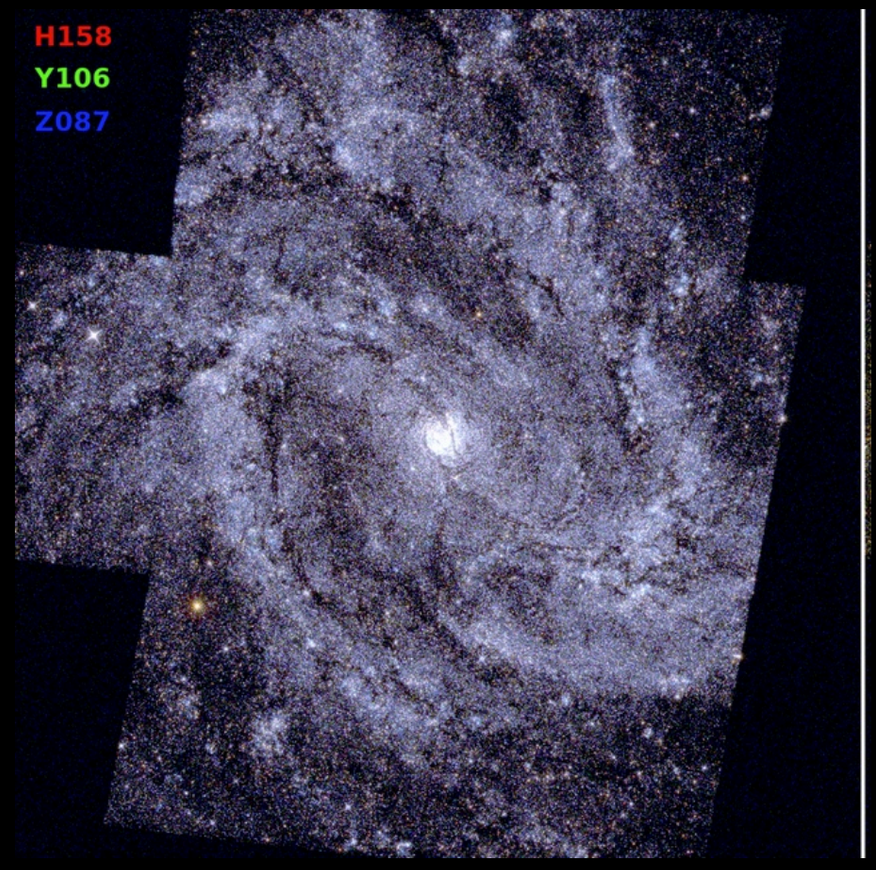
WFIRST Infrared Nearby Galaxy Survey (WINGS)



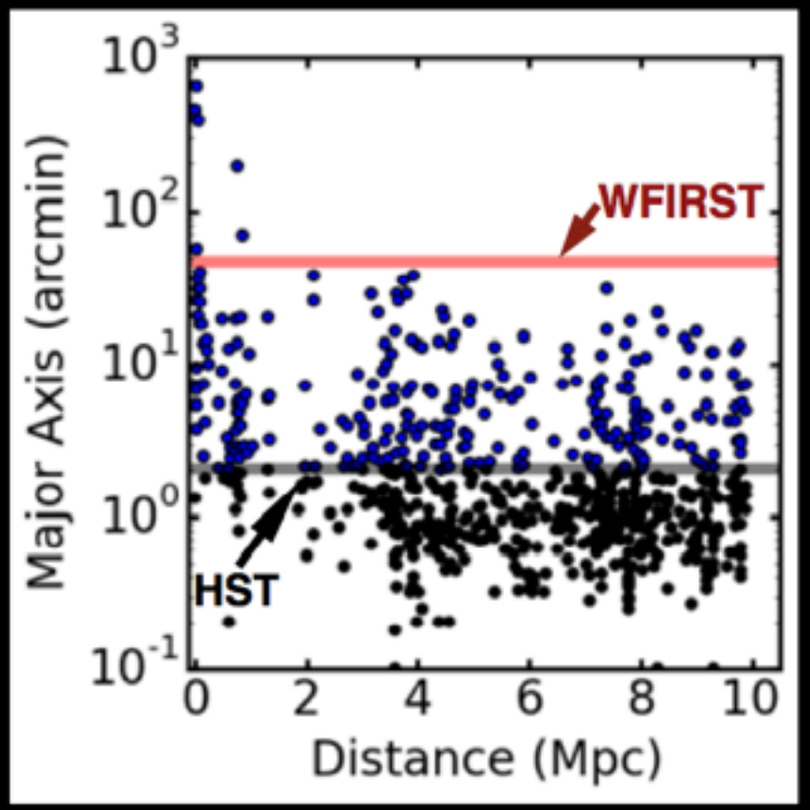
Simulated WFIRST data of M83

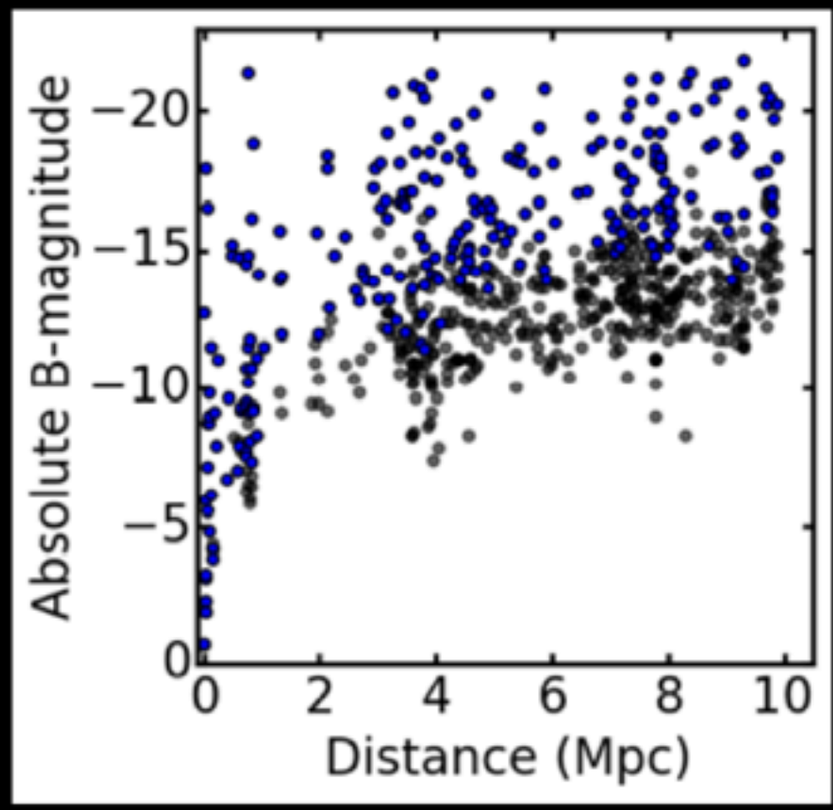
David Sand (Texas Tech)
PI: Ben Williams, Rubab Khan (University of Washington)

Nearby Galaxies Are Great for Astrophysics

- Detailed view and context simultaneously
- Sensitive to galaxy evolution and cosmology
- Anchor our knowledge for interpretation of more distant universe
- Large samples - Subdivide sample for specific goals
- Cover a wide range of galaxy properties

Huge Potential Data Set





$N_{galaxies}$	~500
Distances	<10 Mpc
Metallicities	-2<[Fe/H]<+0.2
Stellar Masses	10^5-10^{11} M_{sun}
Luminosities	-1>M_B>-21
Angular Sizes	0.05°<θ<10°
Point depth	+7>M_{F160W}>-3
Proper Motion	D_{Max}<100 kpc
FoV/Galaxy	1-100
$N_{satellites}$/Galaxy	<100
$N_{streams}$/Galaxy	<100
$N_{clusters}$/Galaxy	<500
# Resolved Stars	~1,000,000,000

Projects and Lead Co-Is

PI: Williams (U. Wash.) Deputy PI: Dalcanton (U. Wash.)

Photometry	Dolphin (Raytheon)
Stellar Halos	Bell (Mich.), Johnston (Columbia), Bullock (Irvine)
Dwarf Satellites	Sand (TTU), Bullock (Irvine)
Small Scale Dark Matter	Walker (CMU), Johnston (Columbia)
Globular Clusters	Seth (Utah)
Star Formation Histories	Weisz (Berkeley)
Dust & ISM	Gordon (STScI), Dalcanton (UW)
Stellar Evolution	Boyer (Maryland)

