Galaxy Formation at Cosmic Noon in the WFIRST Era:

LESSONS FROM 3D-HST

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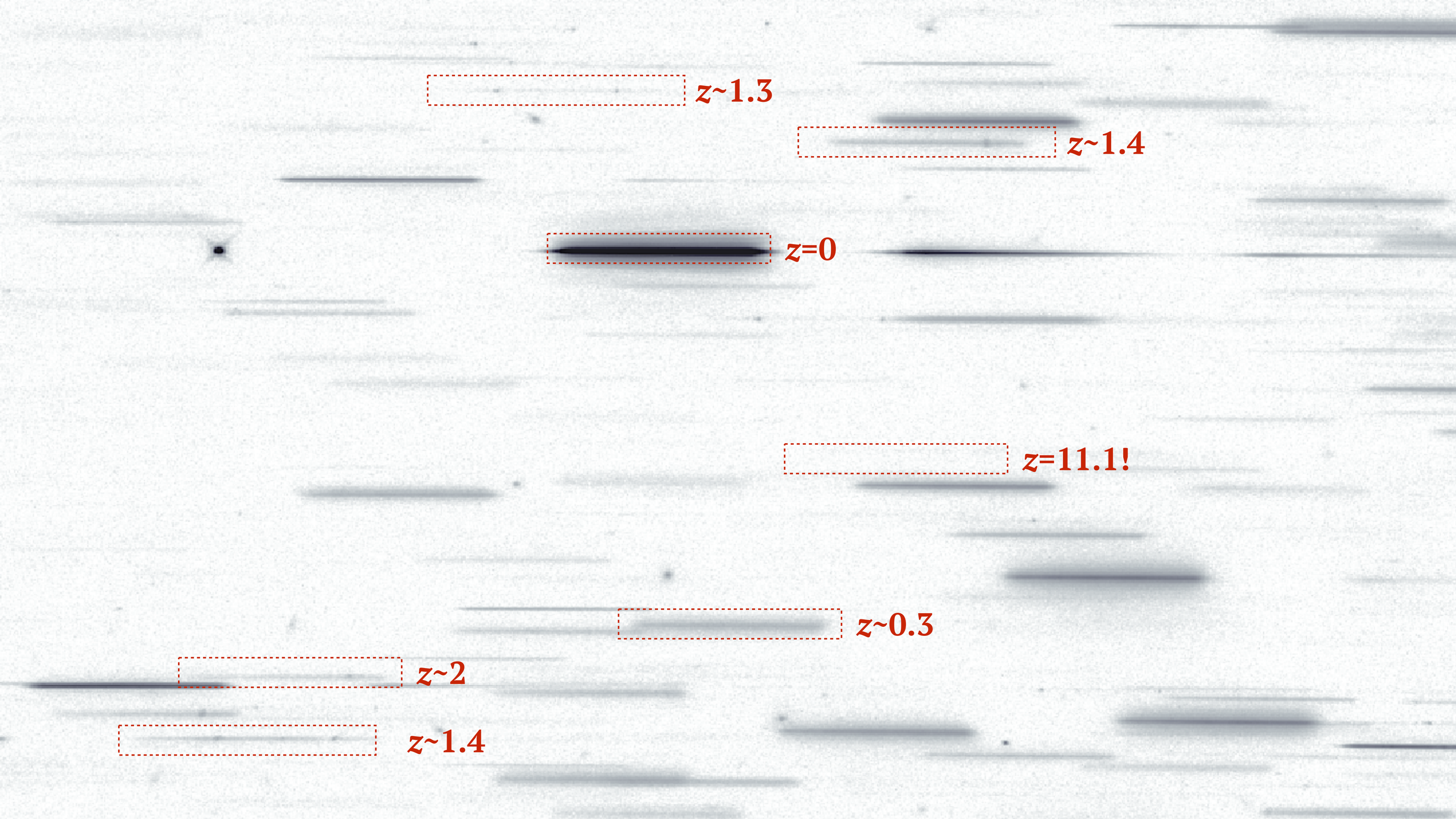
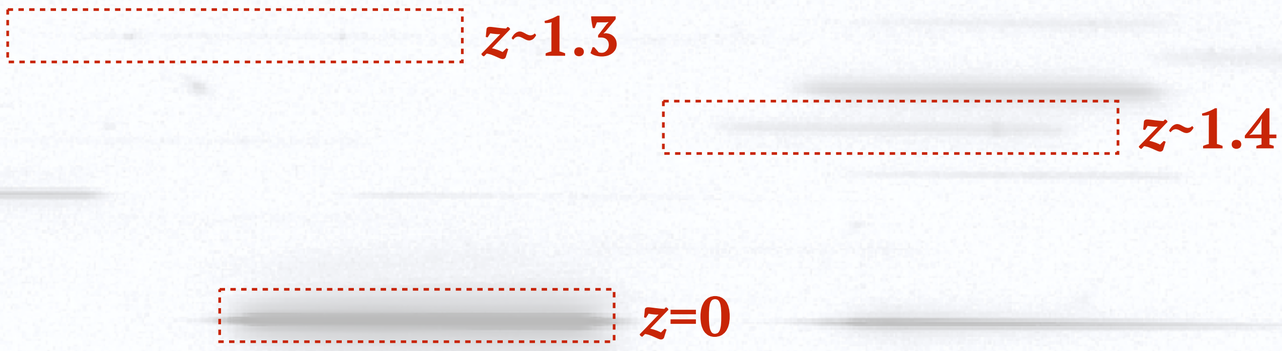
DAWN

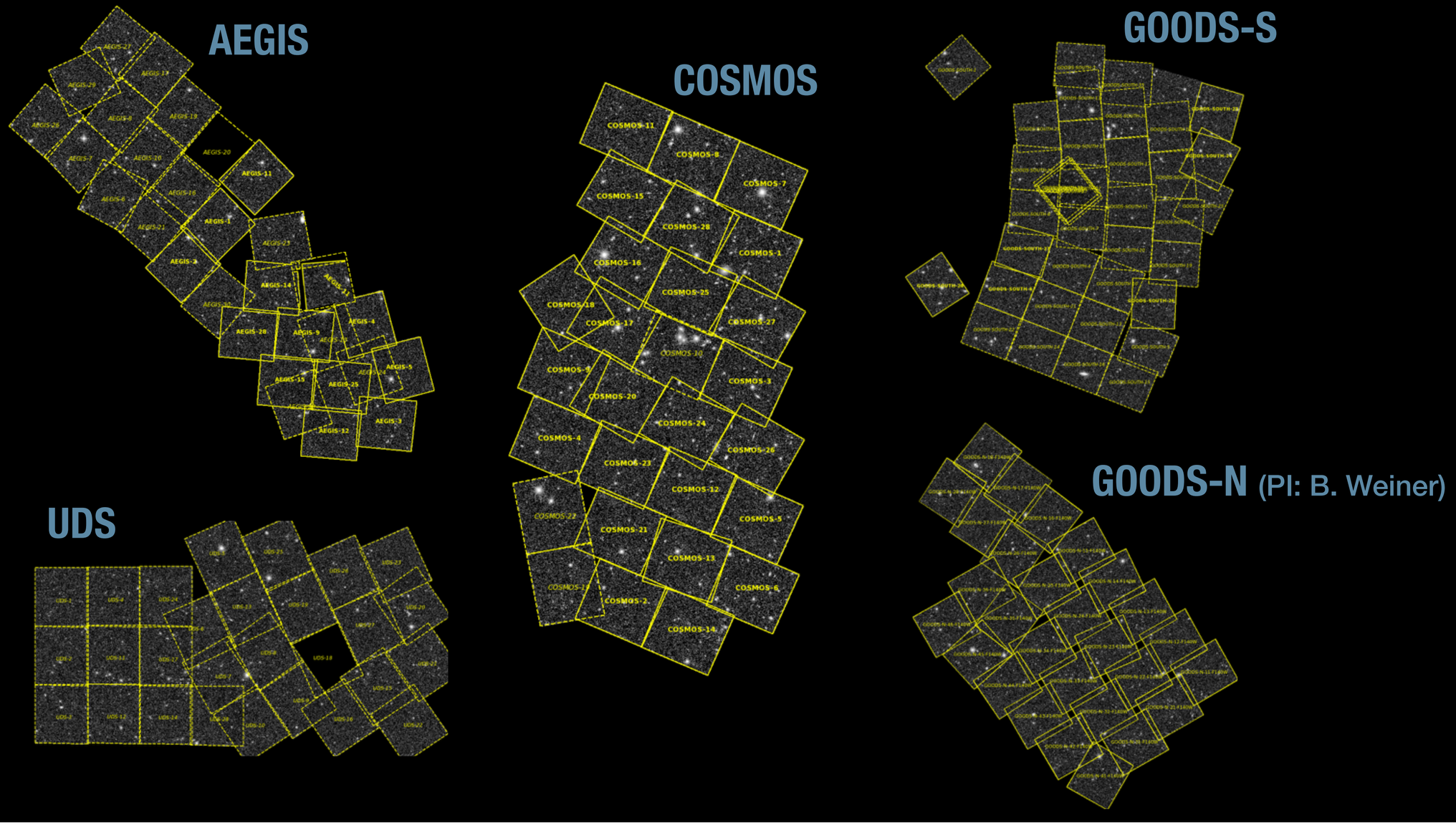
Danmarks Grundforskningsfond
Danish National Research Foundation


