HSC Hyper Suprime-Cam Subaru Strategic Program

PRINCETON UNIVERSITY

# Isolated Dwarf Galaxies Hosting Tidal Debris: Extending the Dwarf-Dwarf Merger Sequence

[on Arxiv today: 1911.08497]


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Princeton University

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# Three Questions

- Does hierarchical assembly matter for dwarf galaxy stellar assembly?

- Can we use HSC-SSP to search for dwarf-dwarf mergers?

- How does recent accretion affect star formation in dwarfs?

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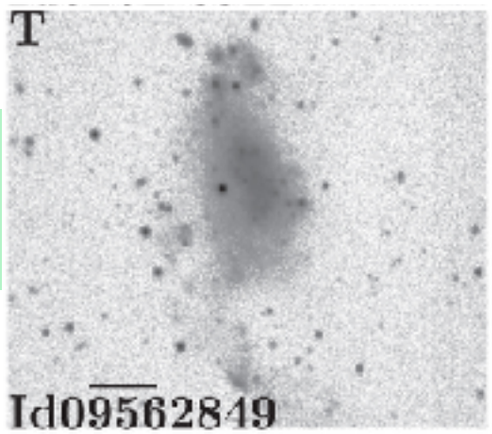
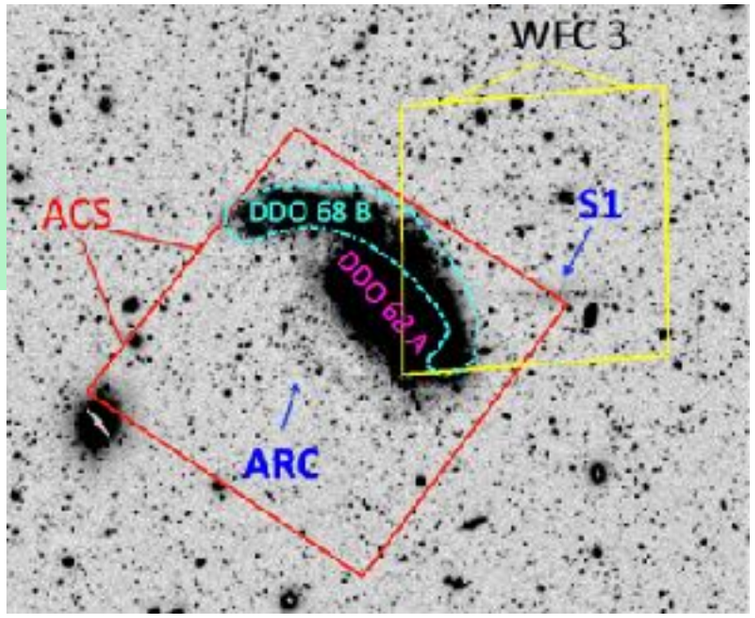
# Is hierarchical assembly important for stellar assembly at dwarf masses?