Team Postdoc: Rubab Khan

Collaborators

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Laura Sales (UCR)
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Julia Roman-Duval (STScI)
Alberto Bolatto (Maryland)
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Jay Anderson (STScI)
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Beth Willman (LSST)
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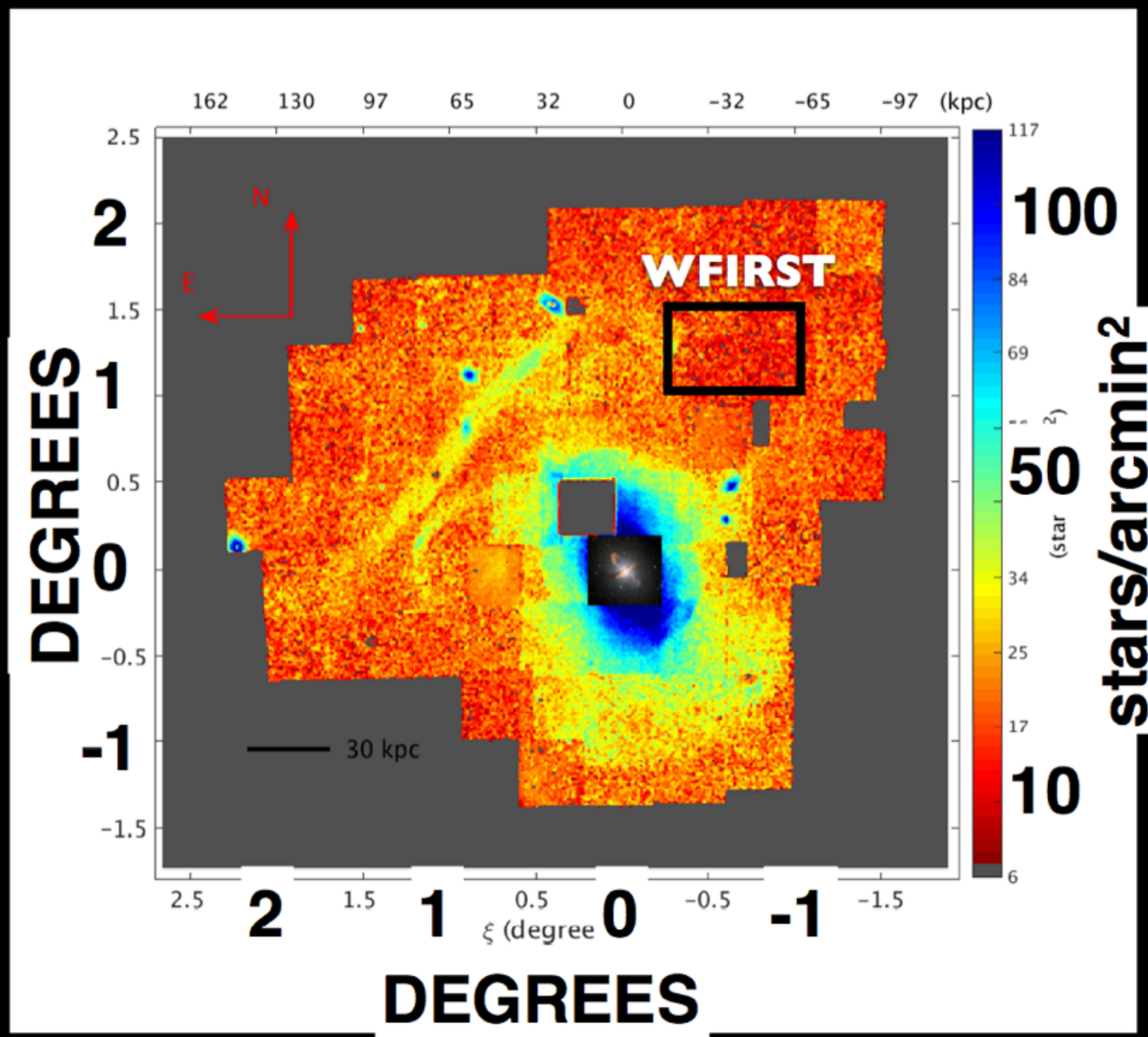
Margaret Meixner (STScI)
Leo Girardi (Padova)
Nicolas Martin (MPIA)
Cliff Johnson (UCSD)
Jay Strader (MSU)
Robyn Sanderson (Columbia)
Adrian Price-Whelan (Columbia)
Sergey Koposov (Cambridge)
Julio Chaname (Catolica)
Jorge Penarrubia (Edinburgh)
Coral Rose Wheeler (UCI)

Some high-level goals

- Develop a photometric pipeline for measuring crowded-field point source photometry and astrometry from WFIRST data (e.g. DOLPHOT for HST).
- Simulate realistic galaxies, halos, and satellite systems -- will allow us to maximize WFIRST's contributions towards constraining dark matter and galaxy formation using observations of the Local Universe.
- What would a WFIRST nearby galaxy survey look like to achieve the most possible science?
- How do WFIRST requirements (e.g. filters, photometric uniformity/stability, etc) flow down to the science results we can achieve in the Local Universe?

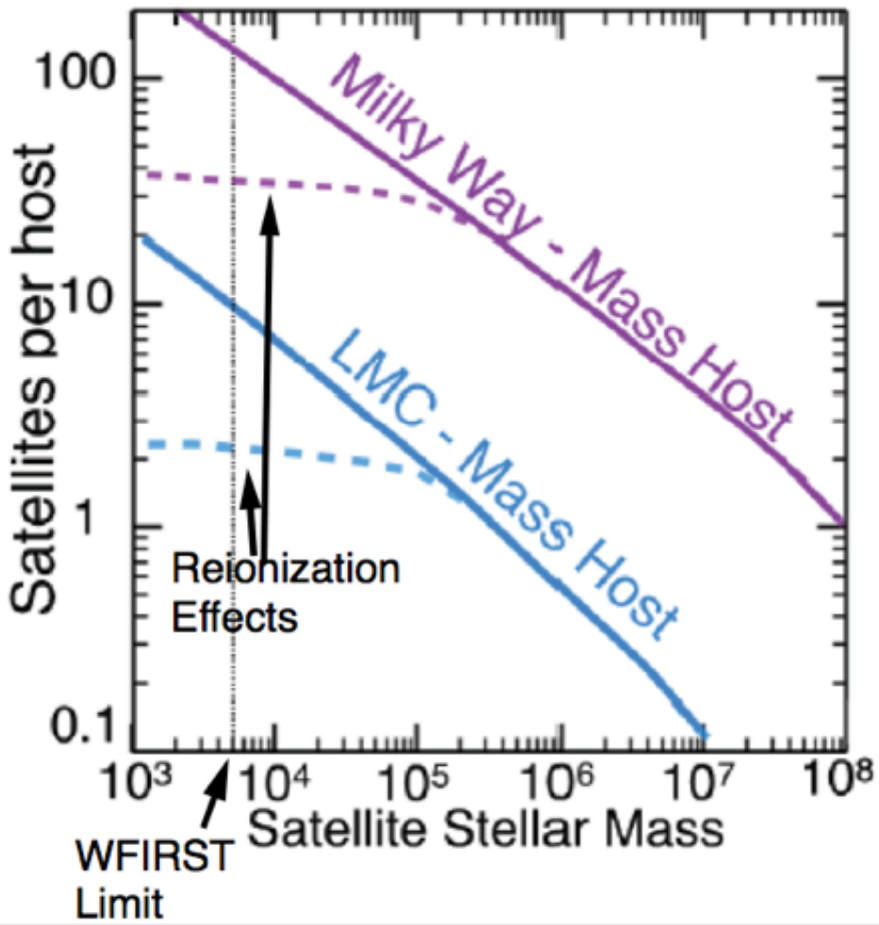
Stellar Halos (Centaurus A)

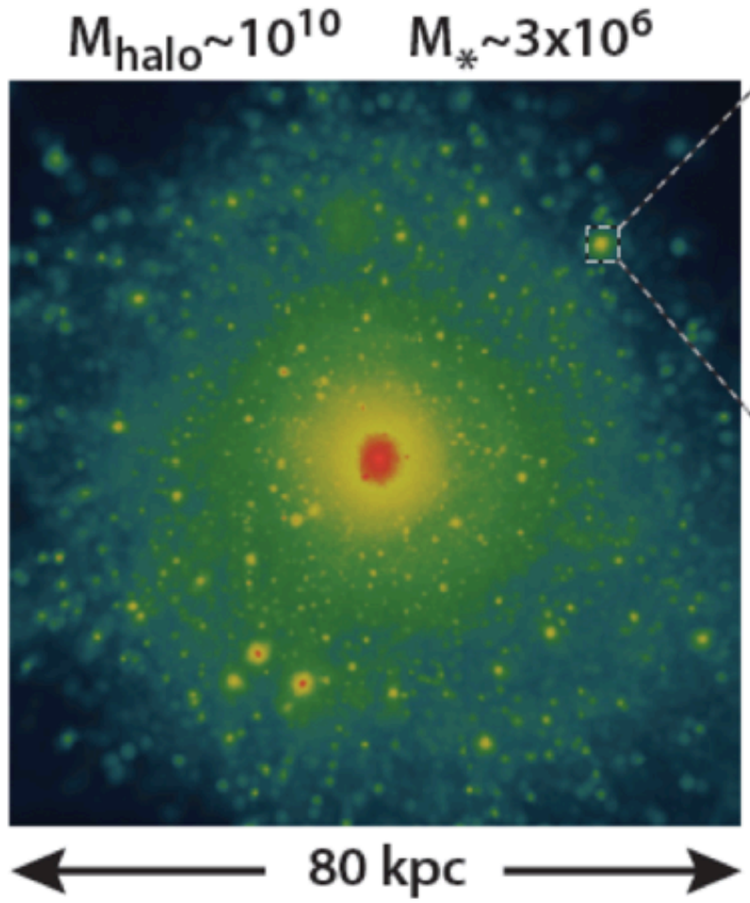


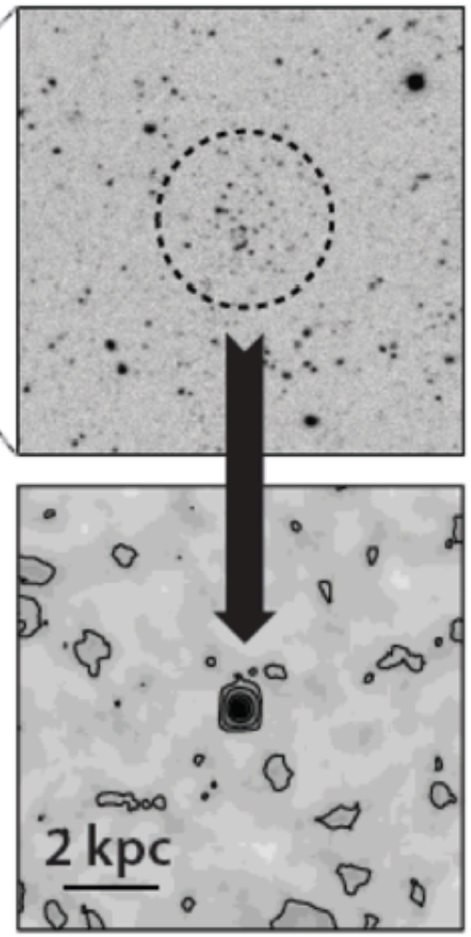
~2 hrs, can find dwarfs with $M_* \sim 5 \times 10^3 M_{sun}$ ($M_V \sim -4$) at ~3.5 Mpc. Ultrafaint dwarf galaxies.