z~1.3
z~1.4
z=0
z=11.1!
z~0.3
z~2
z~1.4

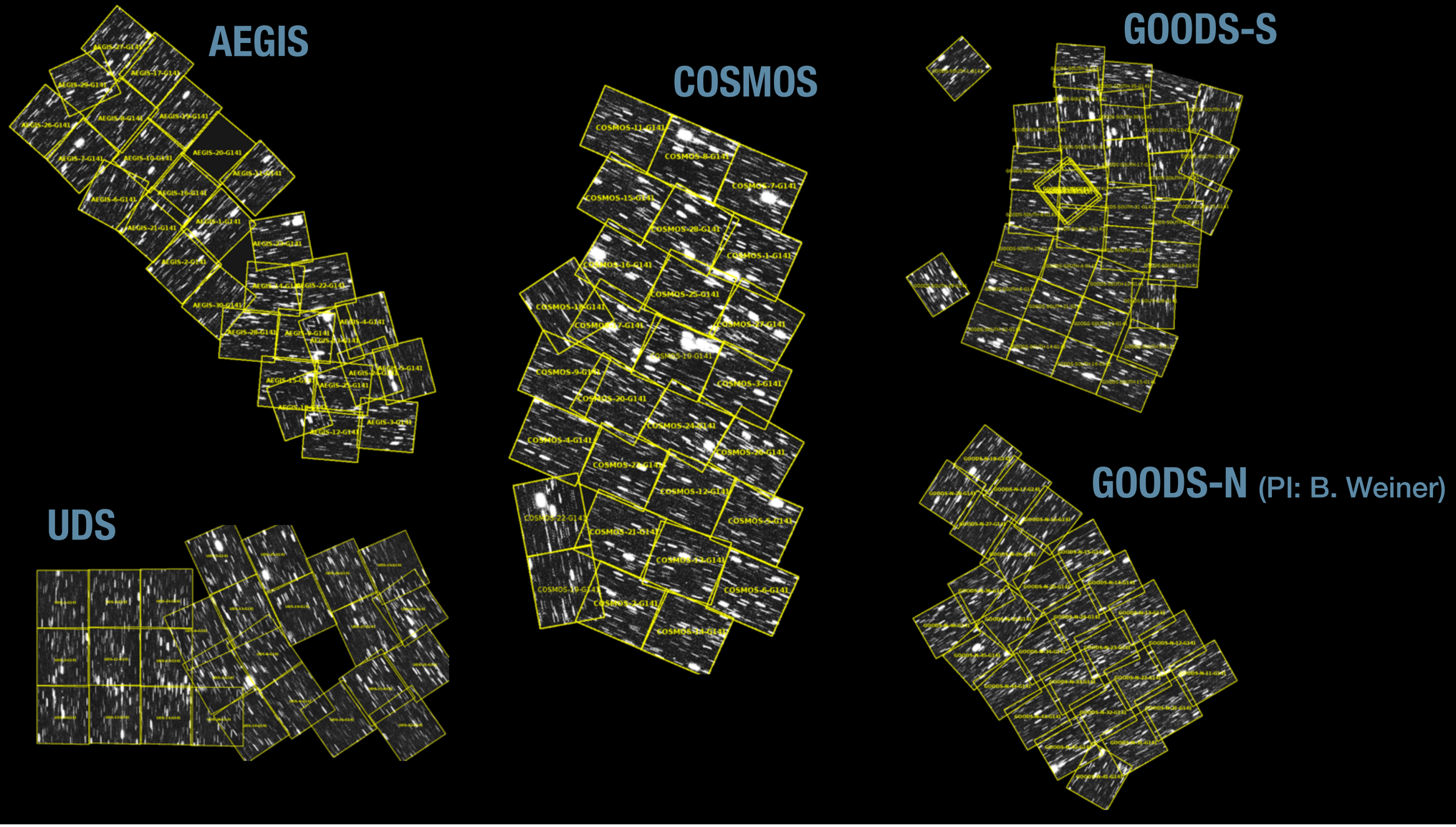


Wide-field slitless surveys at z=1-2:

- Large, uniform, roughly **unbiased samples**
- **Spatially-resolved line diagnostics** @ HST resolution
- **Accurate redshifts** ($\Delta z/(1+z) \sim 0.003$): large scale structure & stacking analyses



3D-HST F140W Mosaics
3dhst.research.yale.edu



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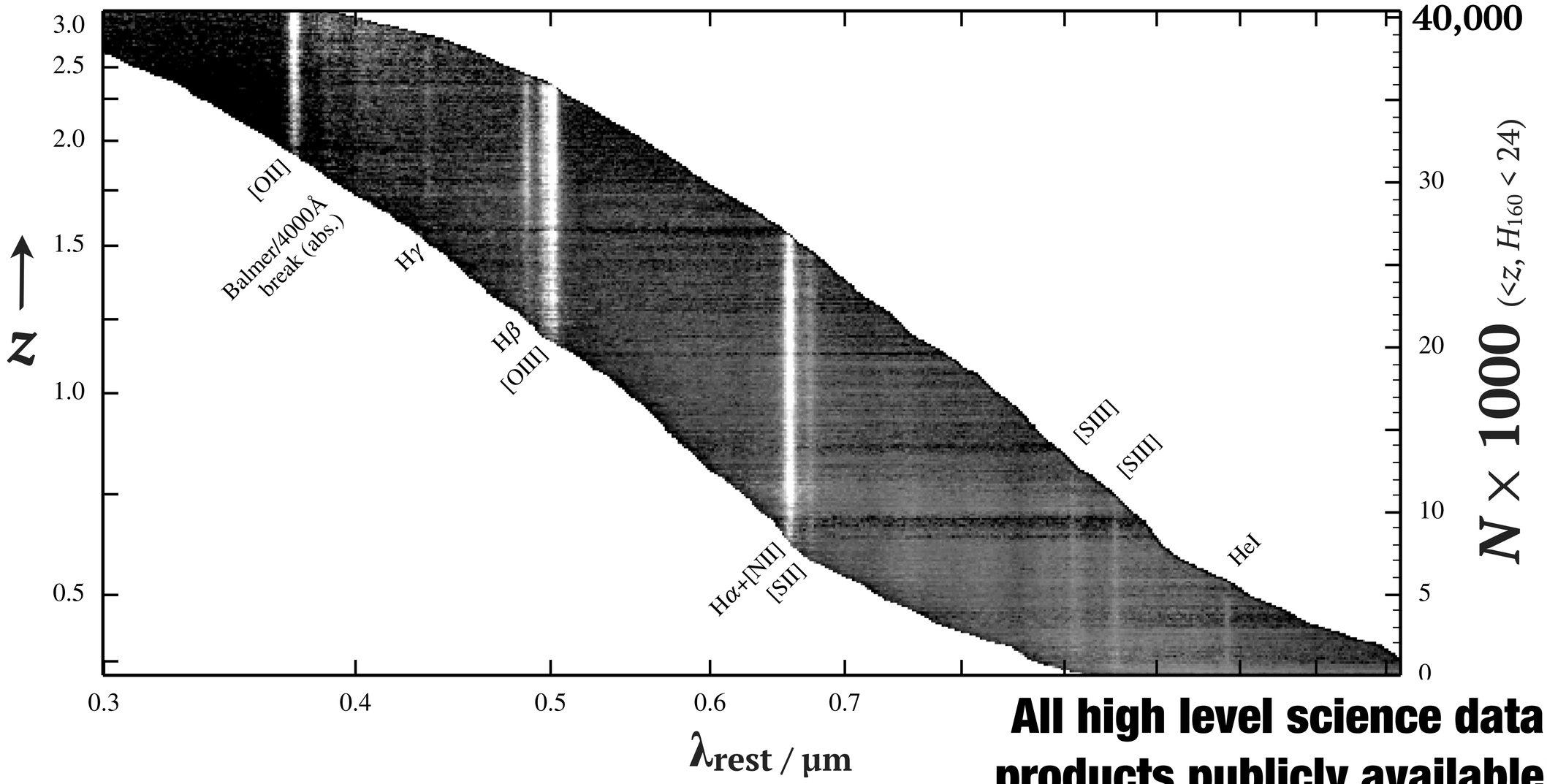


All high level science data products publicly available!

Automated extraction enables robust quantitative measurements for **10s of thousands of galaxies**

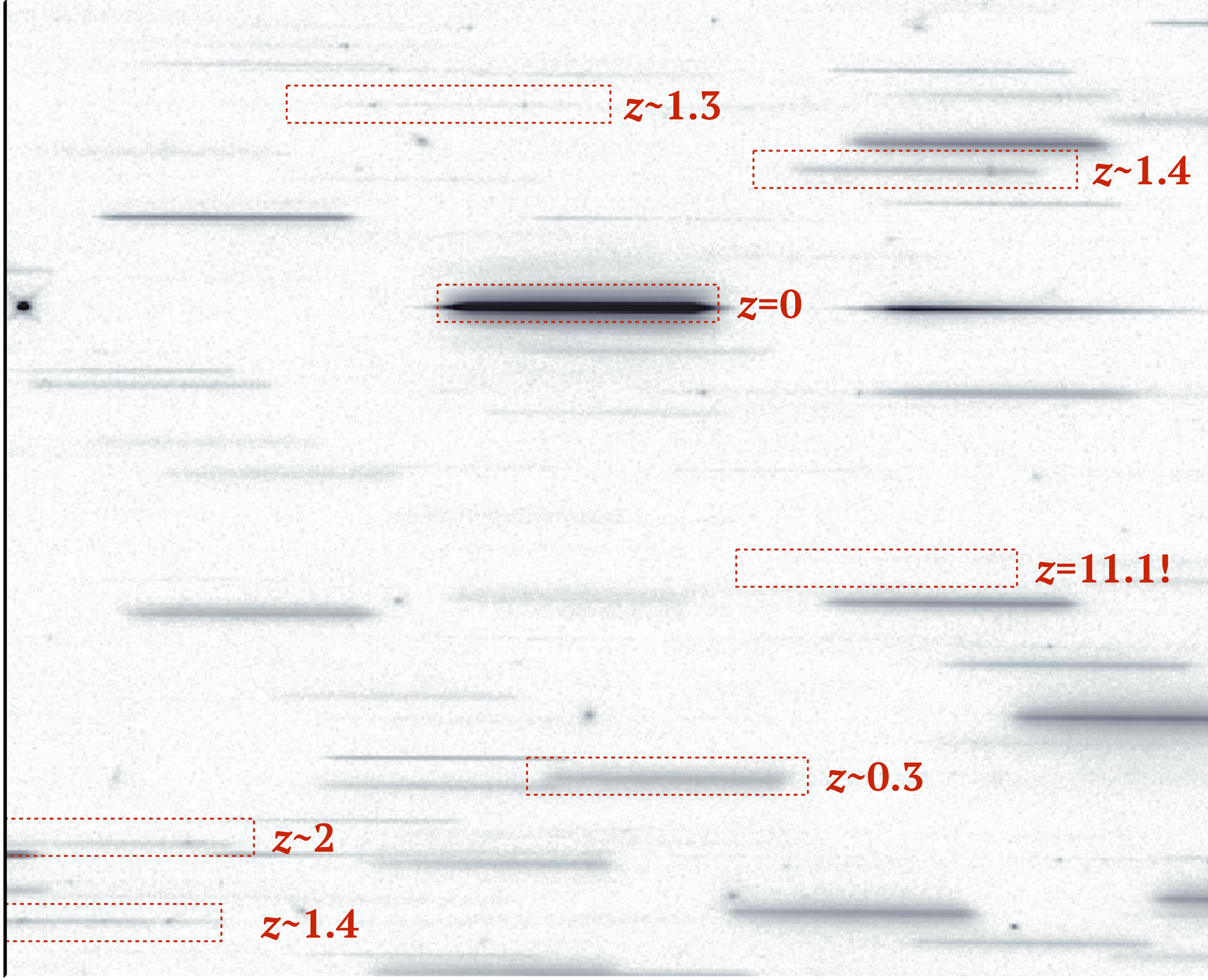
http://3dhst.astro.yale.edu
https://archive.stsci.edu/prepds/3d-hst/