Evidence for dwarf-dwarf pairs & mergers in the Local Universe




Paudel et al. 2018




Annibali et al. 2019

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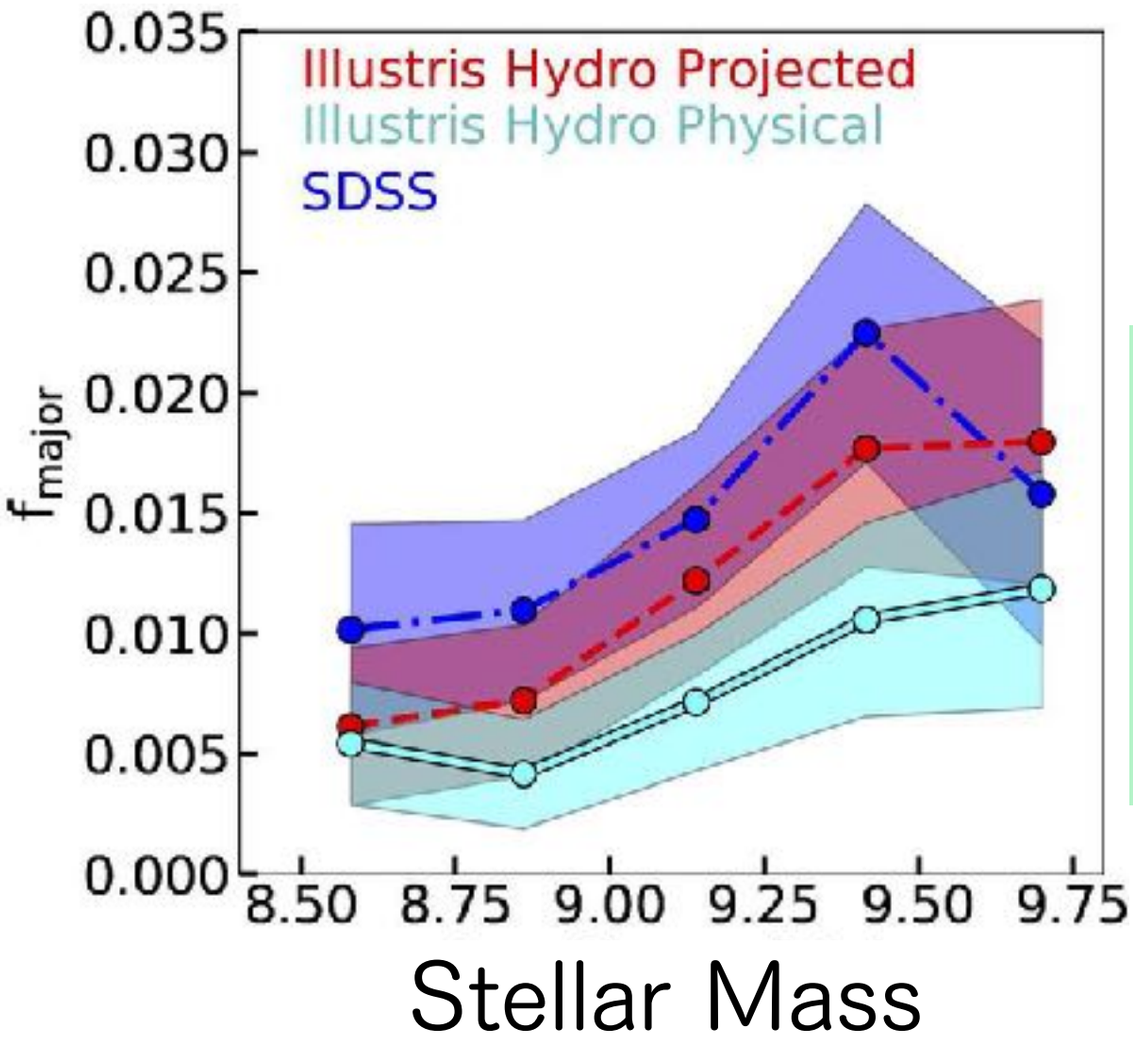
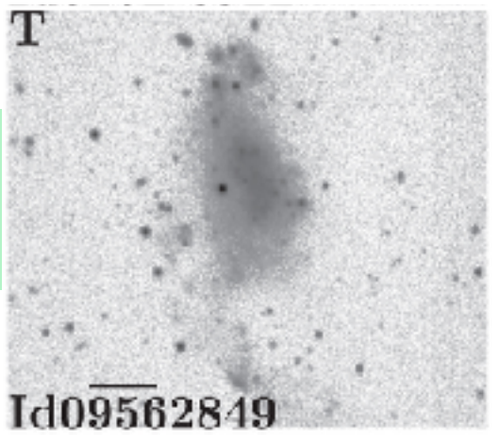
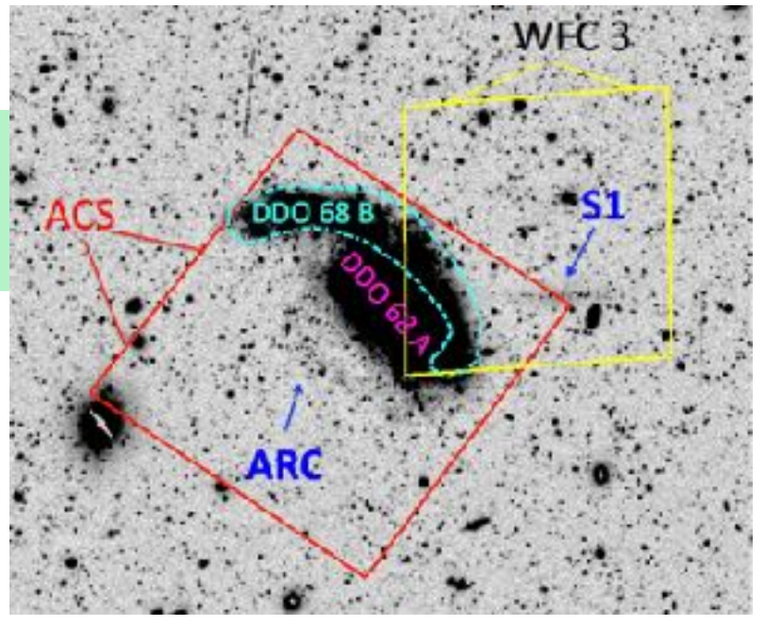