Crnojevic, Sand et al. 2016

Dwarf Satellites

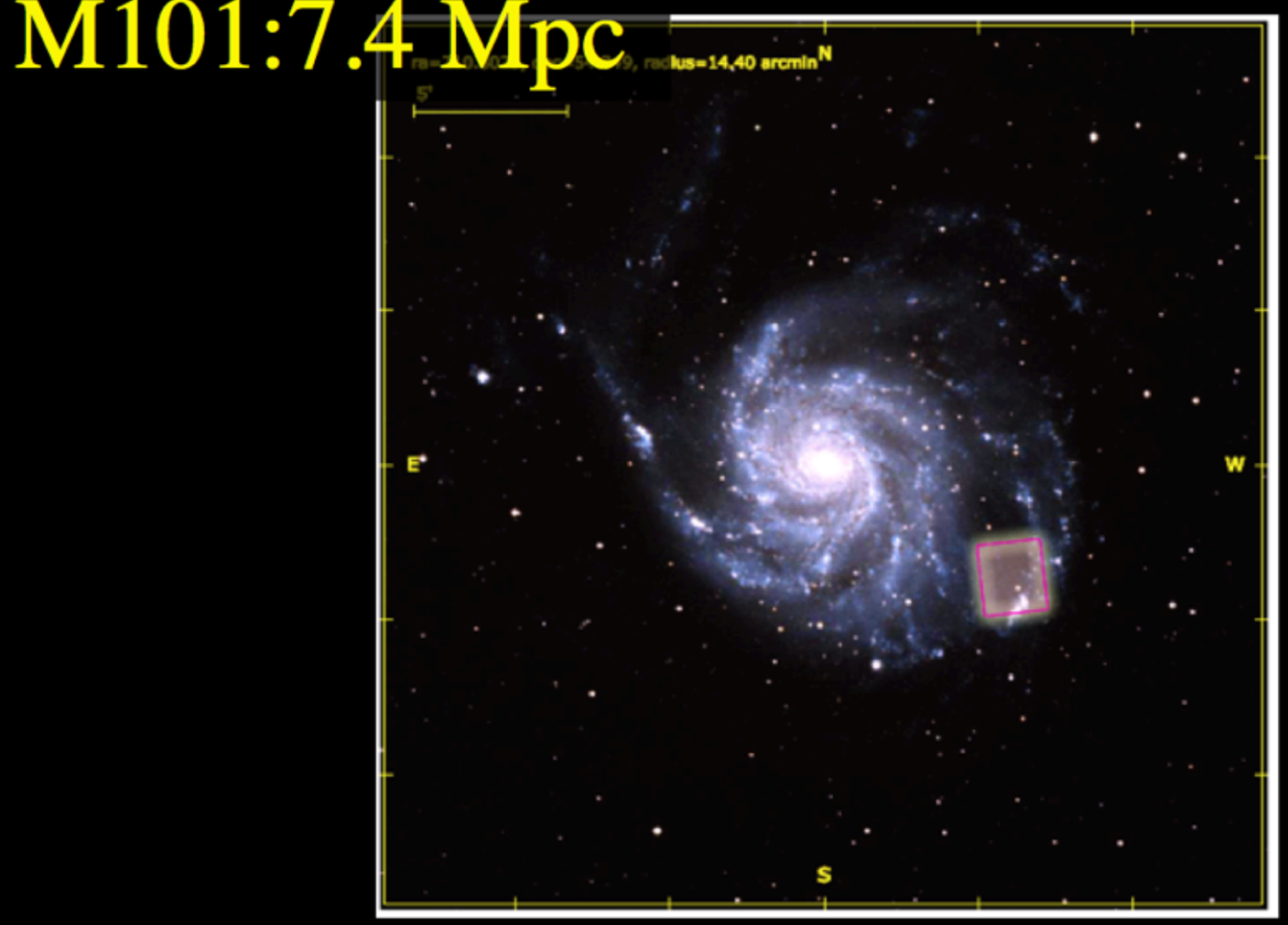




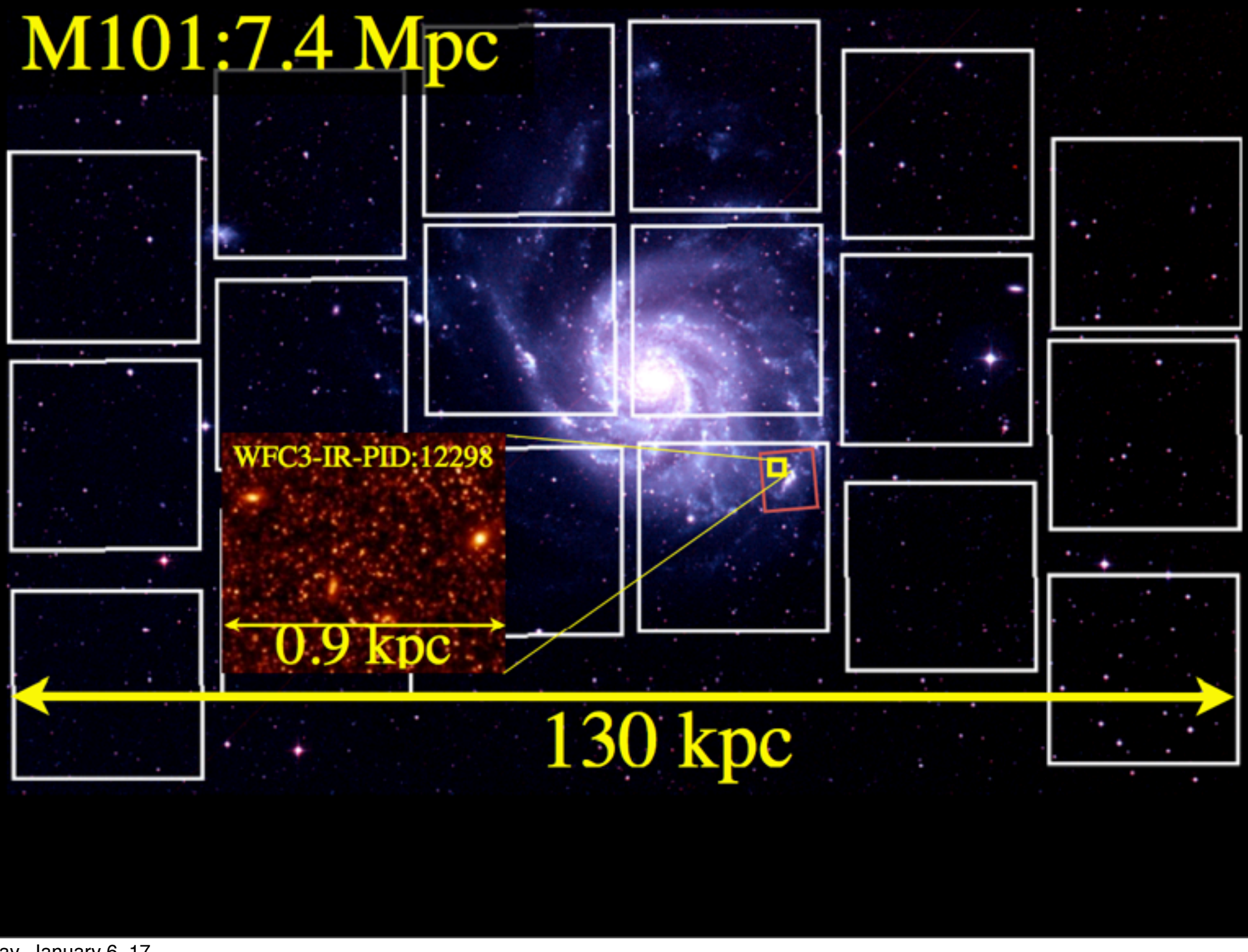


Sales et al. 2013 + updates

For HST, even moderate distance galaxies give sparse coverage



WFIRST gets full coverage



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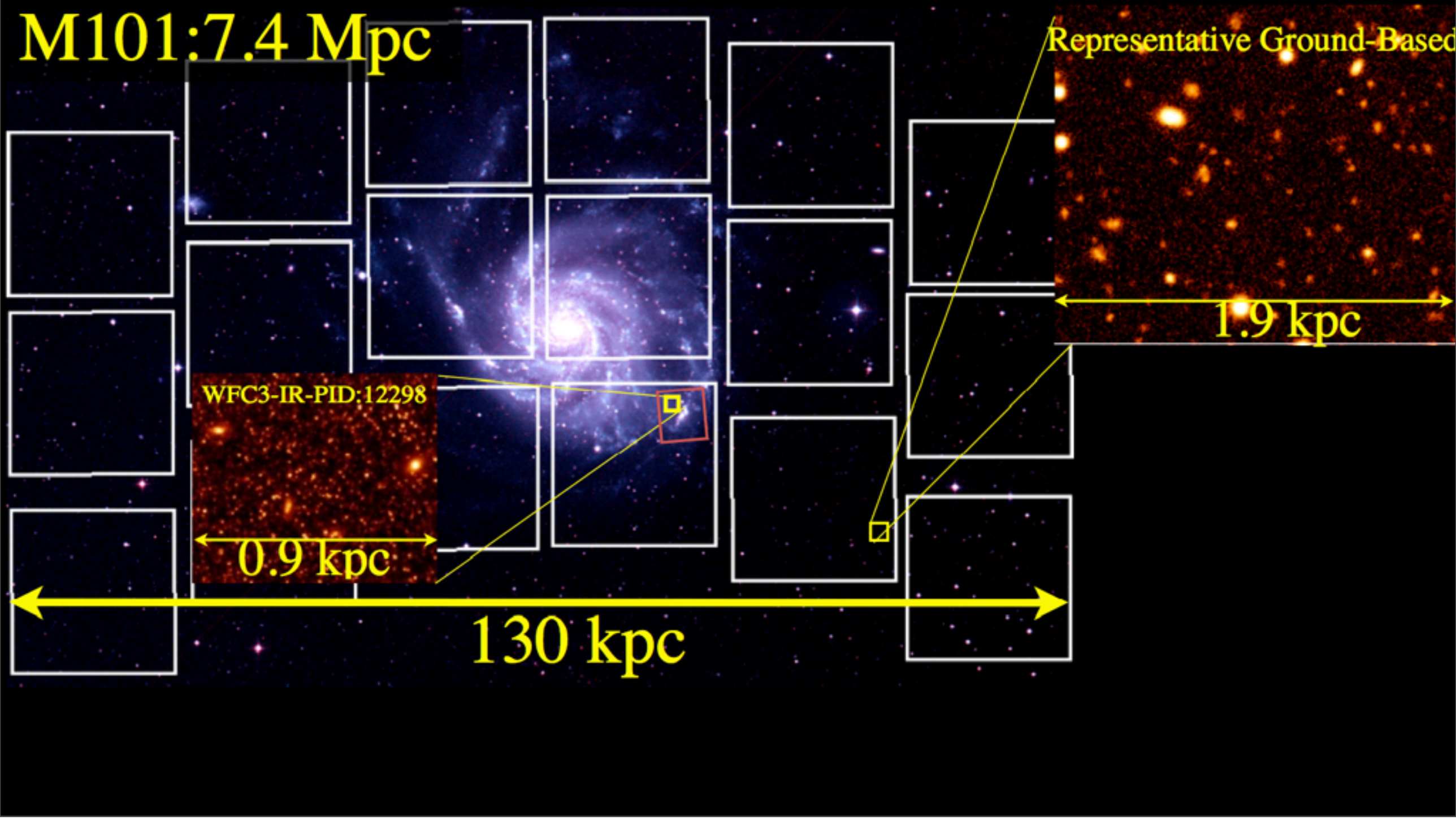

