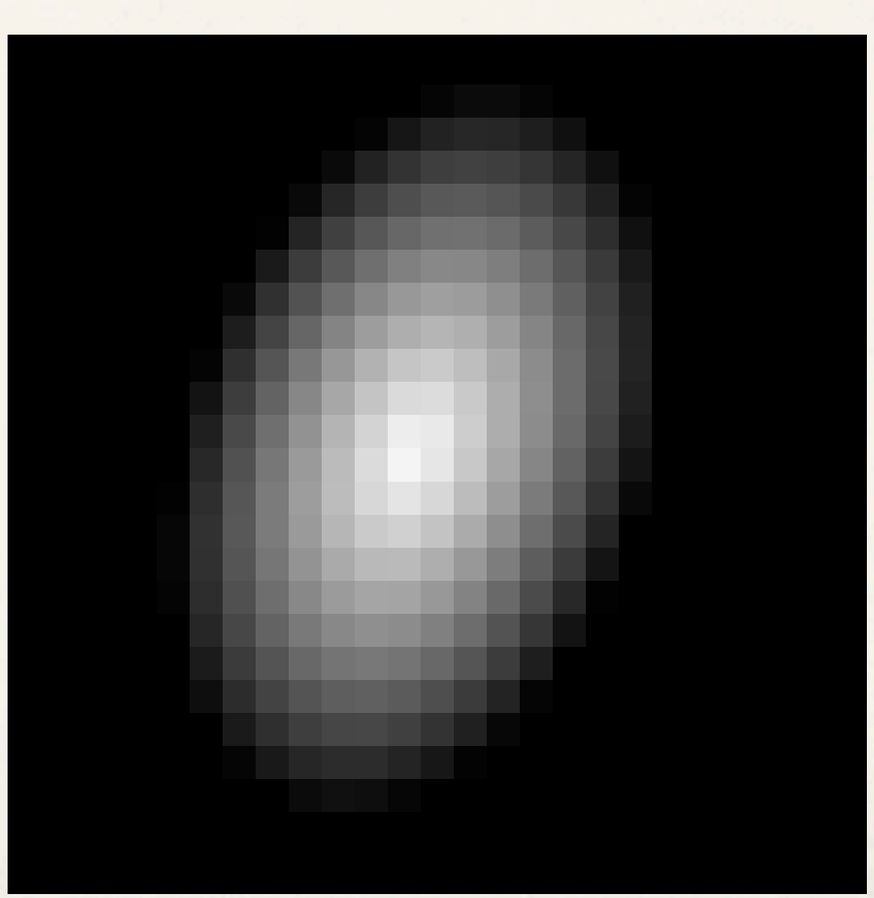
Rebin
Convolve with PSF
Add noise

Measuring the Spatial distribution of Star Formation

Compare to Local Sample - SINGS

Find Size

Model