Paudel et al. 2018




Annibali et al. 2019

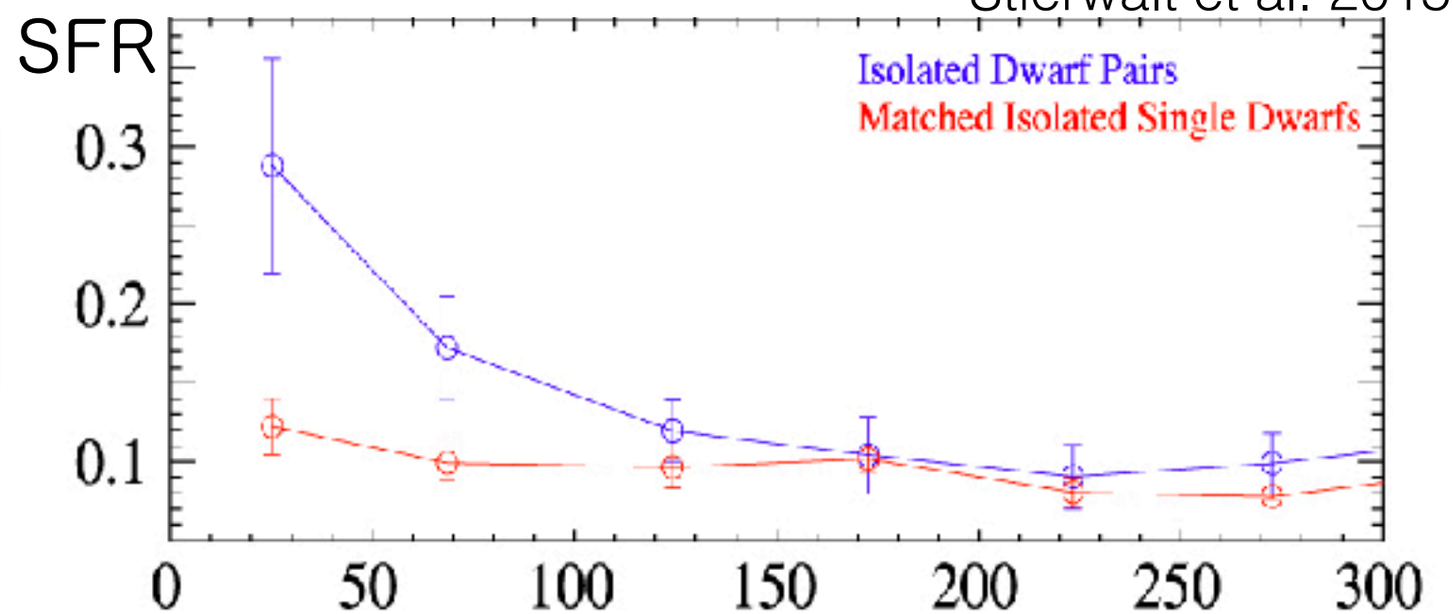
A few percent of dwarfs have >25% mass dwarf companion