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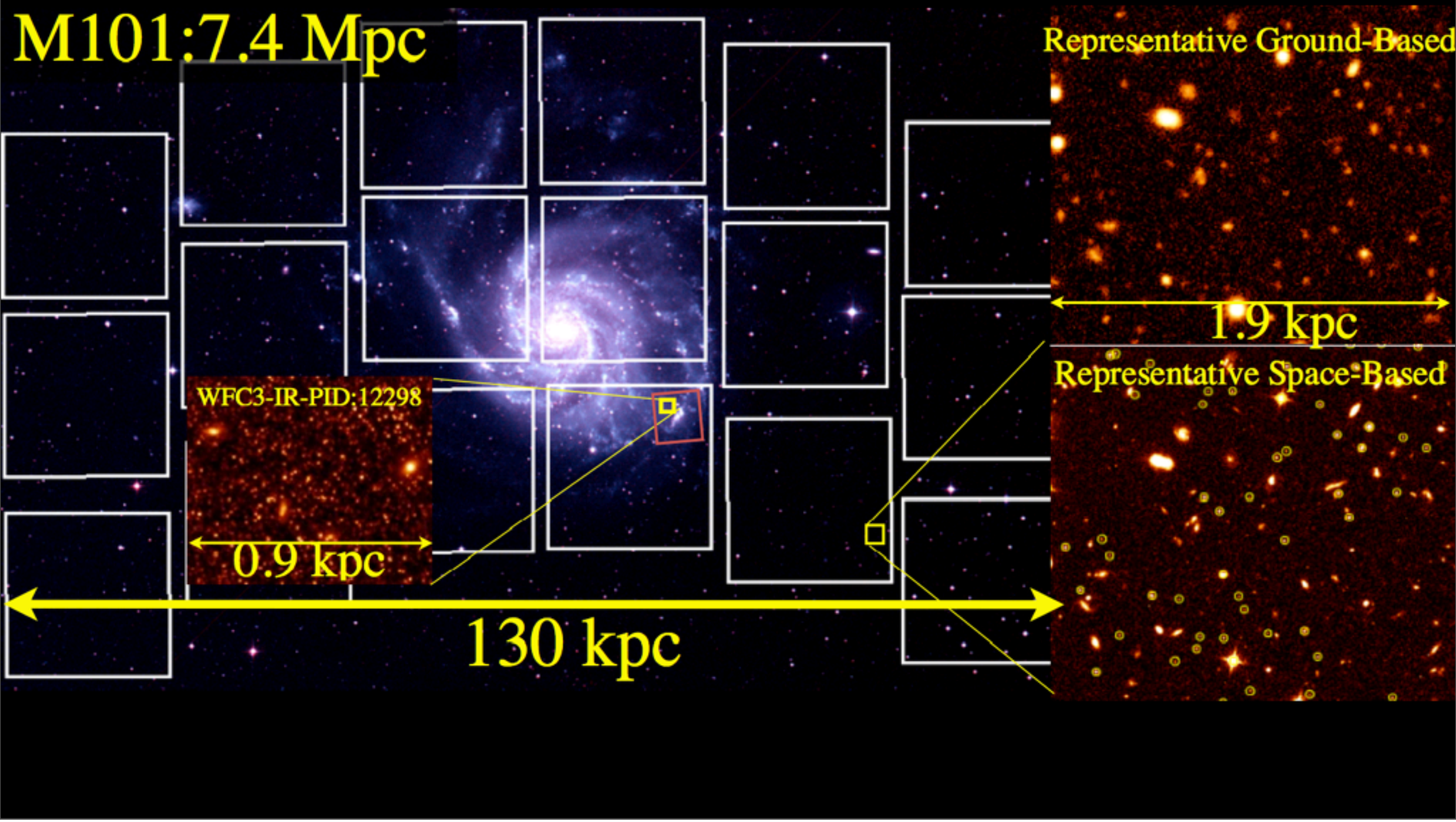
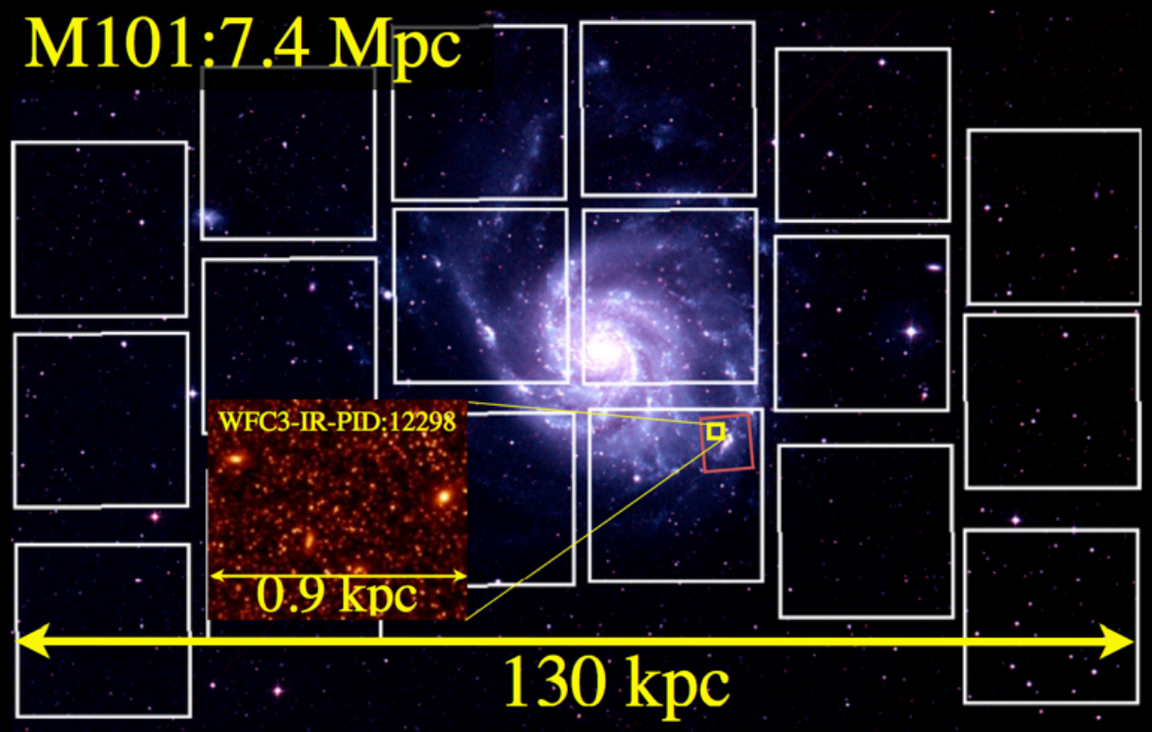
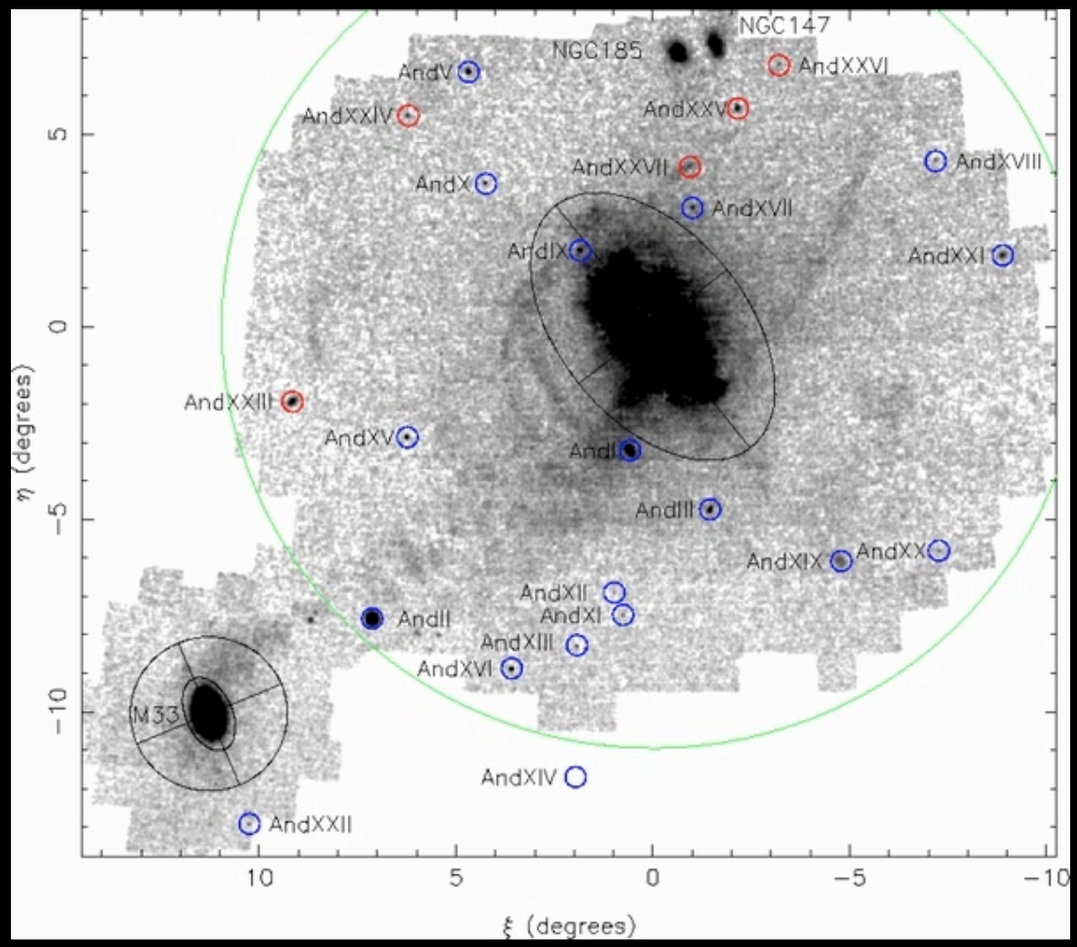