Momcheva et al., (2015)

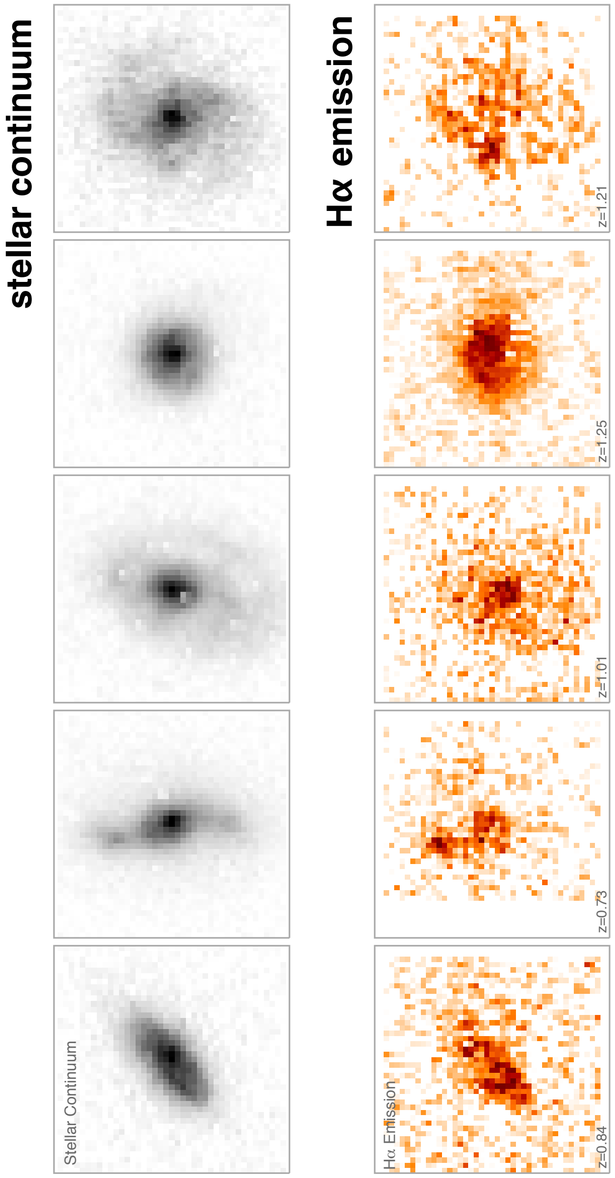
Science Highlights

3D-HST

and grism spectroscopy



Line Morphologies provide spatially resolved information on ~1kpc scales



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- **Age gradients** Akhshik, Whitaker et al., in prep

} **gravitational lensing helps!**

… and many more excellent papers!

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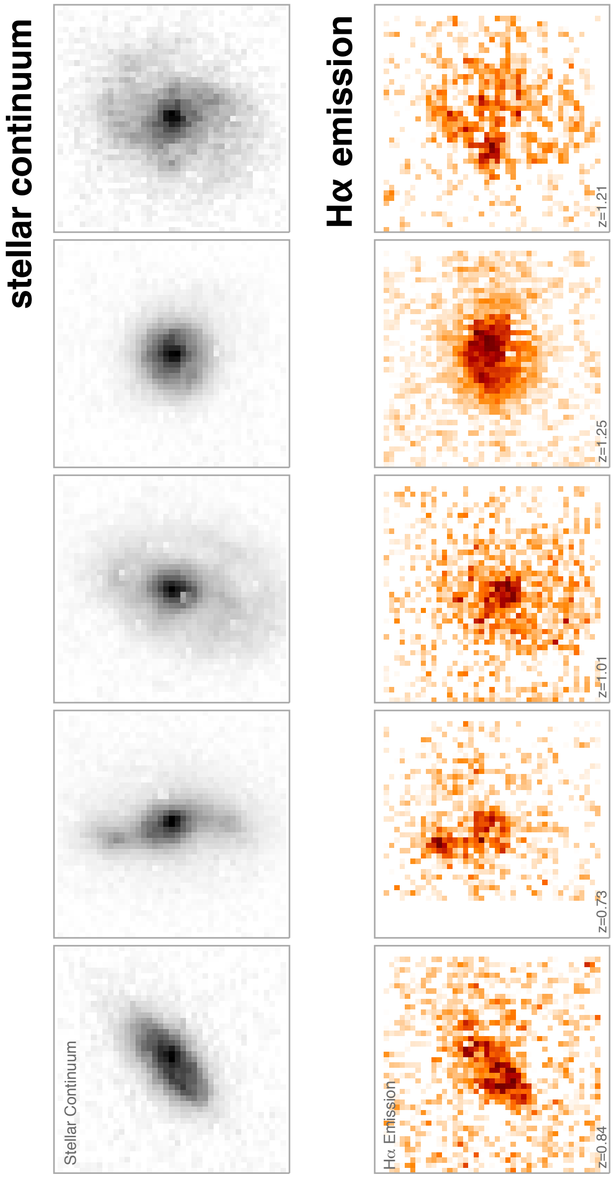

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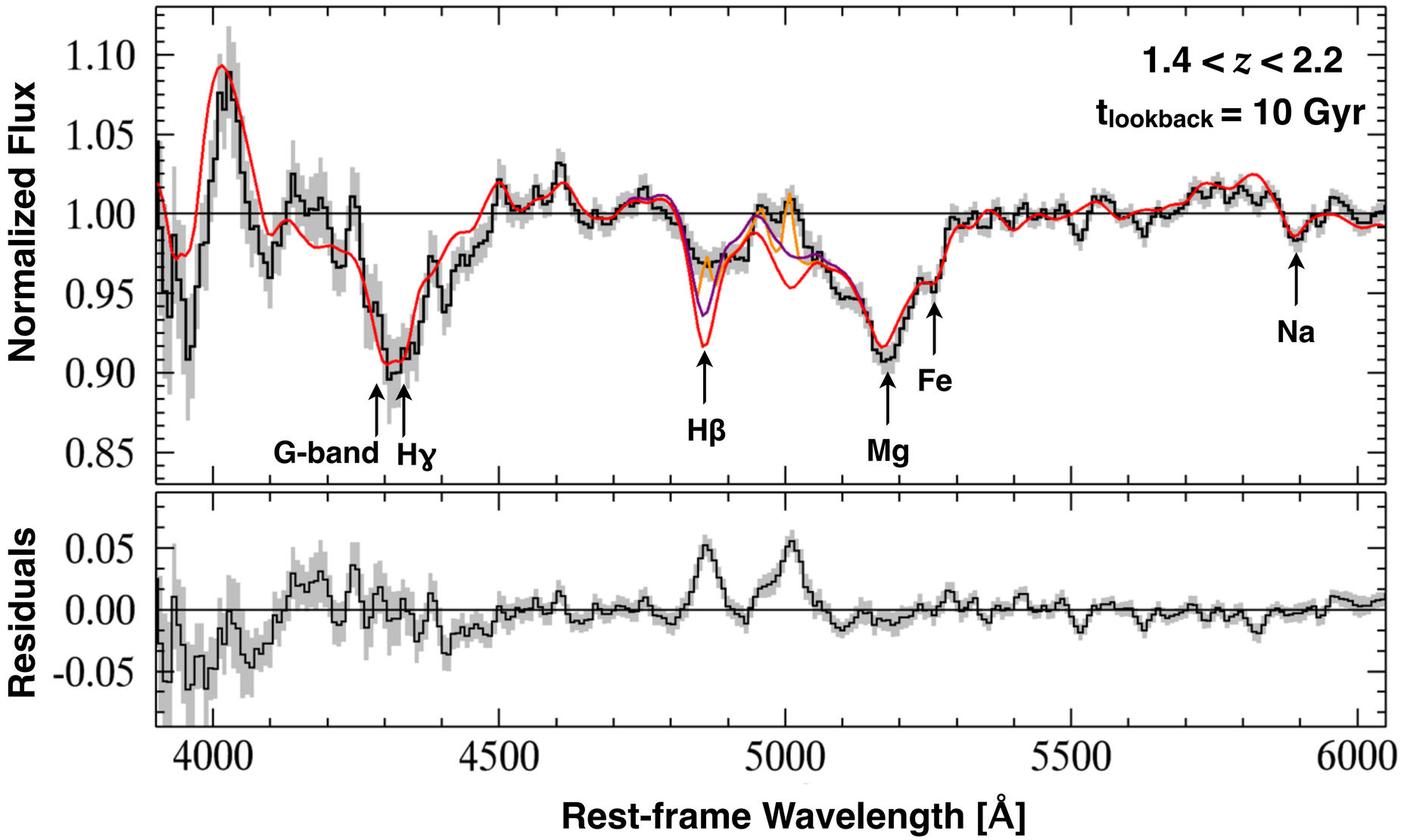
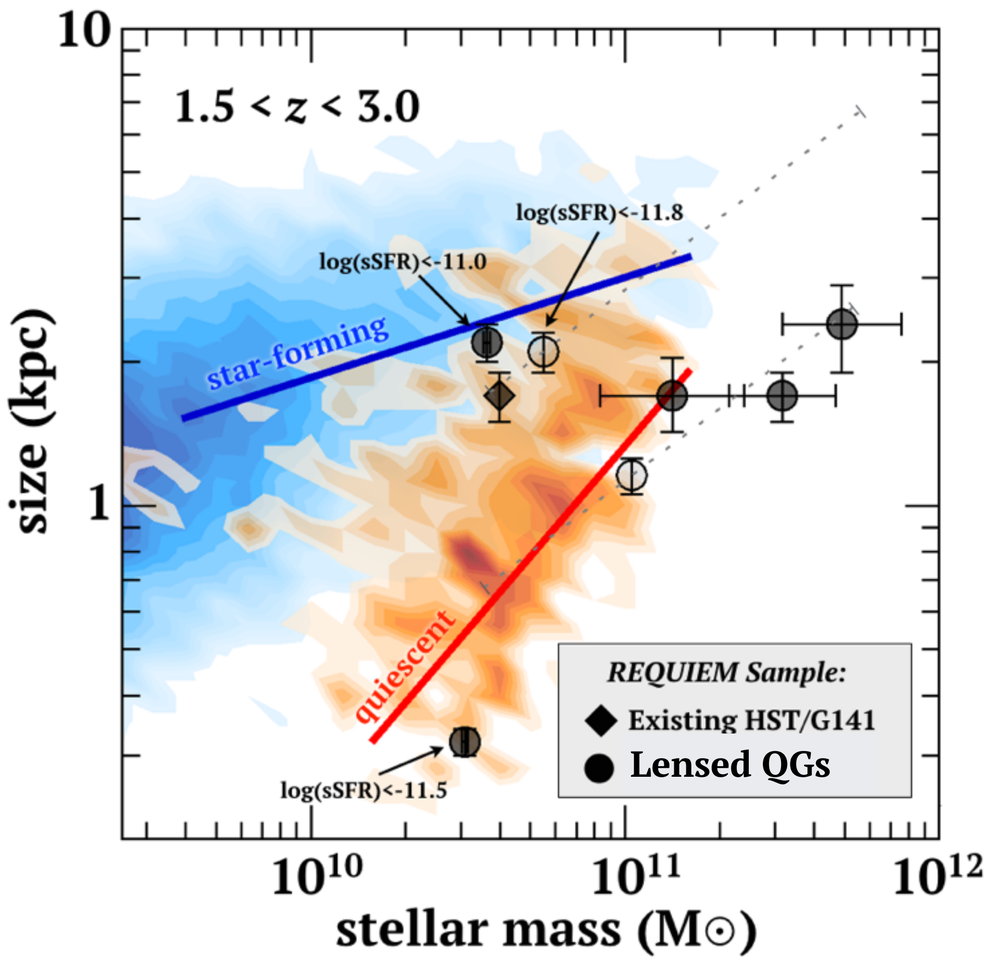
When did the stars form? Ages of quenched galaxies