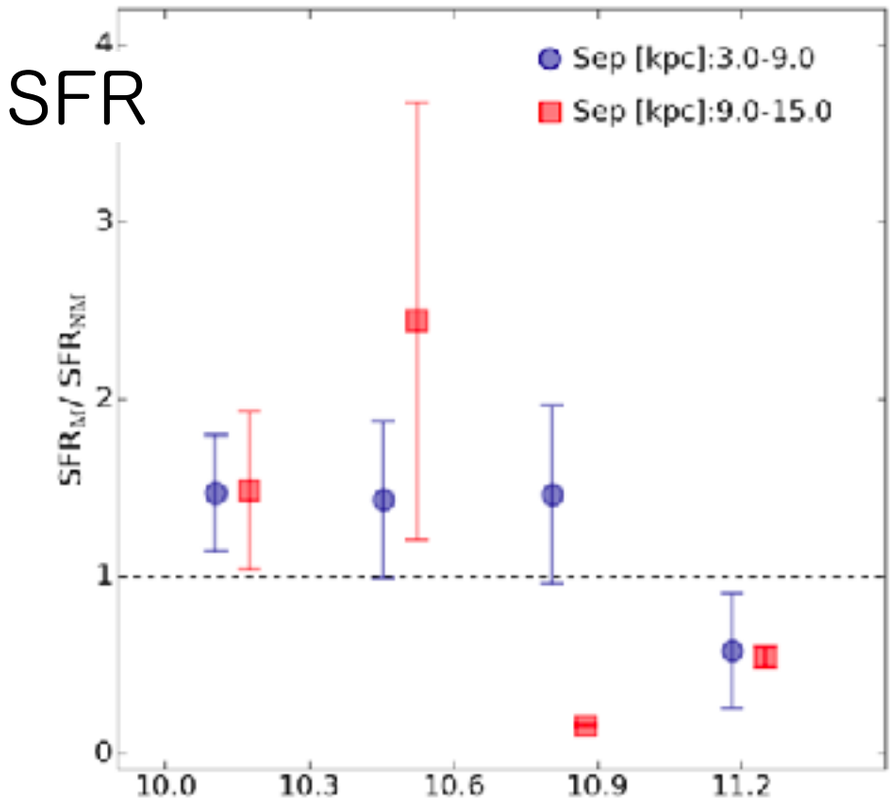
Besla et al. 2018

# Is hierarchical assembly important for stellar assembly at dwarf masses?

Evidence that a low-mass companion enhances star formation in dwarfs

Stierwalt et al. 2015




(As opposed to massive galaxies, recall Andrea's talk)