WFIRST gets full coverage

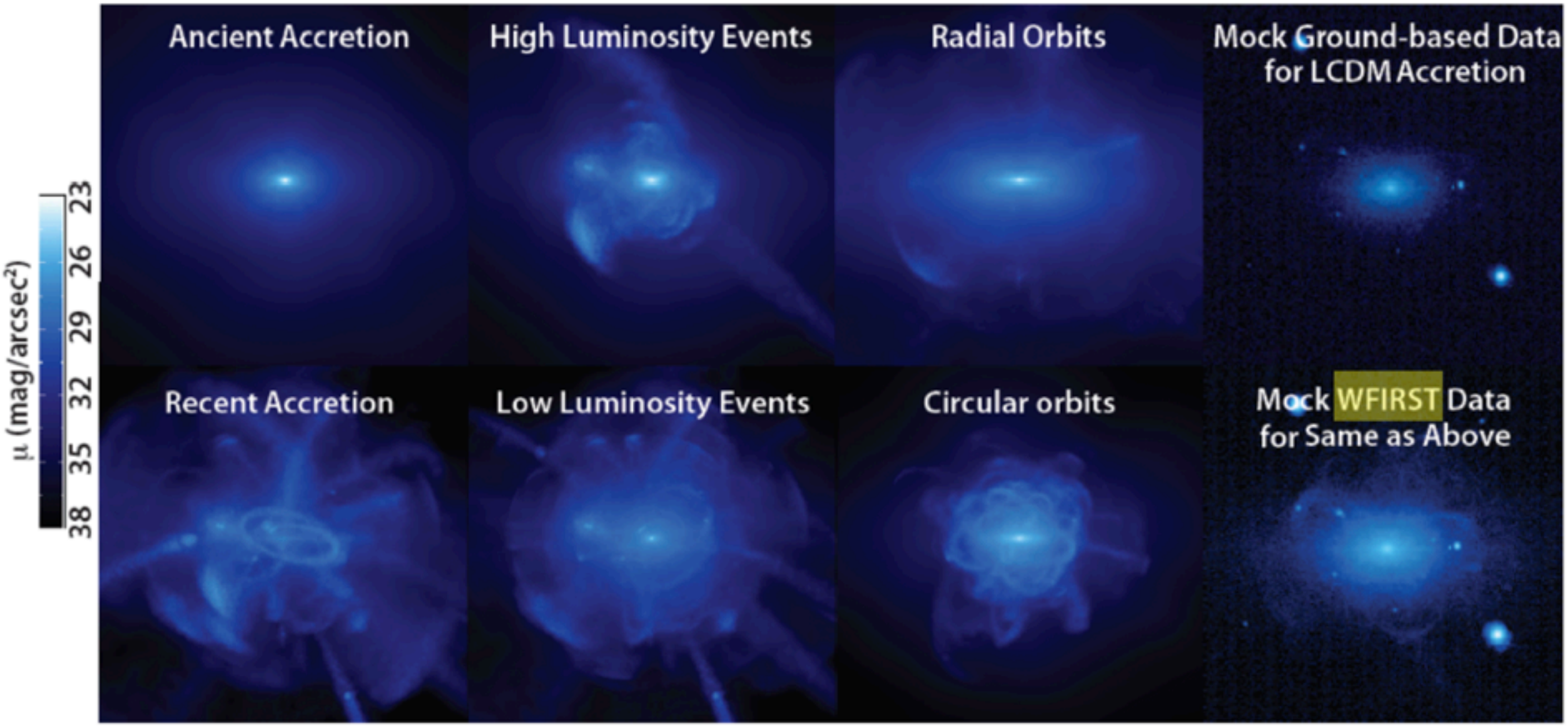


~10 hours with WFIRST at 10 Mpc

PAndAS Survey of M31



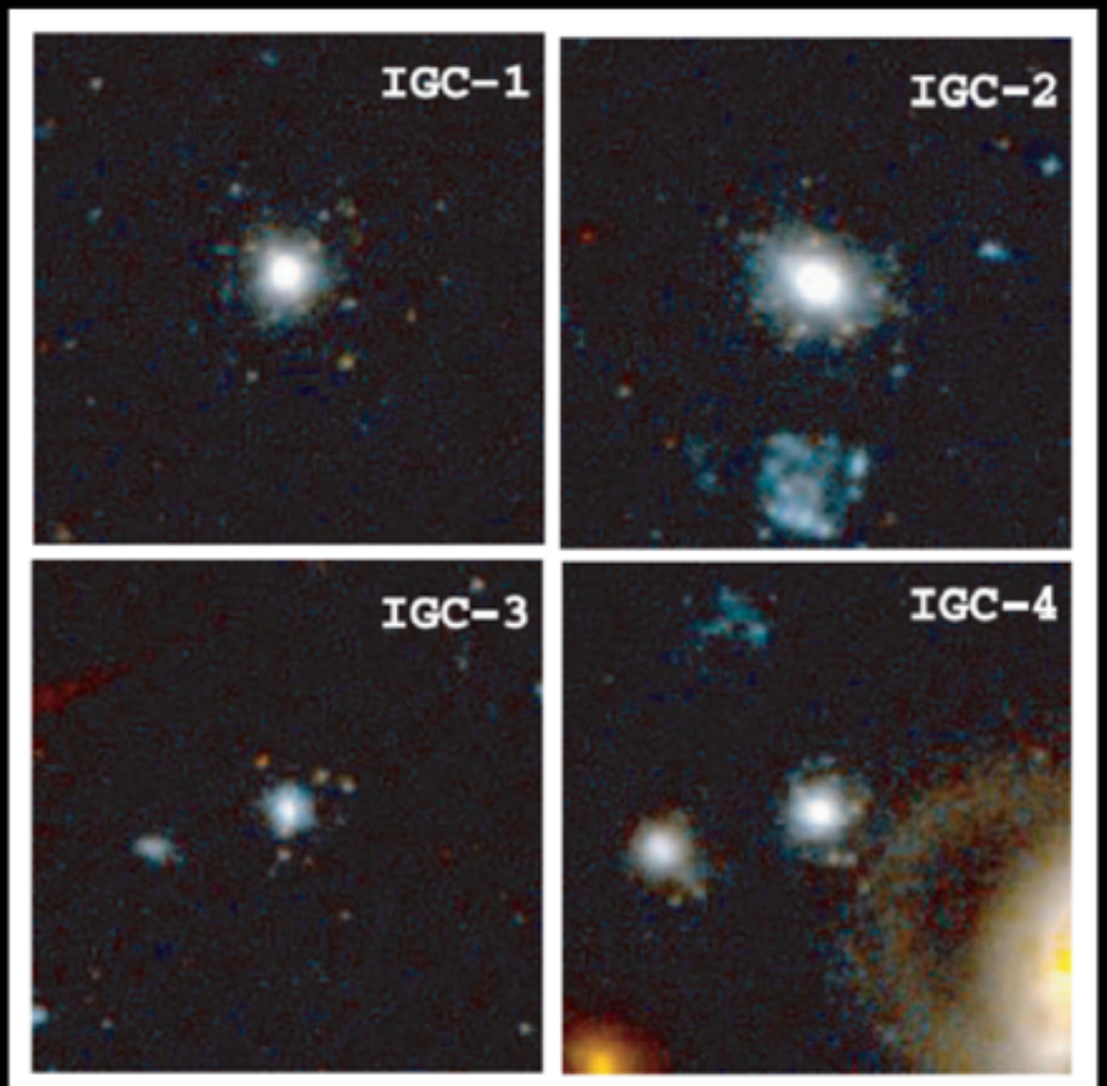
Stellar Halo Structures



Number, luminosity, shape of streams → Types, timing and orbits of galaxies accreted.
Disrupted streams → Small-scale dark matter halos.