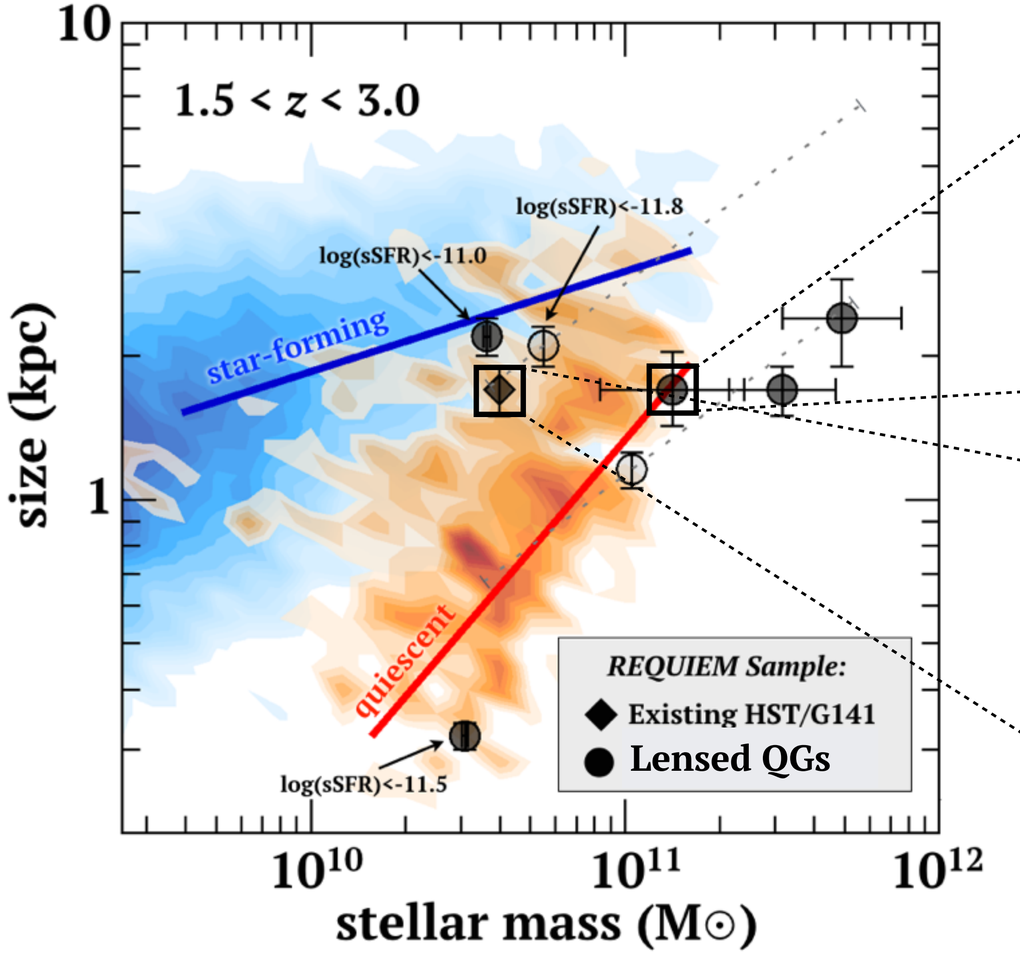
Whitaker et al. 2013

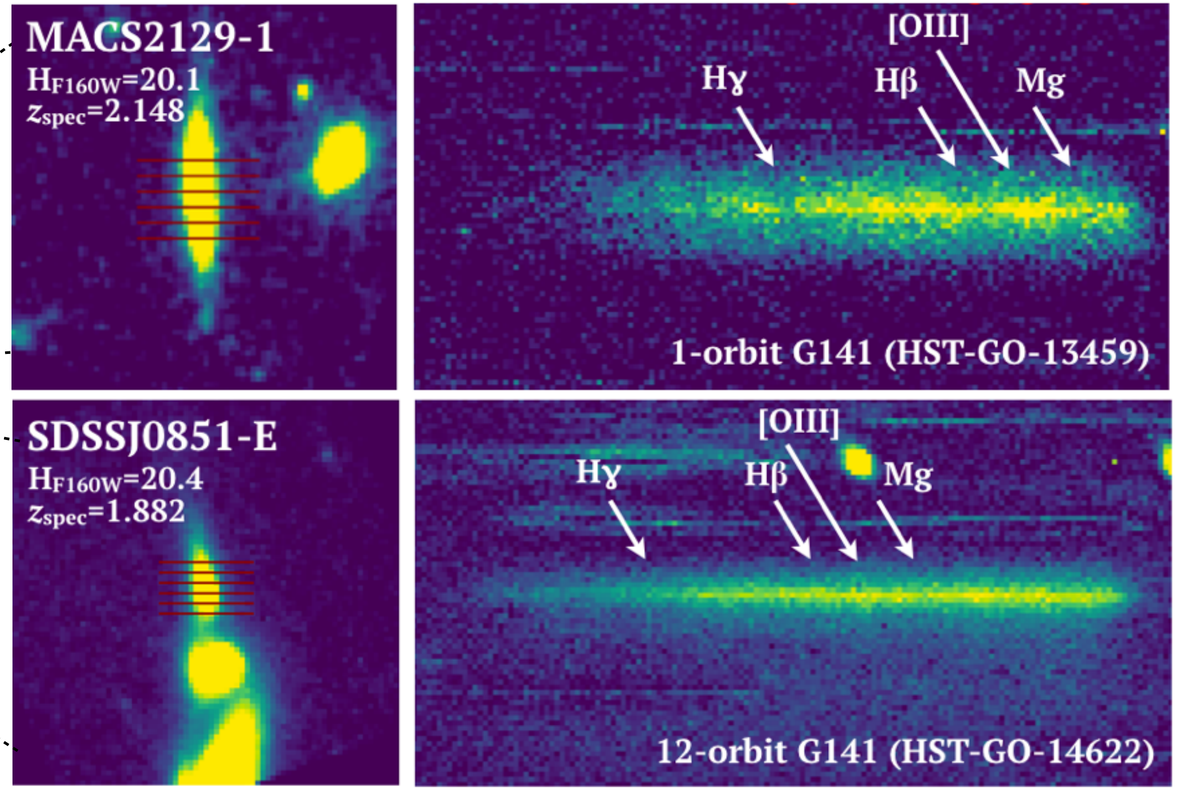
What quenches galaxies? Spatially-resolved absorption spectroscopy