Silva et al. 2018

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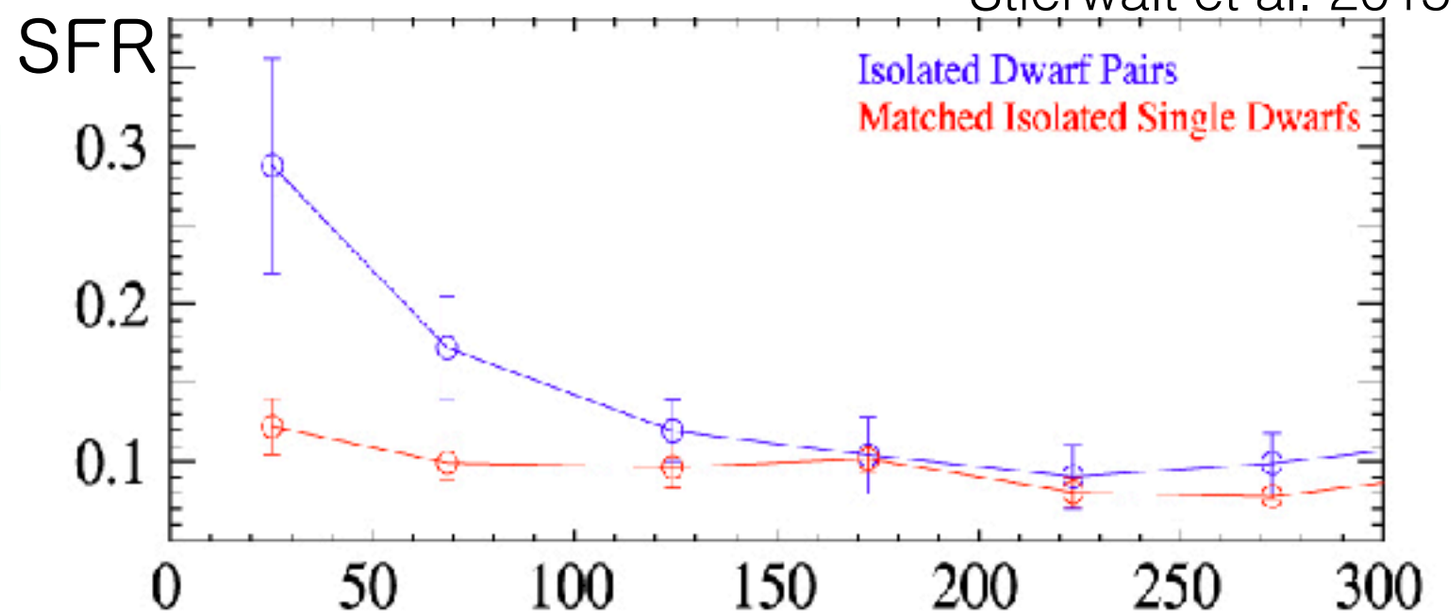
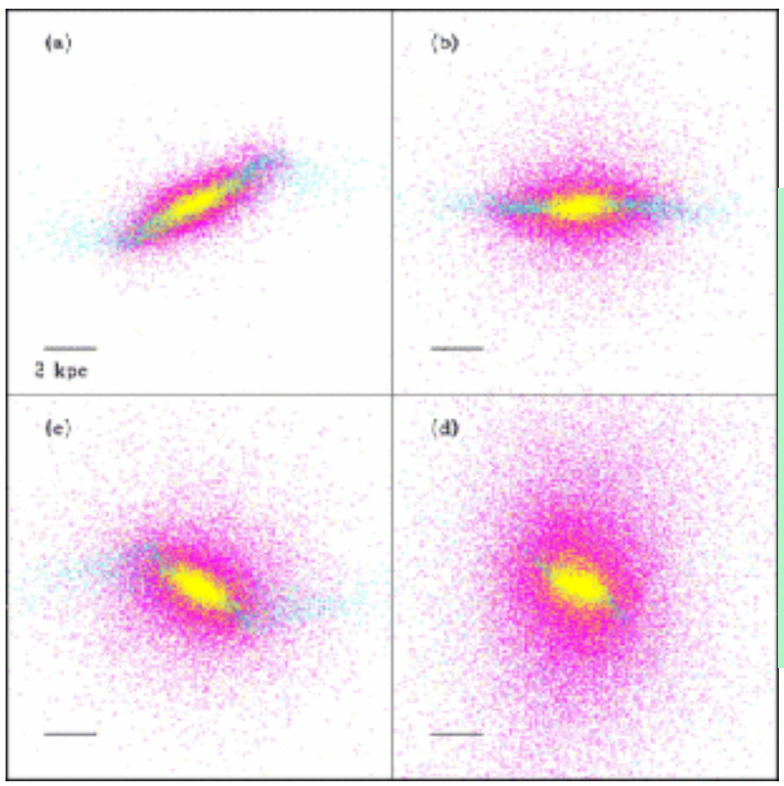