Williams: WFIRST Infrared Nearby Galaxy Survey

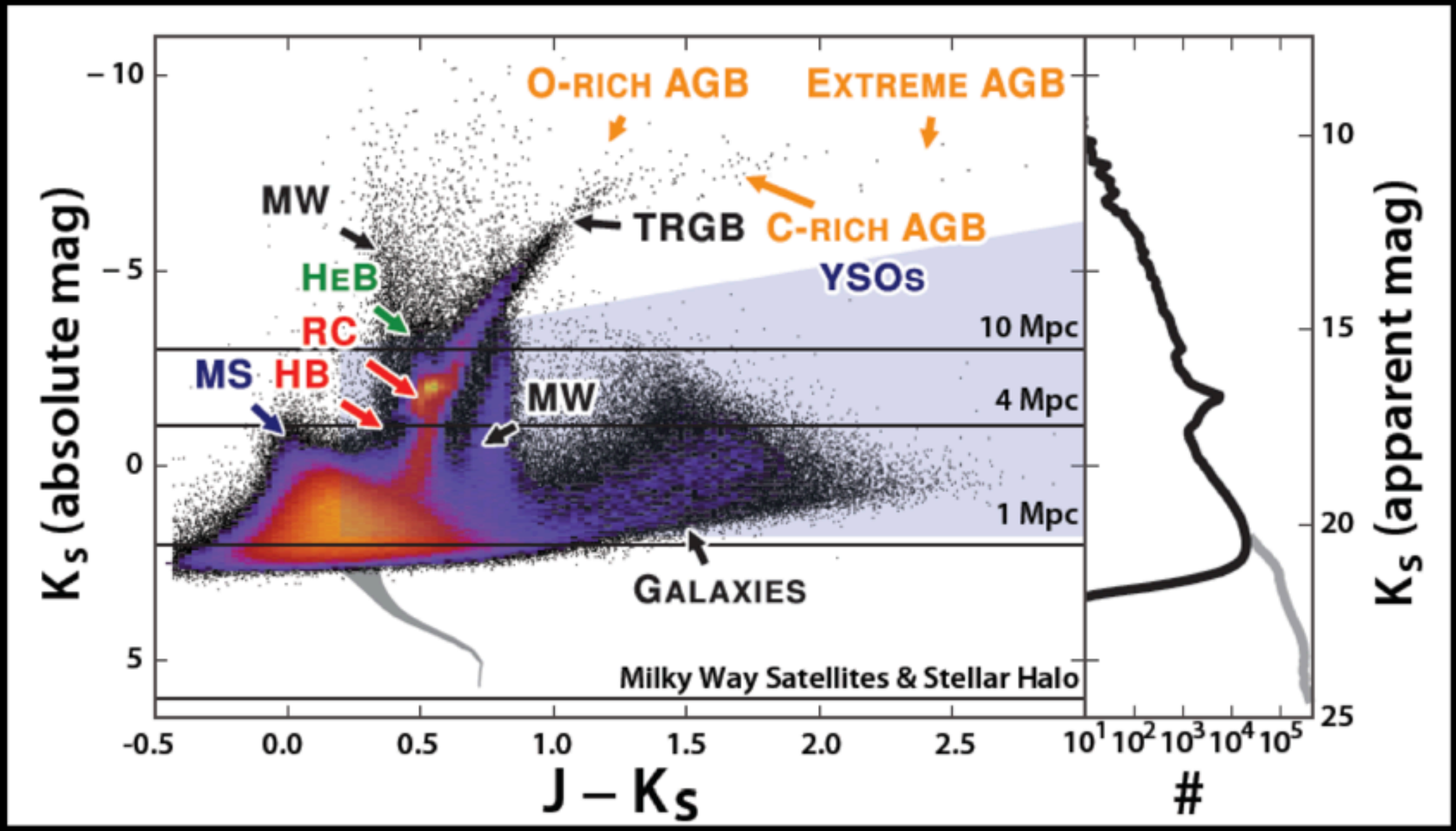
Globular Clusters



Virgo intracluster globulars
(Williams et al. 2007)

- Old: Probe early epochs of galaxy assembly and halo formation
- WFIRST partially resolves >90% of GCs in galaxies <10 Mpc
- Individual RGB stars can give information on metallicity
- Spectroscopy Targets

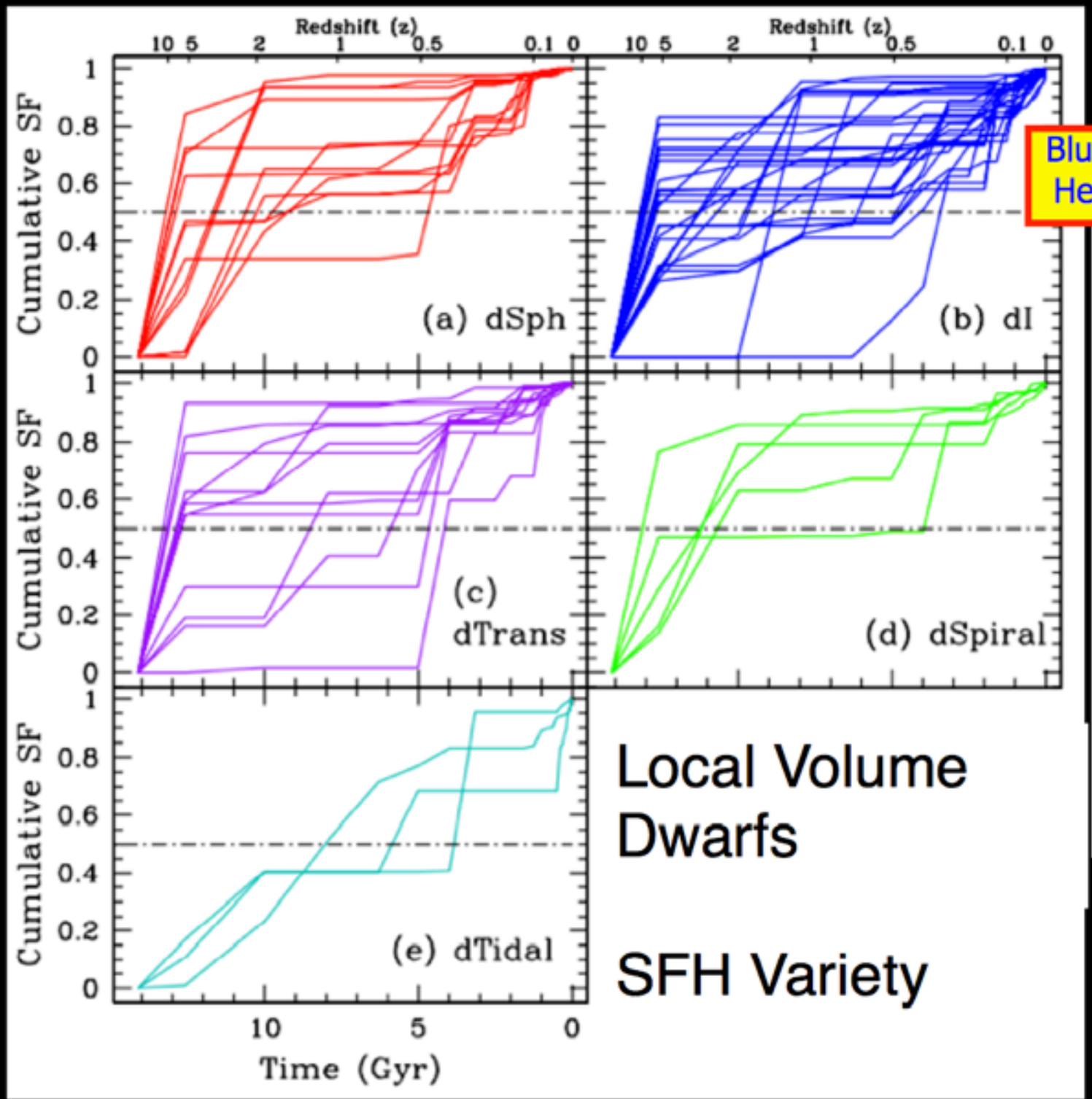
Stellar Populations



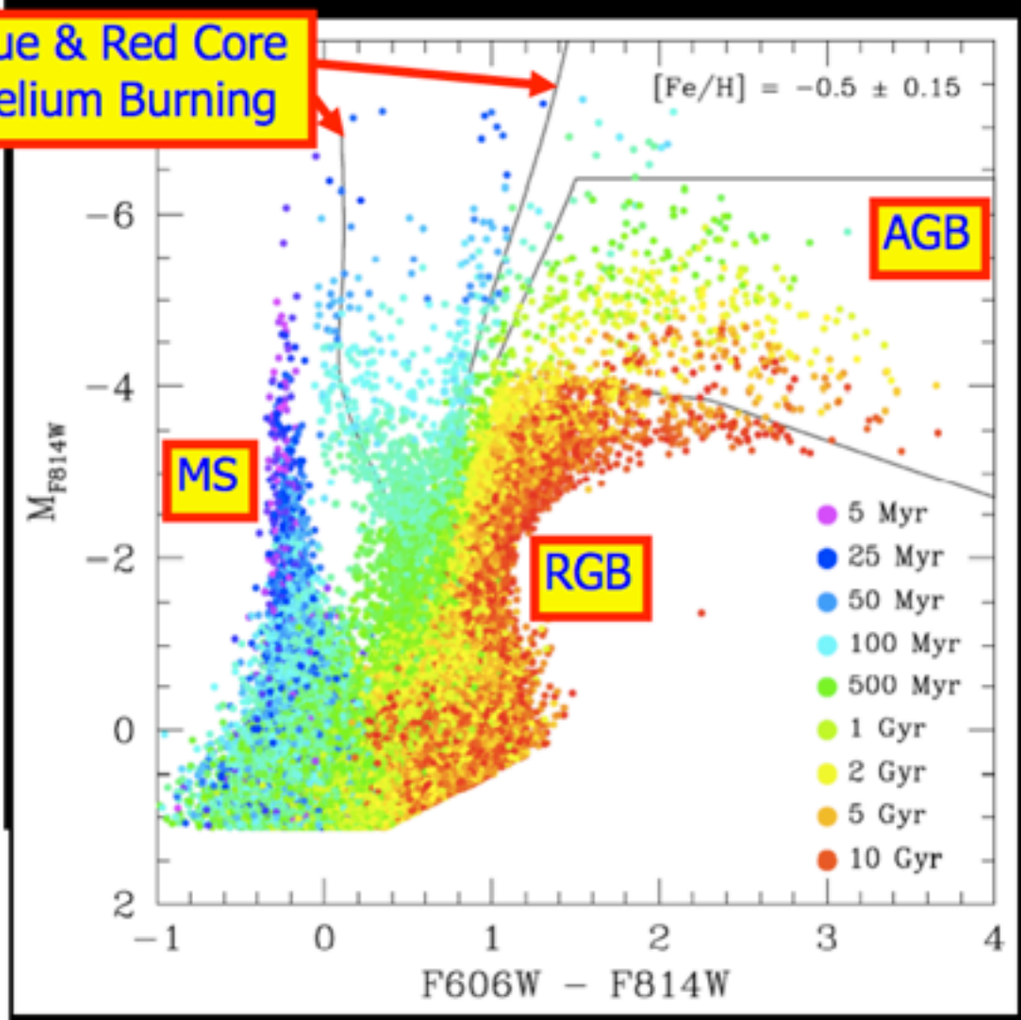
Huge increase in sampling of short-lived, high-luminosity phases