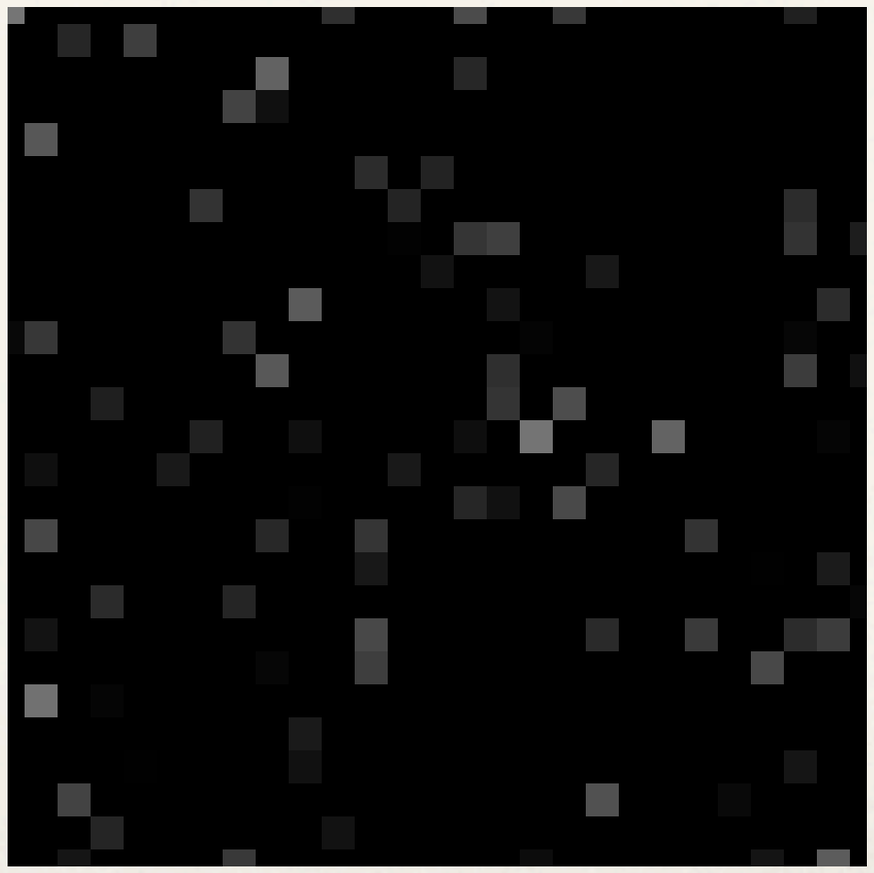


Measuring the Spatial distribution of Star Formation

Compare to Local Sample - SINGS

Find Size

Residual

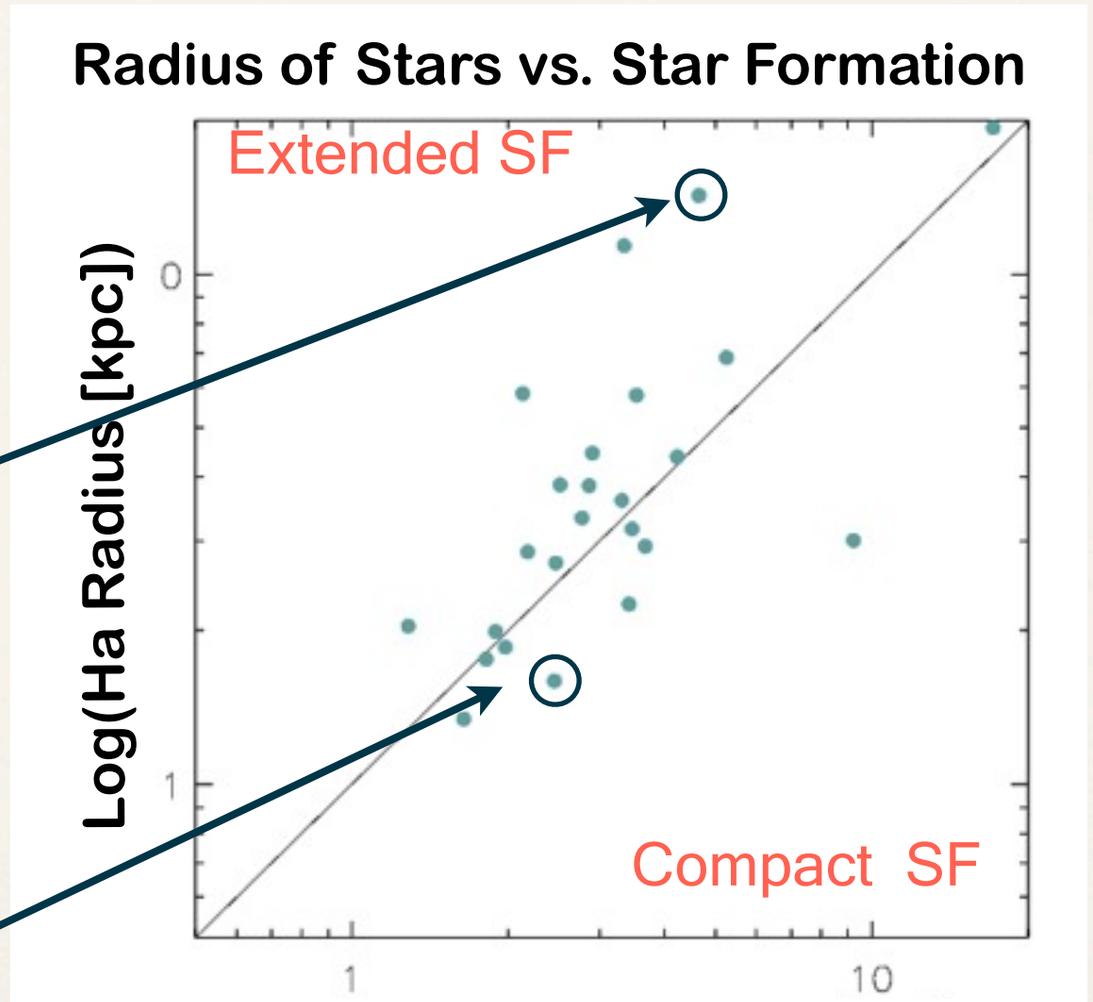