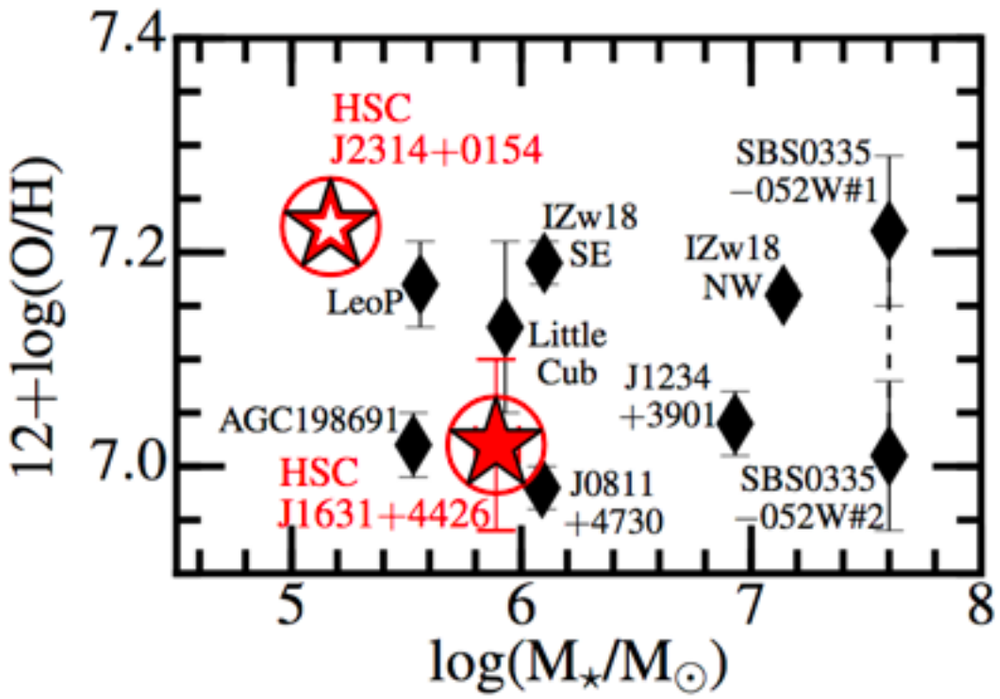




Bekki 2008

Dwarf-dwarf mergers also proposed origin of Blue Compact Dwarfs & dwarf stellar halos

More generally, we see a large diversity in dwarf galaxy structure — what drives this diversification?