Crowding limited --> Important to simulate

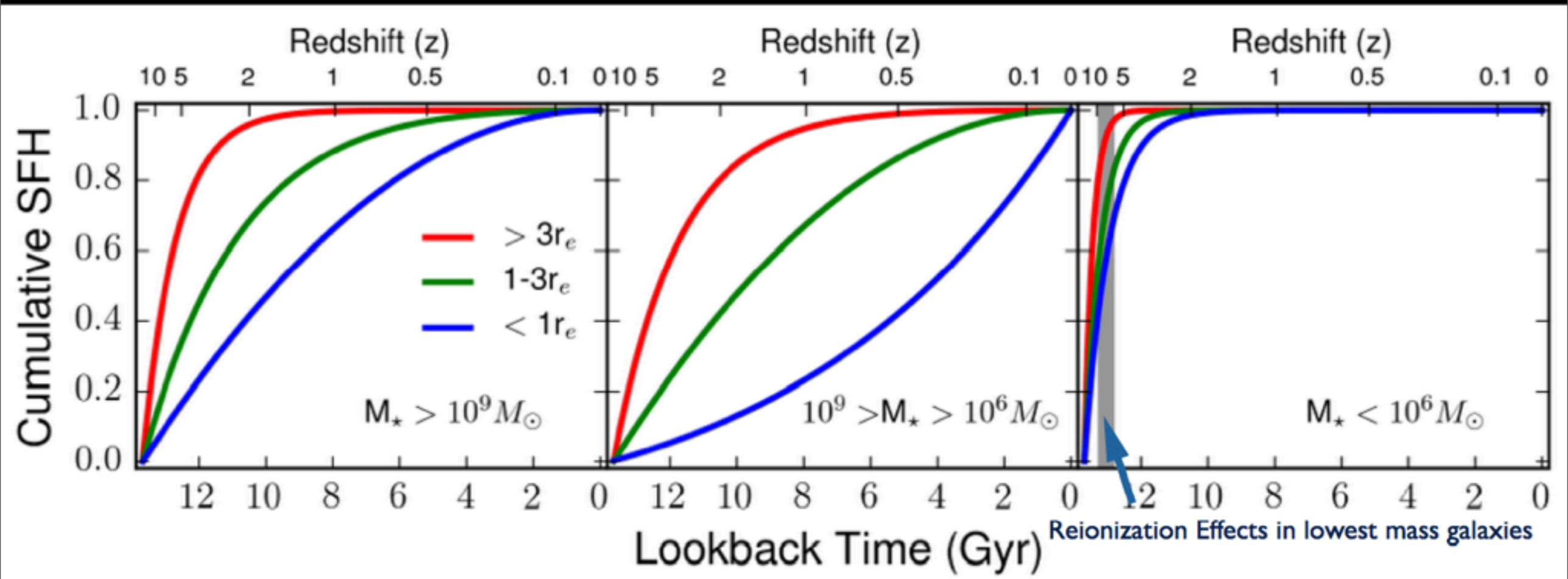
Star Formation Histories



Weisz et al. 2011



Star Formation Histories

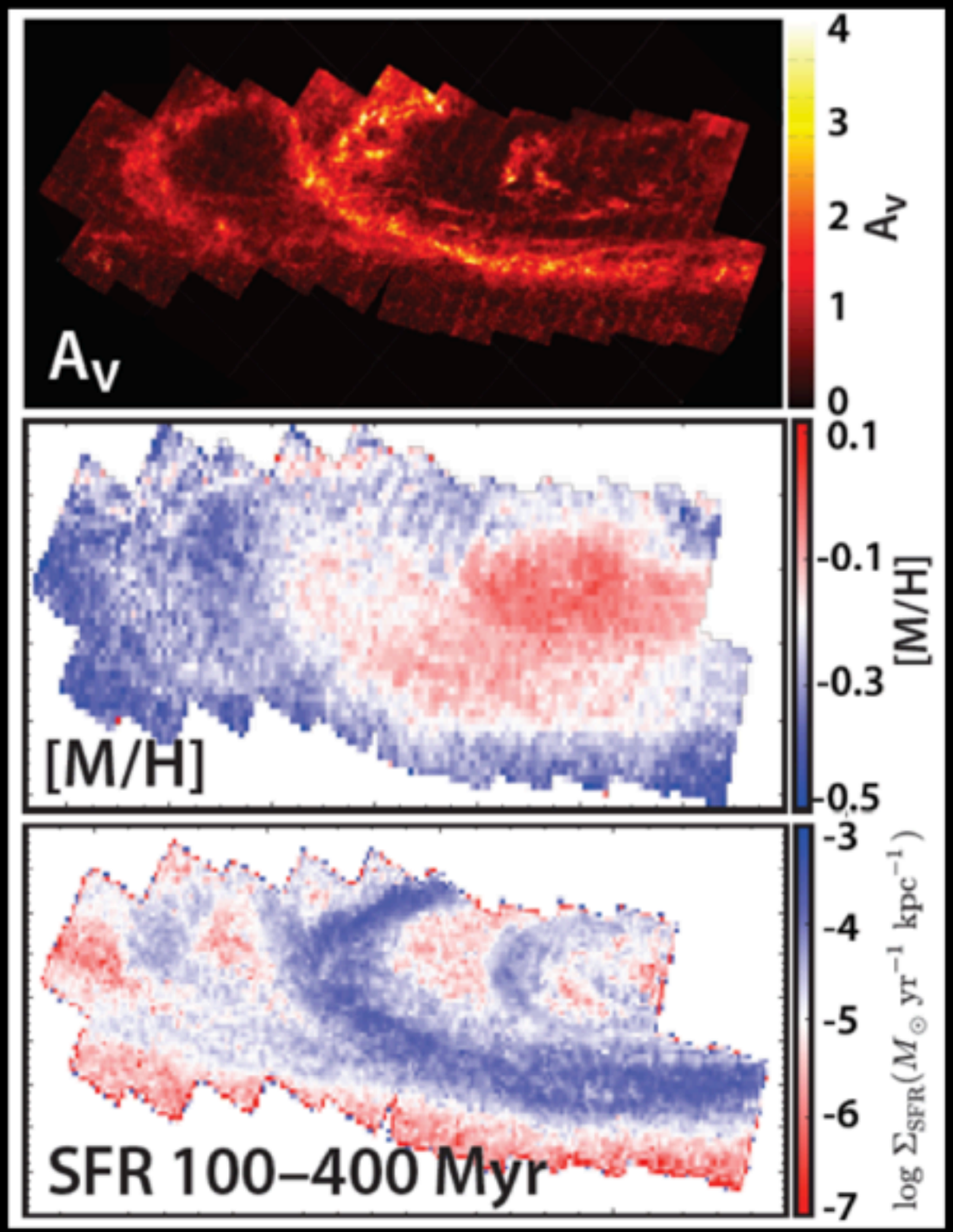


Wide Field Coverage Probes Trends with Radius

Large Sample Probes Trends with Galaxy Mass.

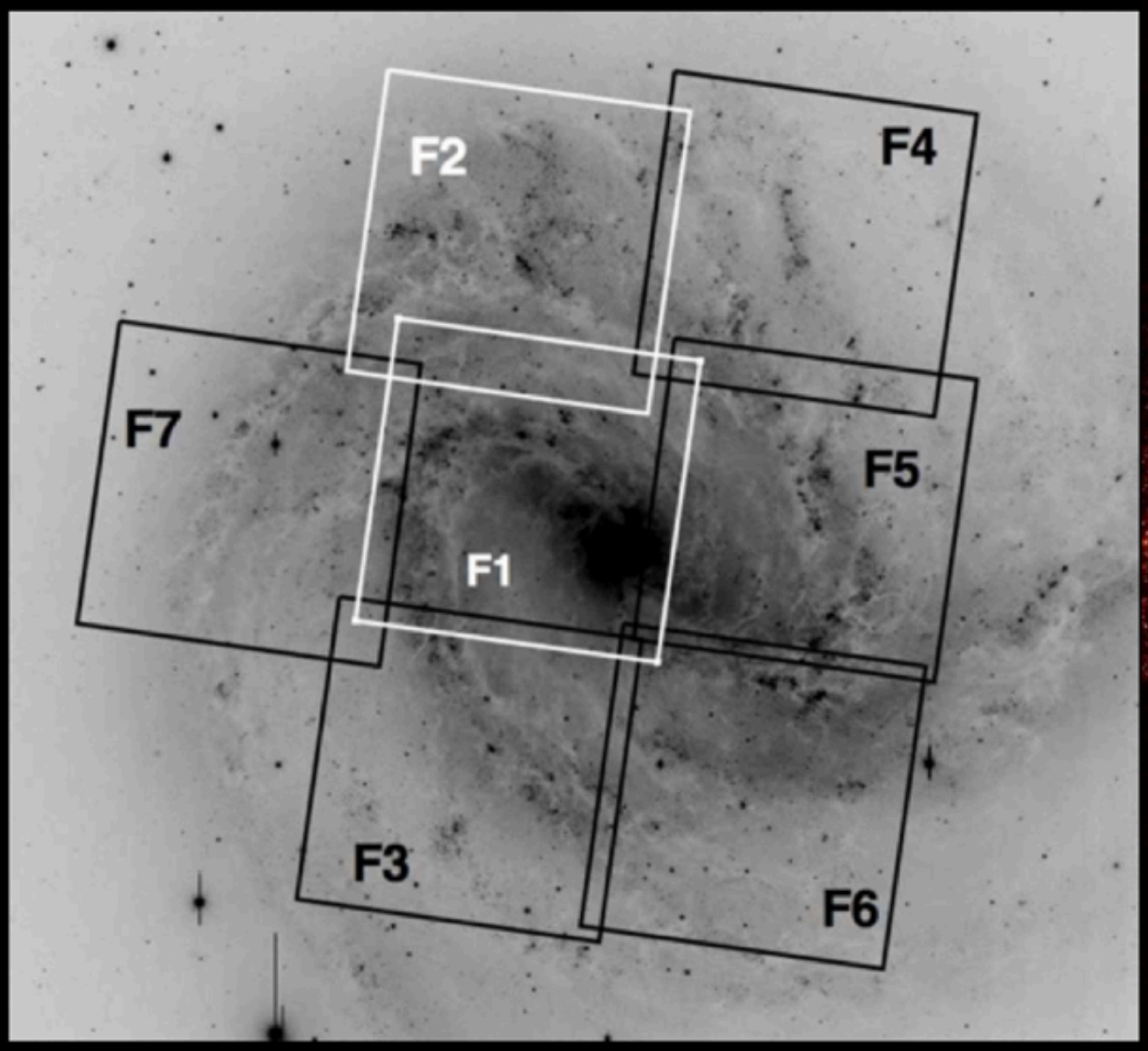
Lowest masses sensitive to reionization.