Preliminary Results

Spatial distribution of Star Formation

Results - The local universe

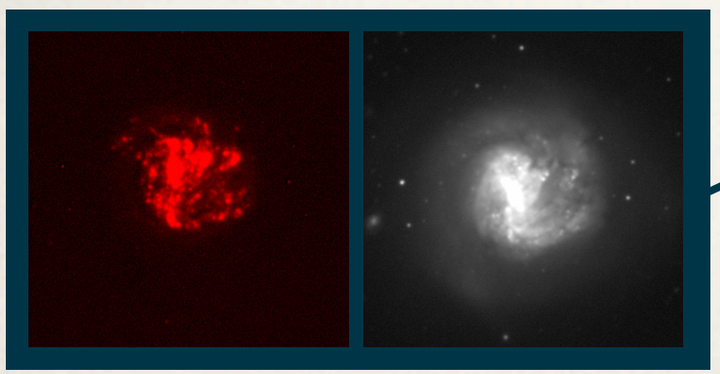
z~0

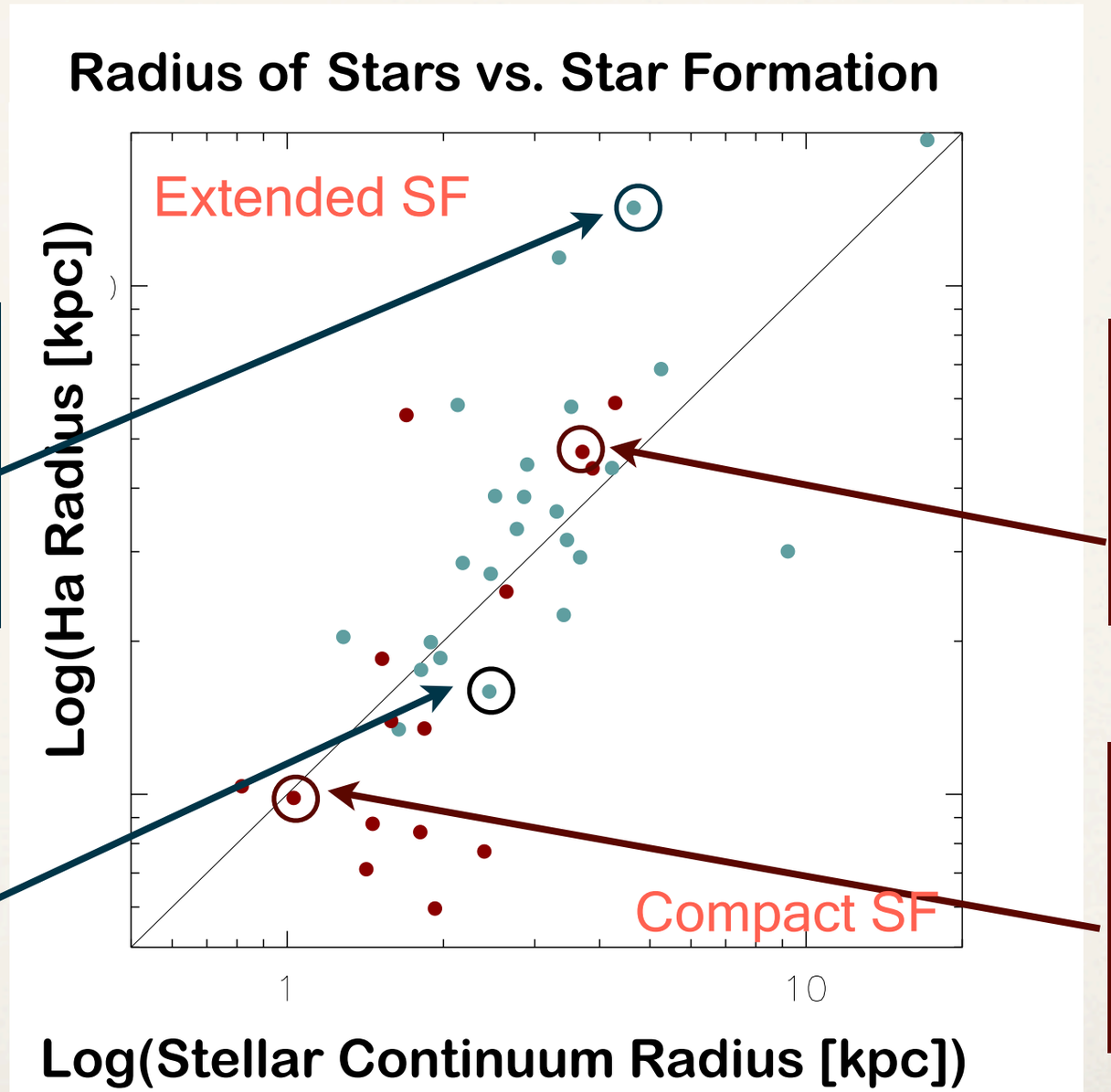