What quenches galaxies? Spatially-resolved absorption spectroscopy

DAWN REQUIEM

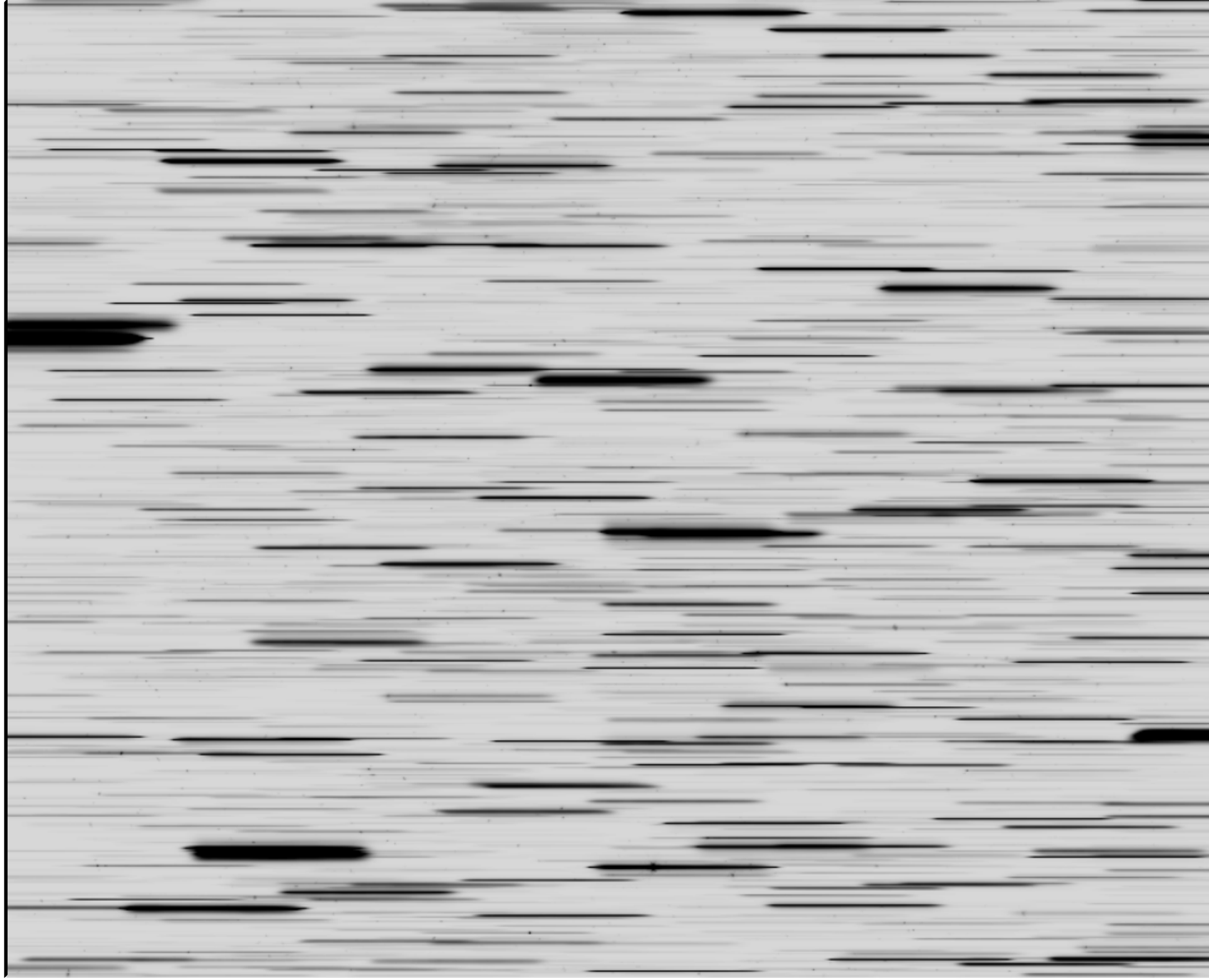




Akhshik et al. in prep

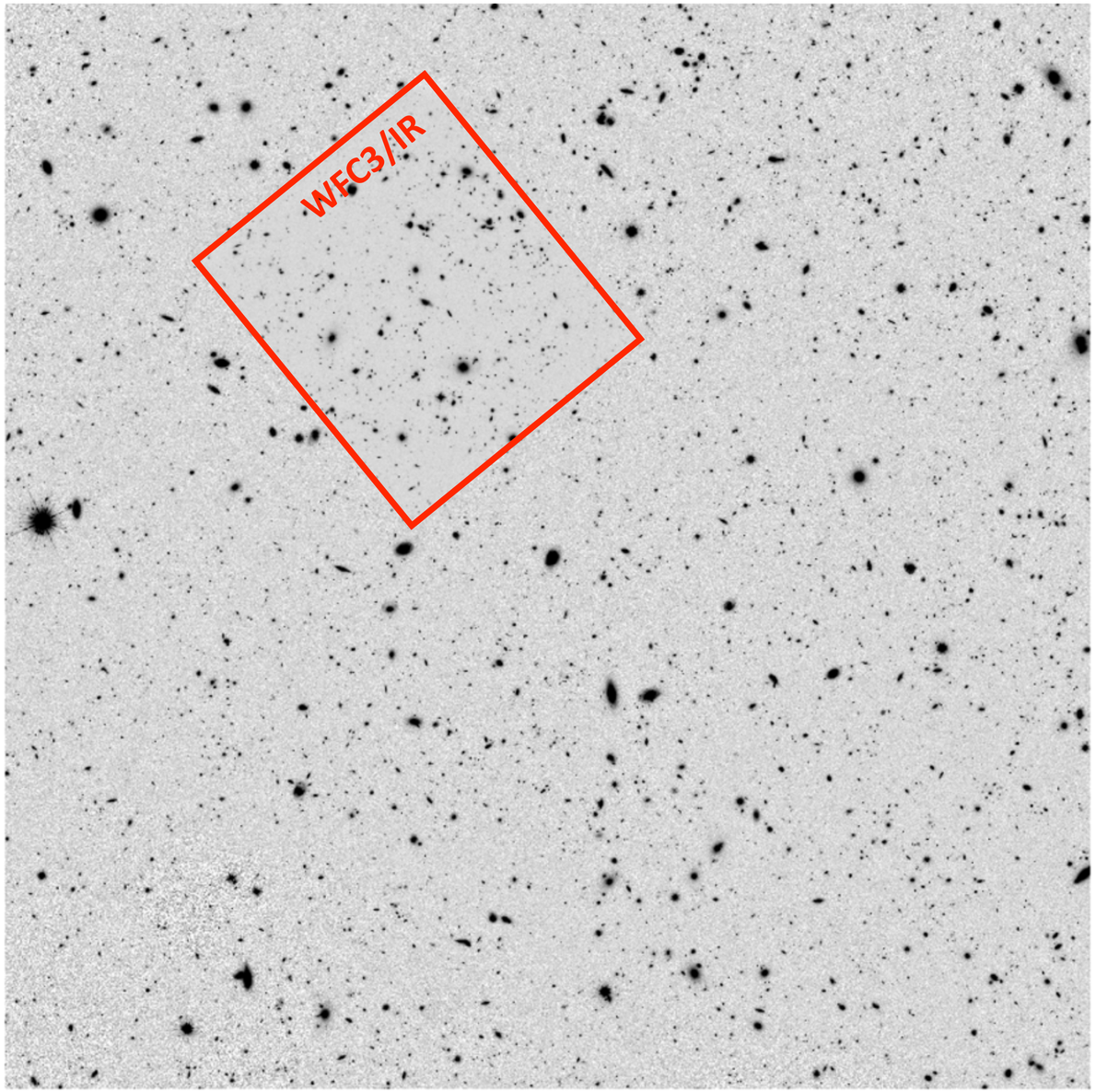

International Research Experience for Students
DAWN IRES Scholars Program
https://www.uconn.dawn.edu/
DAWN
NSF-IRES
Application Deadline Feb 1, 2019
NSF
experience.
explore
excel.
empower.

Future Prospects



WFIRST Simulations: what can we expect?

Single 4k WFIRST detector



Simulation by G. Brammer
https://github.com/gbrammer/grizli/

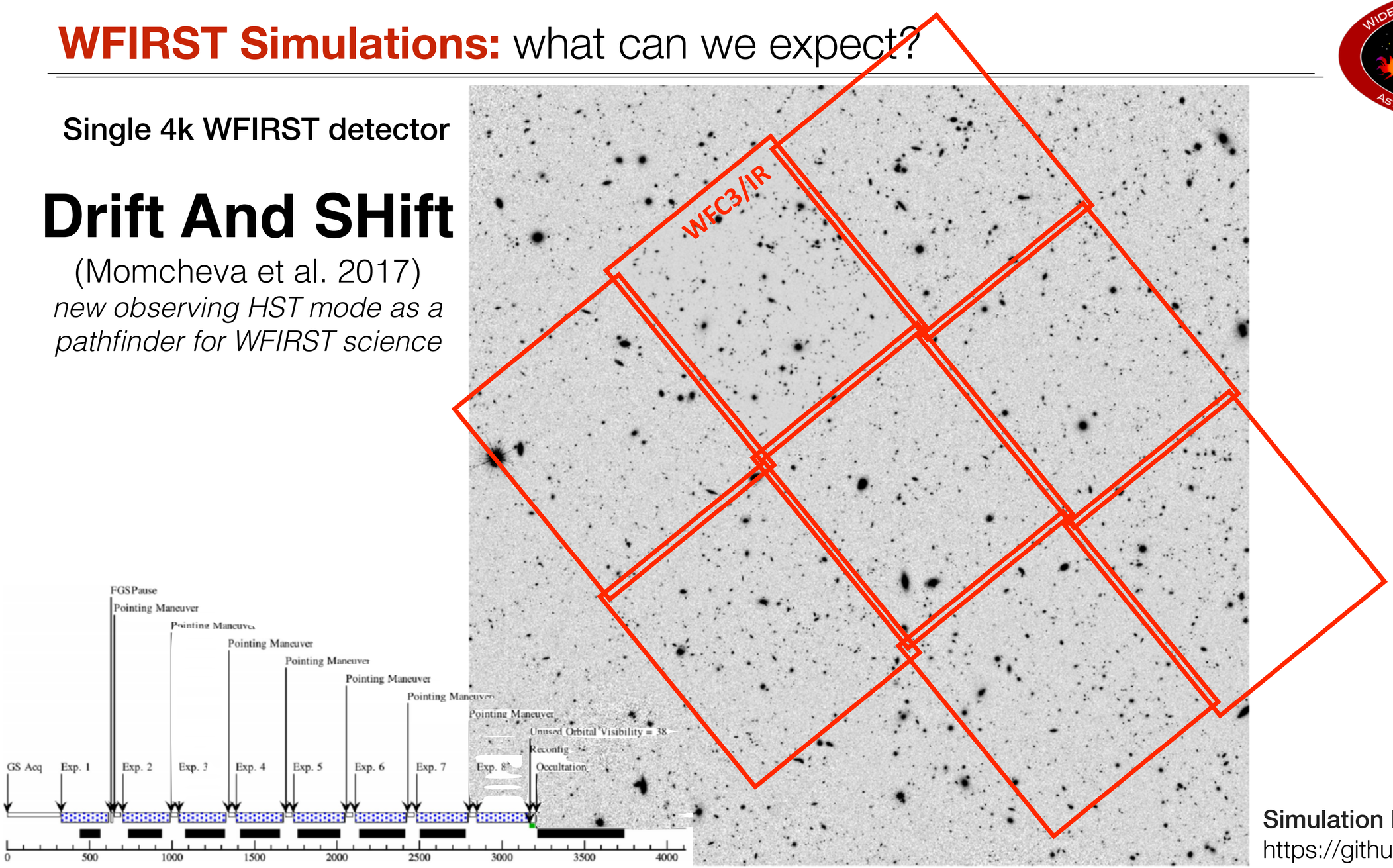
WFIRST Simulations: what can we expect?