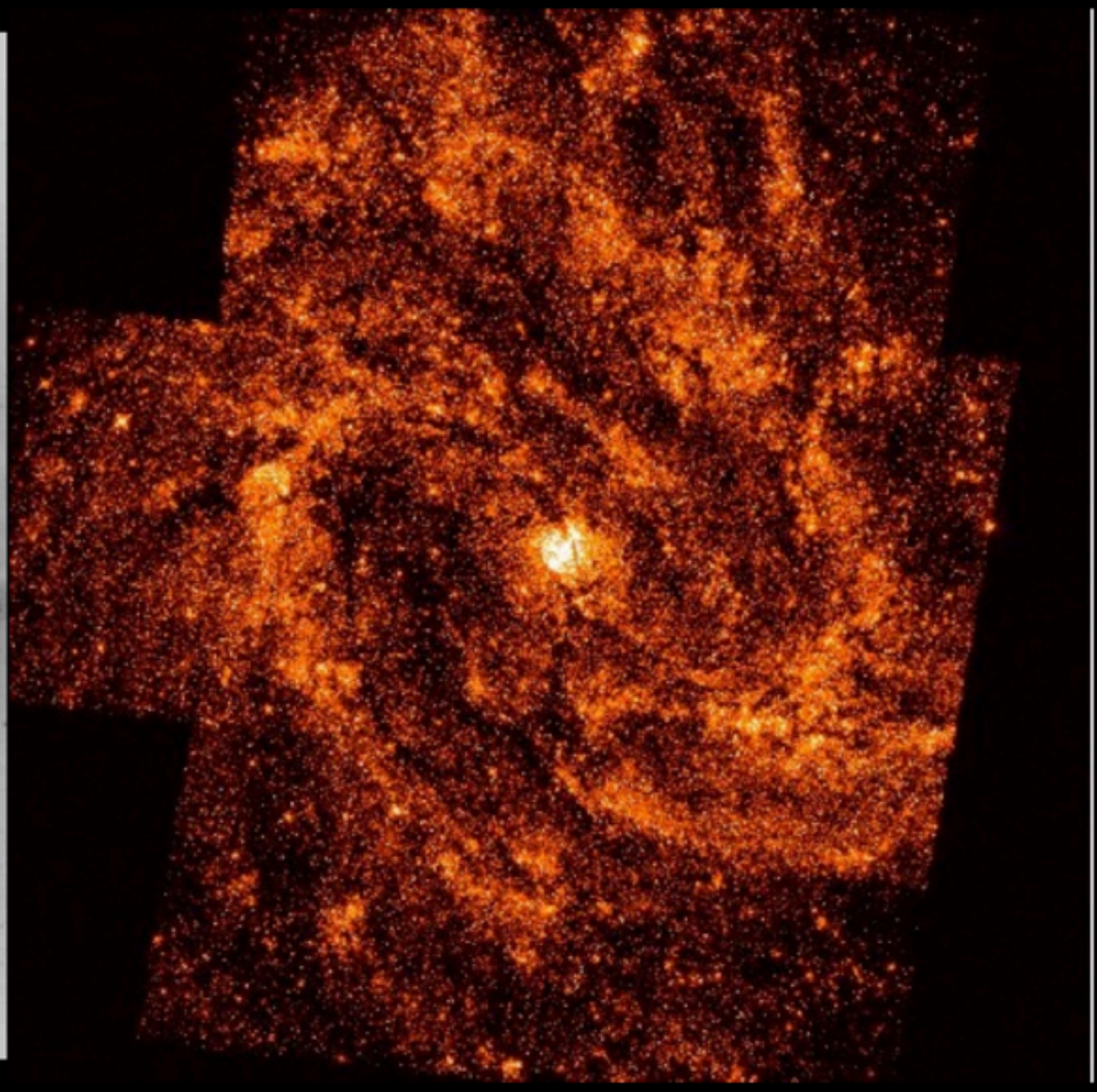
Dust and Population Maps



- RGB Width → Dust Absorption
- RC/RGB Color → Metallicity
- Main Sequence → Star Formation Rate

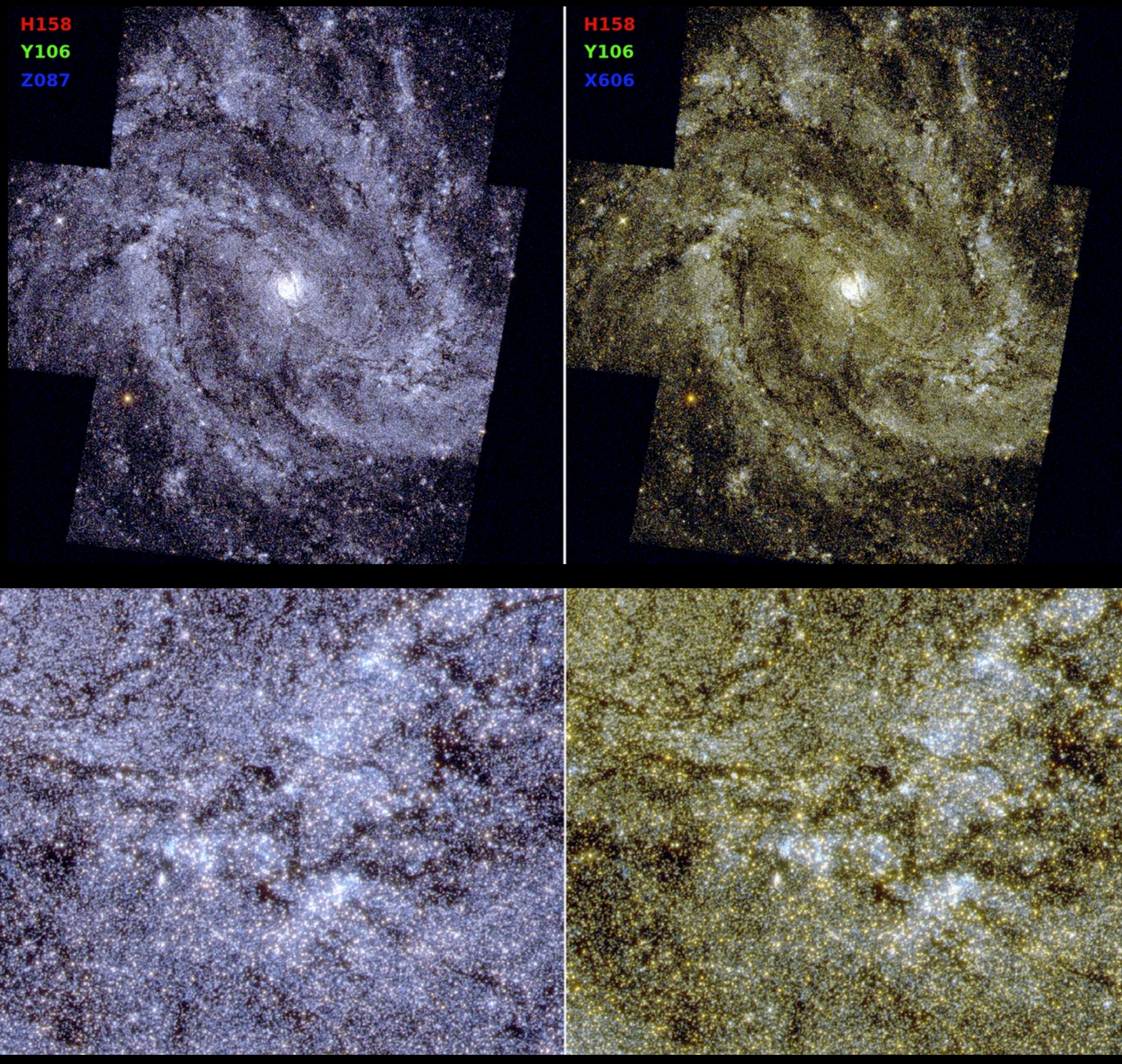
Beginning to simulate WFIRST data





7 Field UVIS Mosaic —– One WFIRST 4k x 4k detector

Beginning to simulate WFIRST data



Conclusions

Maximizing the value of a WFIRST survey of nearby galaxies

Sample Selection: Number/properties we need for variety of projects

Distance Distribution: More tiling vs. longer exposures

Depth: What is optimal for various sub-projects?

Area: How far out in the halo does the science return decrease?

Filters: How many bands? Which bands?

Scheduling: Proper motion possibilities; transients as well.

Data Products: Crowded field photometry (including quality metrics)

Friday, January 6, 17