Spatial distribution of Star Formation

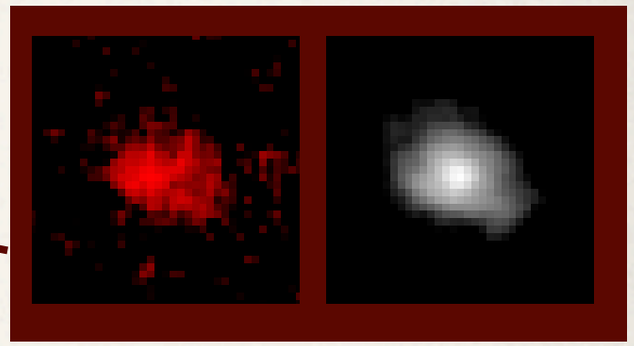
Preliminary Results - The z~1 universe

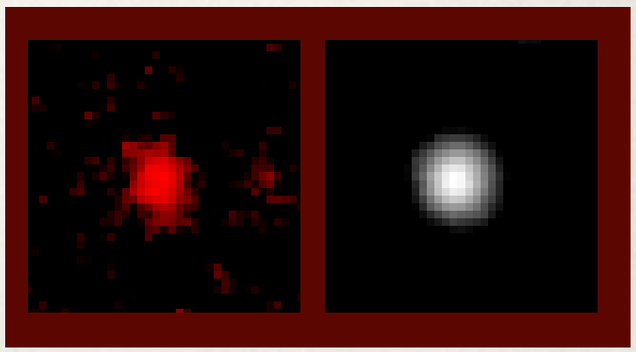
z~0



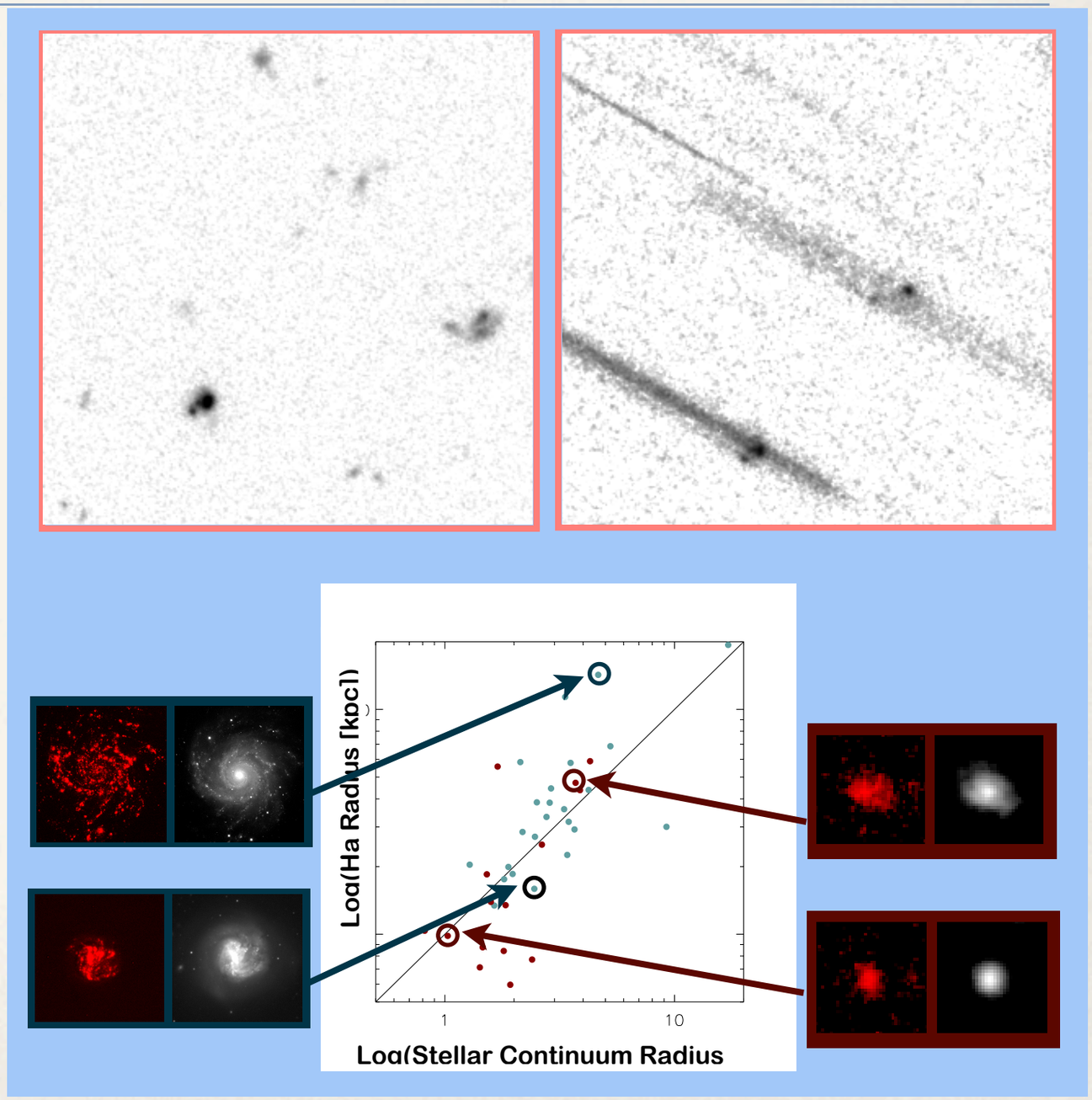


z~1





Spatial distribution of Star Formation

3dHST

- WFC3 grism has opened up new window on the distant Universe
- Expect more 3D-HST data and results in the coming year!