Single 4k WFIRST detector

Drift And SHift

(Momcheva et al. 2017)

new observing HST mode as a pathfinder for WFIRST science



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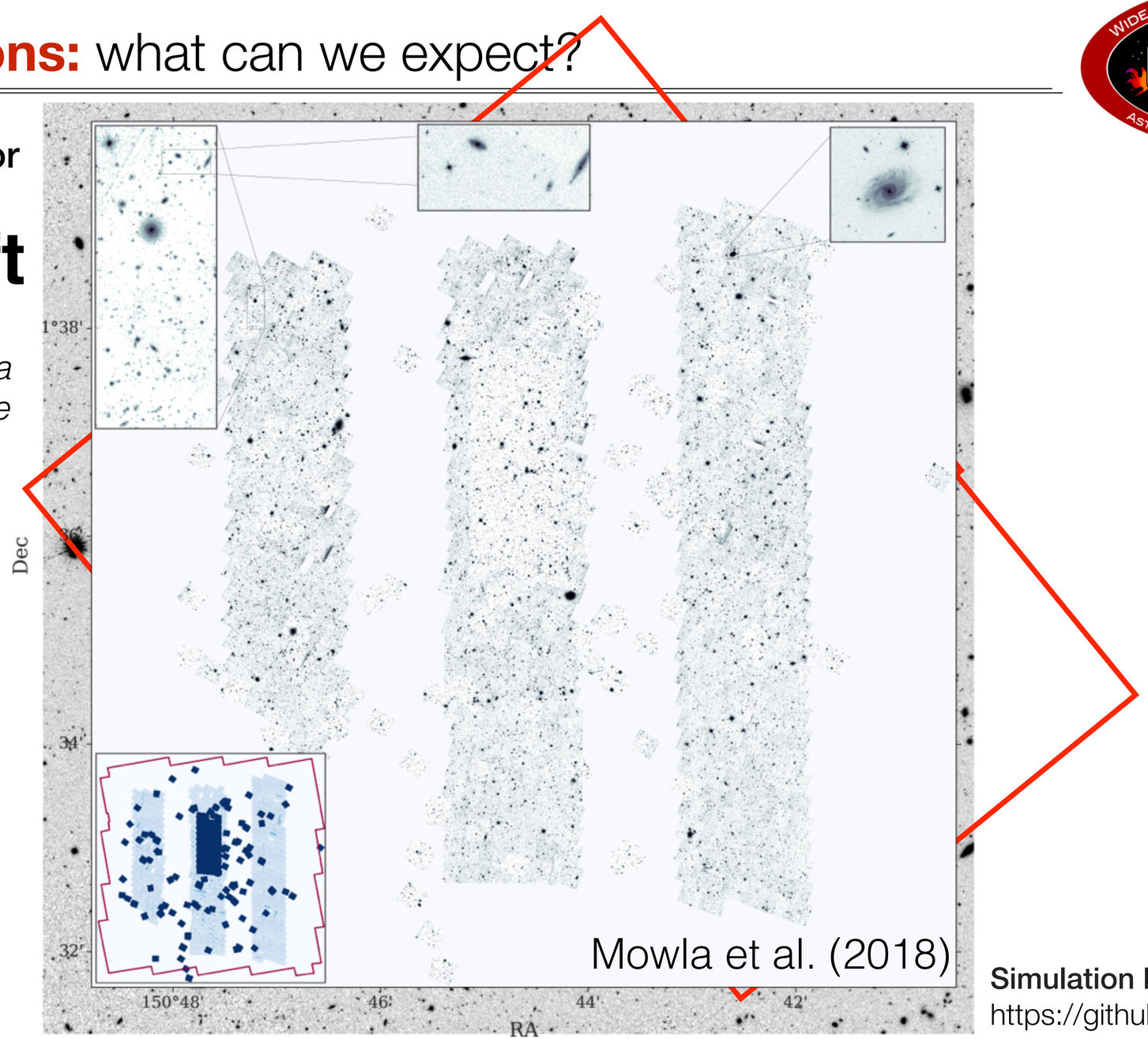

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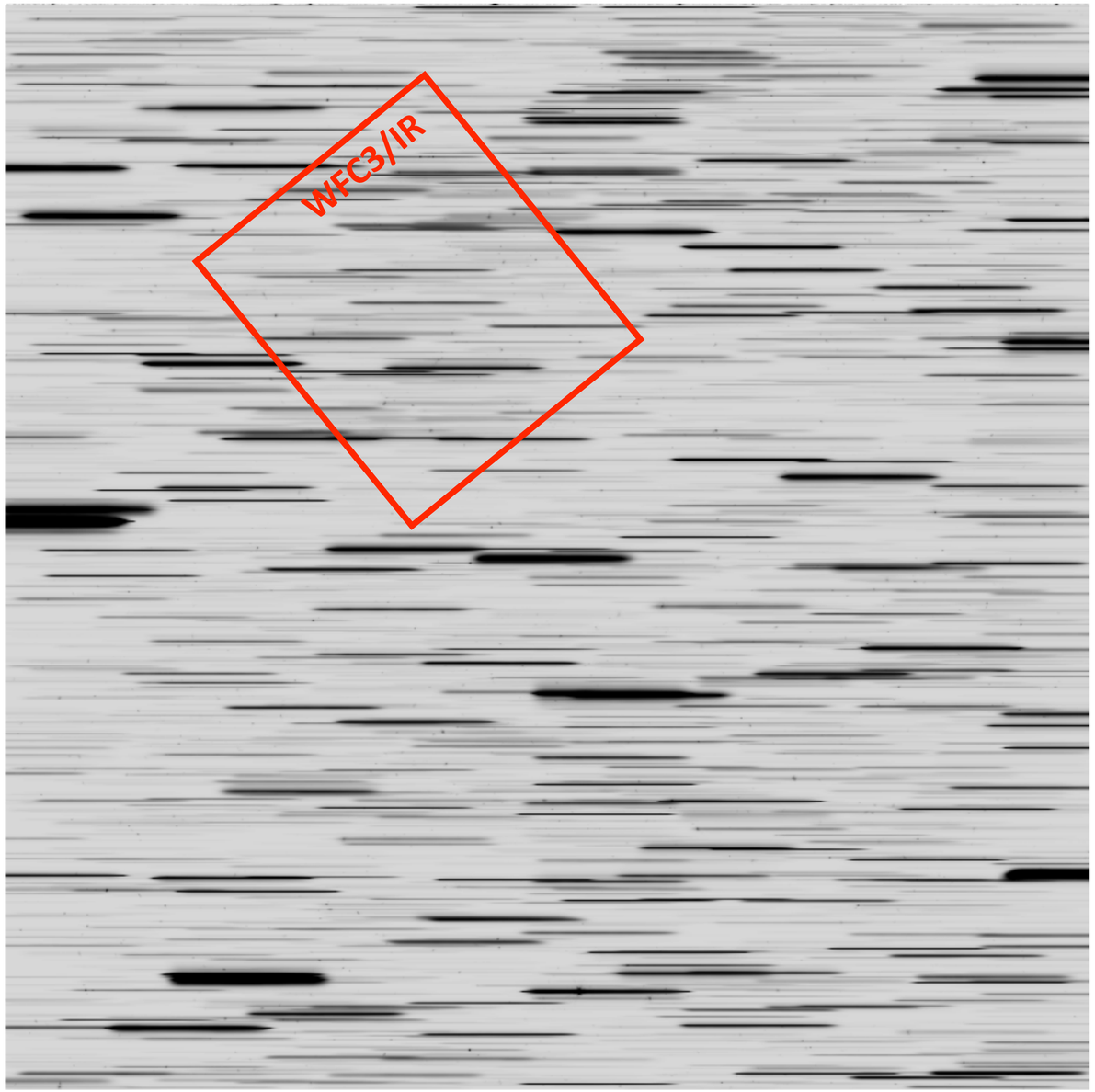
Single 4k WFIRST detector

Dispersed by the HLS grism



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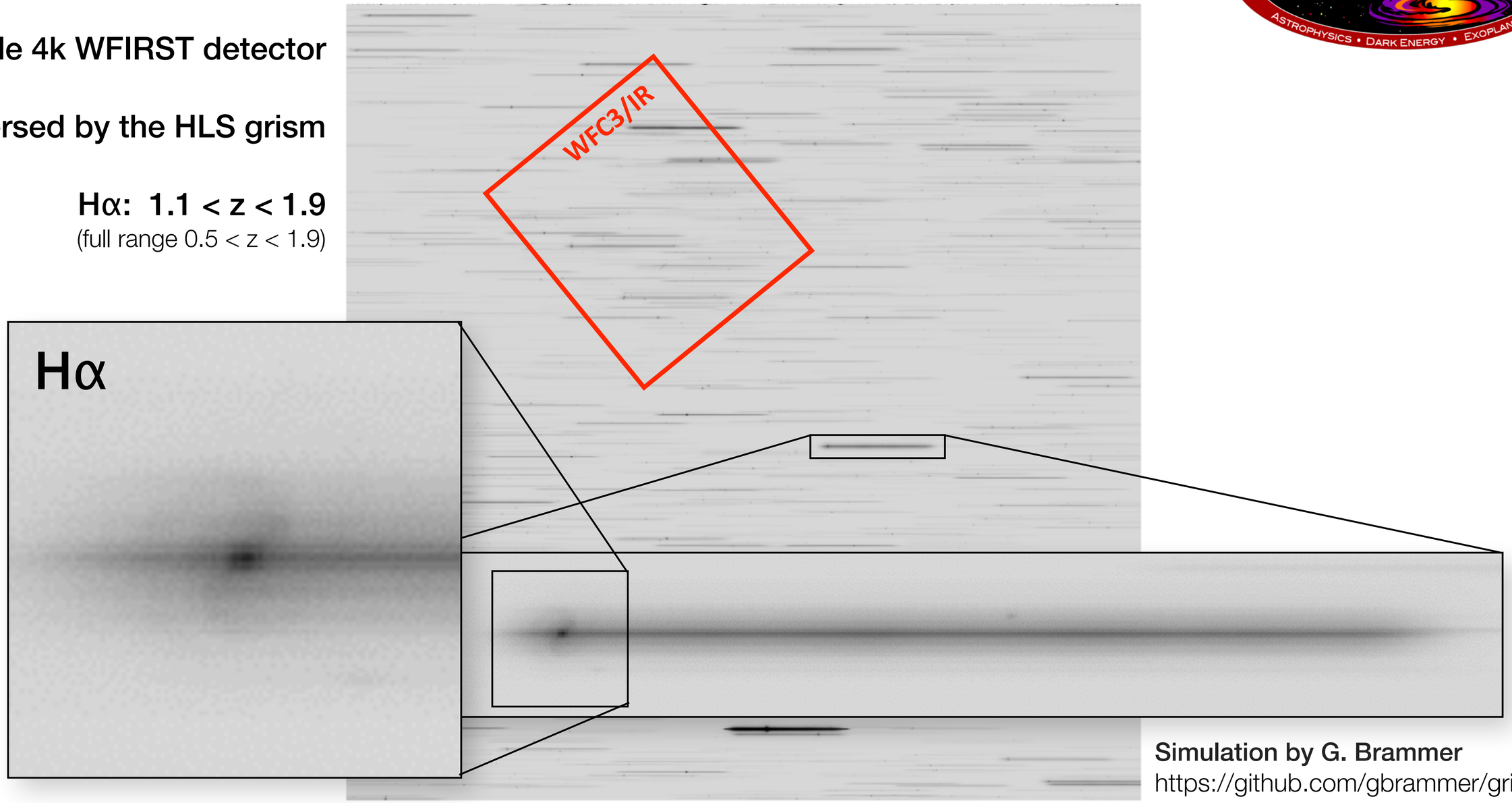
WFIRST Simulations: what can we expect?

Single 4k WFIRST detector

Dispersed by the HLS grism

Hα: 1.1 < z < 1.9
(full range 0.5 < z < 1.9)



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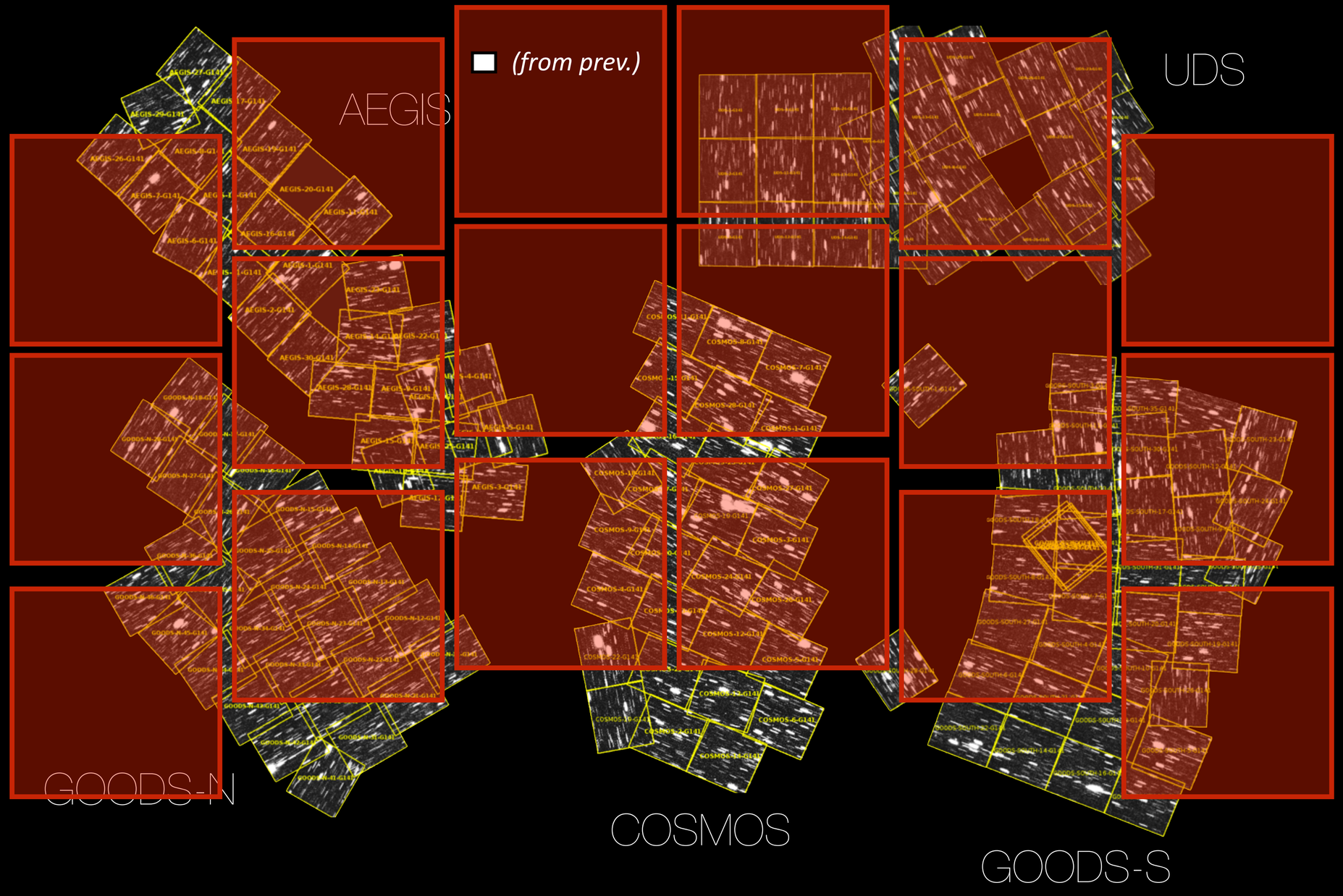
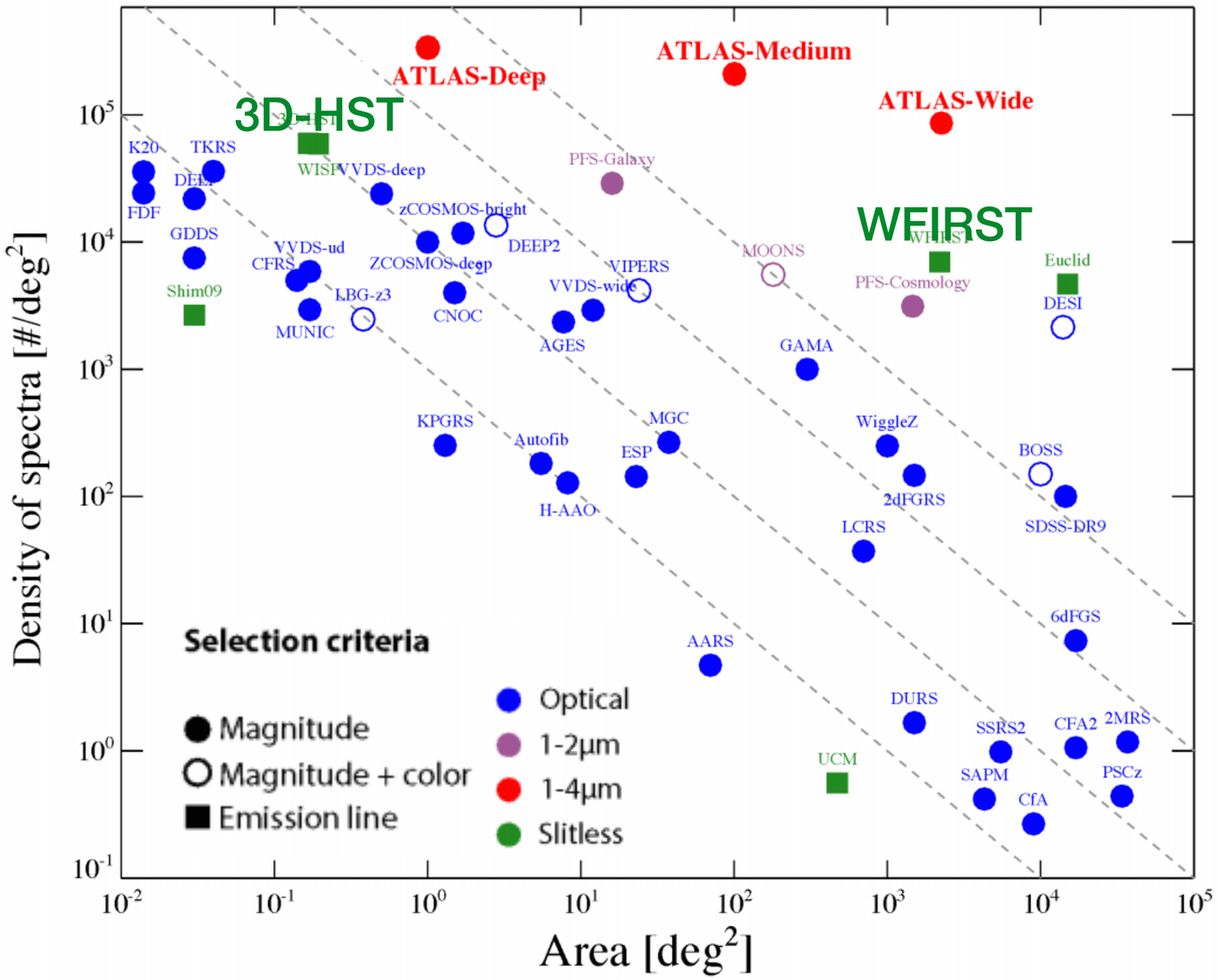
WFIRST/HLS: 0.28 deg^2 / pointing, 2000 deg^2 total



Space-Based Spectroscopic Surveys push to uncharted parameter space

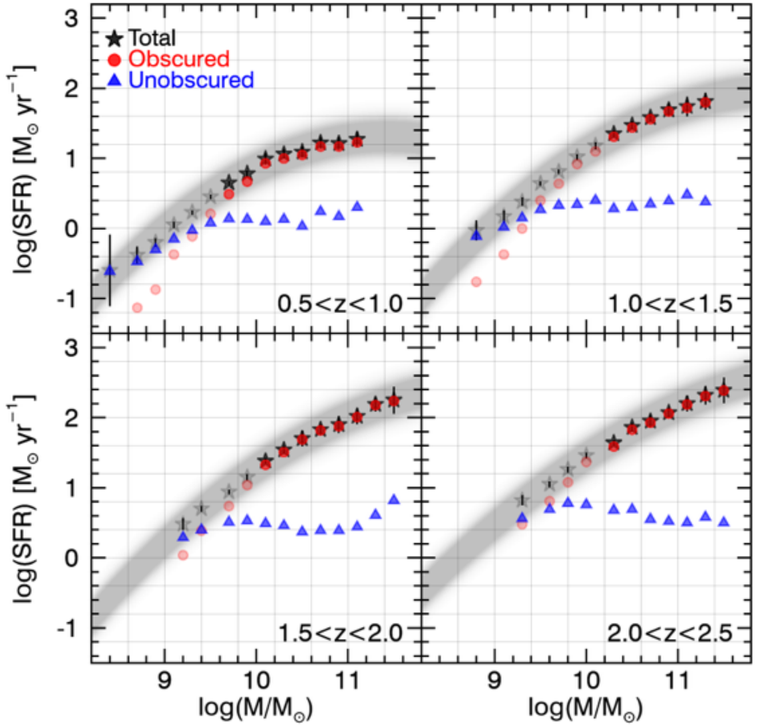


Wang et al. 2018

Line Morphologies provide spatially resolved information on ~1kpc scales

WFIRST 2025	ATLAS 2030	CETUS 2030
• **2000 deg^2**	• **100/2000 deg^2**	• **100/2000 deg^2**
• **2.4m** telescope (≈HST)	• **1.5m** telescope	• **1.5m** telescope
• 1.0 – 1.9 μm	• 1.0 – 4.0 μm	• 0.18 – 0.35 μm; 0.3-0.5”
• **R ~ 400-800** (resolves Hα, [NII])	• **R = 1000**	• **R = 1000/20,000/40,000**

obscured & unobscured star formation



Whitaker et al. 2017b

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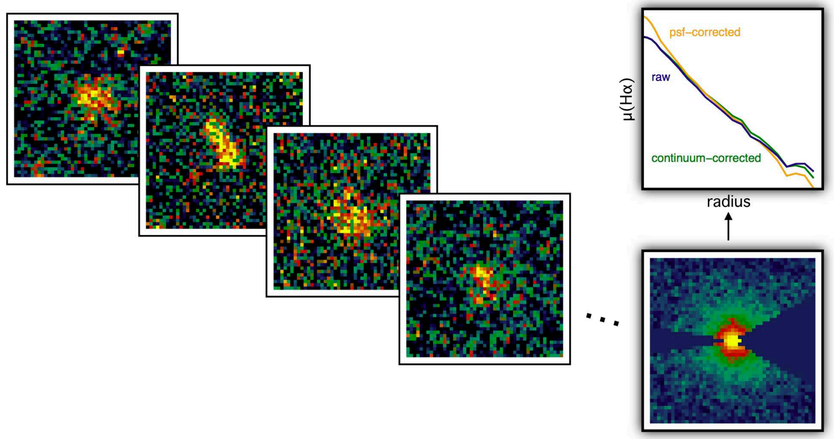
Offers amazing number statistics!

Hα Maps



N_{3DHST}~2700 galaxies total

$N_{2000\ deg^2}$ > **20 million** galaxies total

(plus ATLAS extends out to z~5)

Nelson et al. 2016

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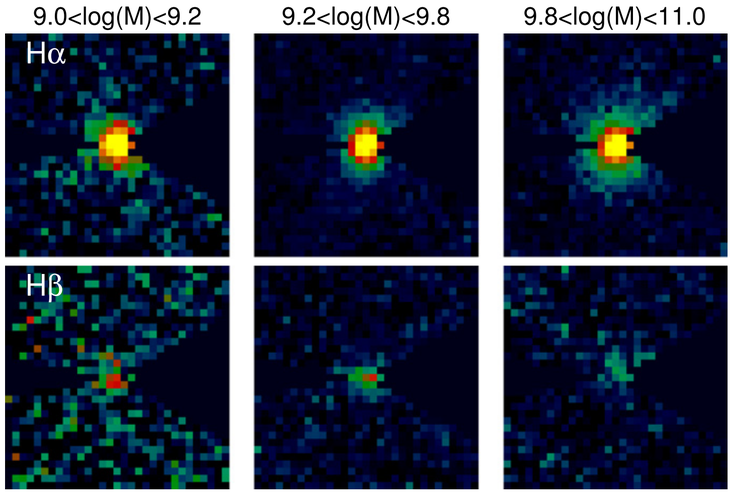
ATLAS 2030
- **100/2000 deg^2**
- **1.5m** telescope
- 1.0 – 4.0 μm
- **R = 1000**

Offers amazing number statistics!

Hα and Hβ Maps



N_{3DHST}~600 galaxies total

$N_{2000\ deg^2}$ > **5 million** galaxies total

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Nelson et al. 2016

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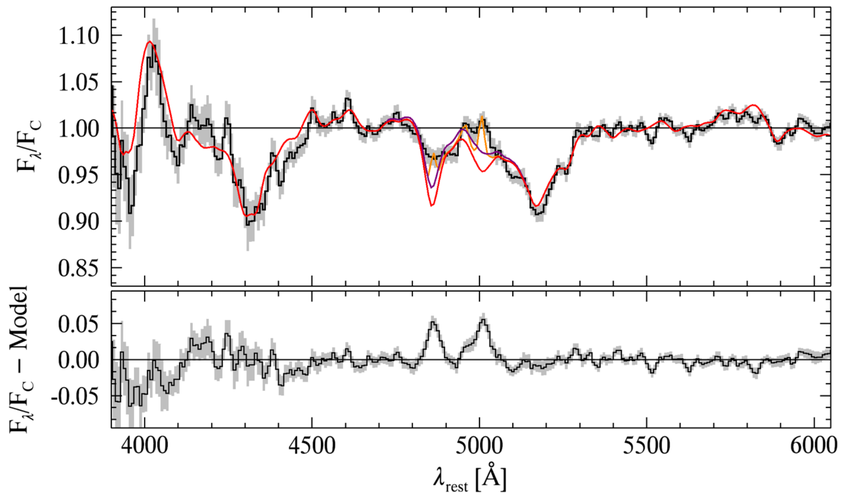

N_{3DHST}~200 quiescent galaxies

$N_{2000\ deg^2}$~**1.6 million** quiescent galaxies

Whitaker et al. 2013

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Wide area + unbiased sample + spectral information = perfect probe of ENVIRONMENT!

- What role does environment play in star formation efficiency?
- Does dust attenuation depend on environment?
- Do galaxies quench earlier in denser environments?
- What role do AGN play in quenching?
- …

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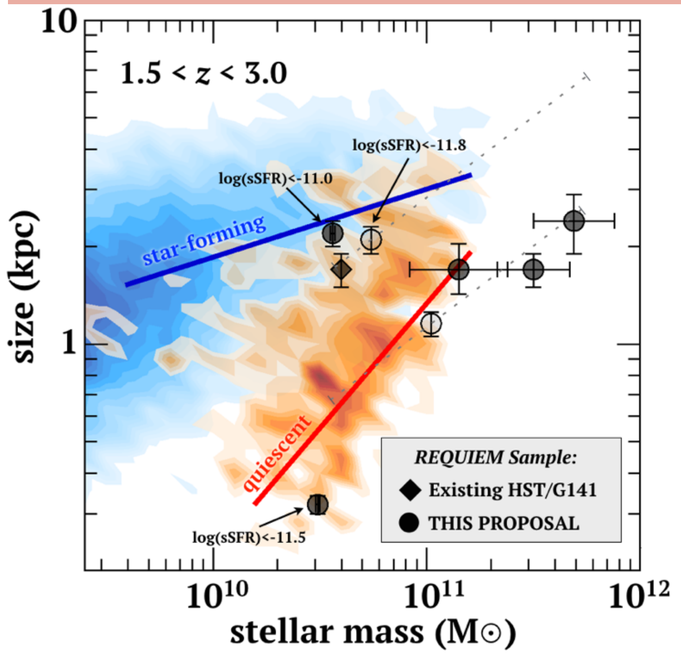

New samples of gravitationally lensed targets!

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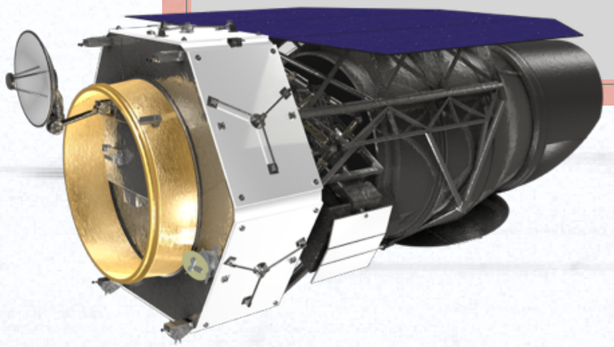
LESSONS FROM 3D-HST

Slitless grism surveys (like 3D-HST) offer a **highly complete spectroscopic resource** for galaxy evolution studies.

Future prospects of transformative studies with **wide area spectroscopy:**

- Measurements of environment
- Spectroscopic measurements of age, dust, metallicity
- Studies of rare galaxy populations



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