## Extremely Metal-Poor Dwarfs

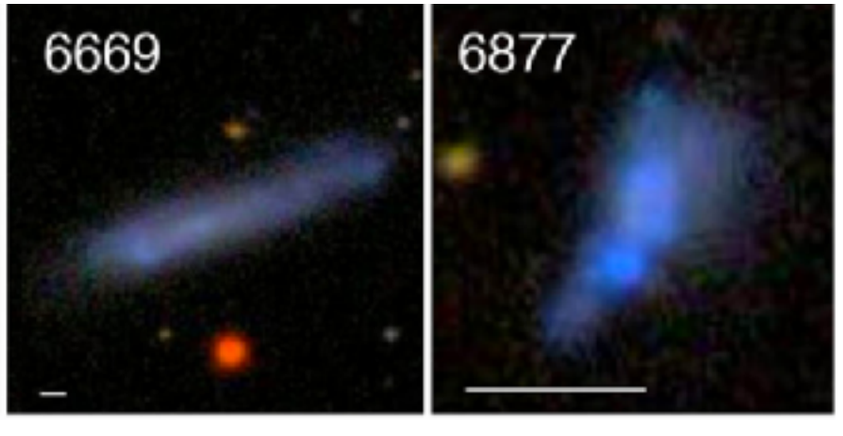



Kojima et al. 2019

## Blue Compact Dwarfs

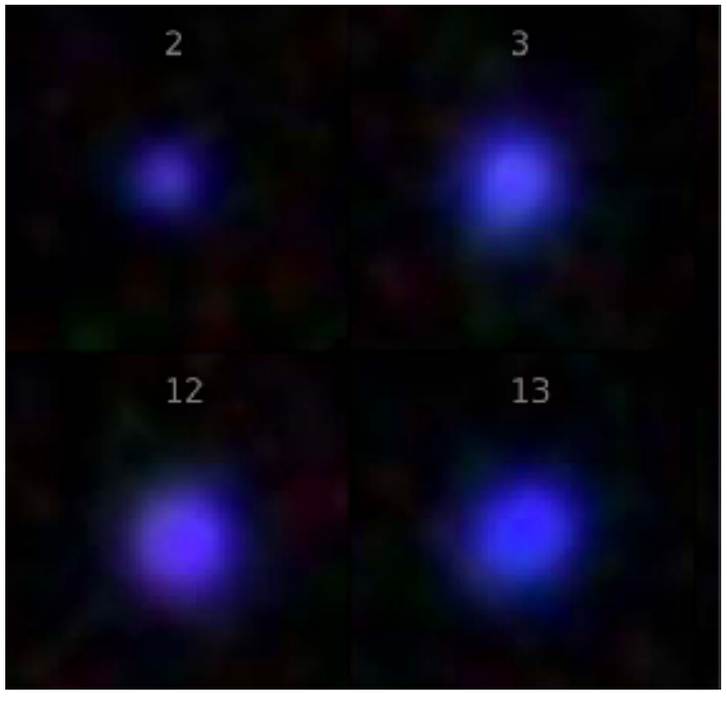
UM454

## Tadpoles




Elmegreen et al. 2012

## Blueberries




Yang et al. 2018

# Three Questions

- Does hierarchical assembly matter for dwarf galaxy stellar assembly?

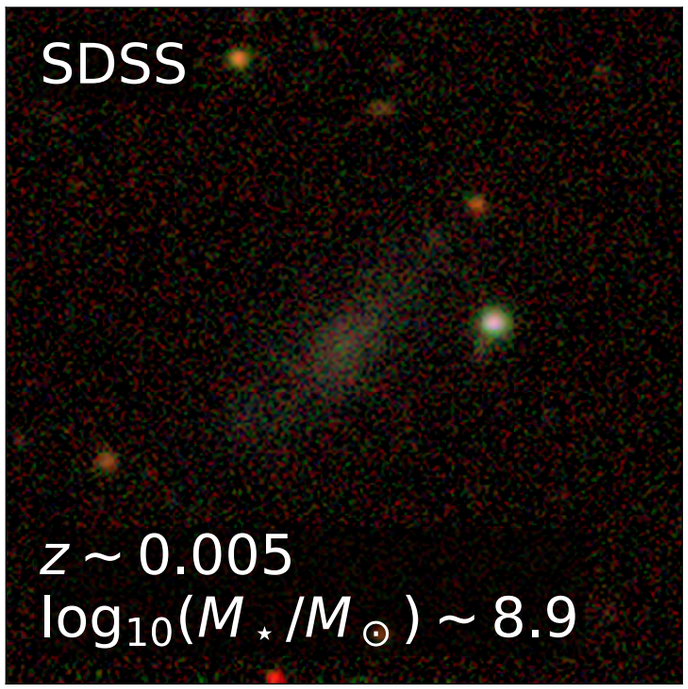
- Can we use HSC-SSP to search for dwarf-dwarf mergers?

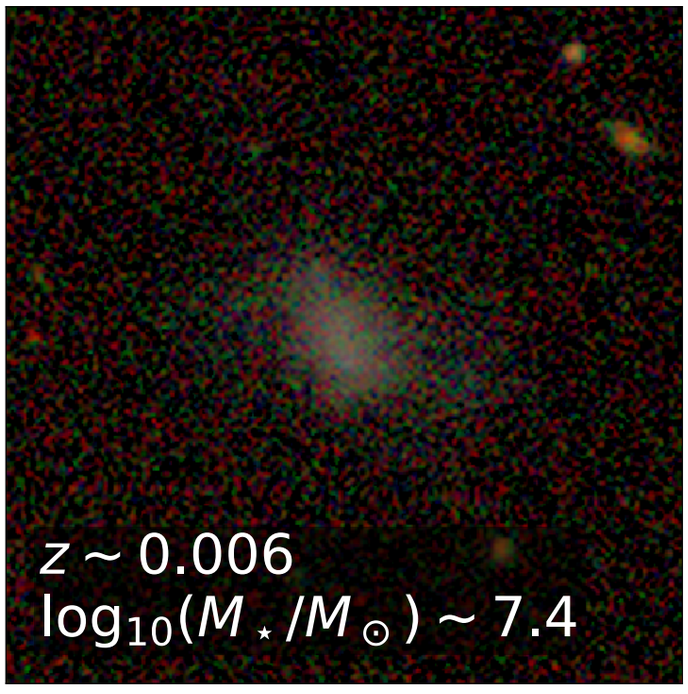
- How does recent accretion affect star formation in dwarfs?

# Why HSC?

Dwarfs are intrinsically small & faint.

To detect merger signatures, need deep and high resolution imaging.



# Why HSC? Breadth + Depth + Resolution

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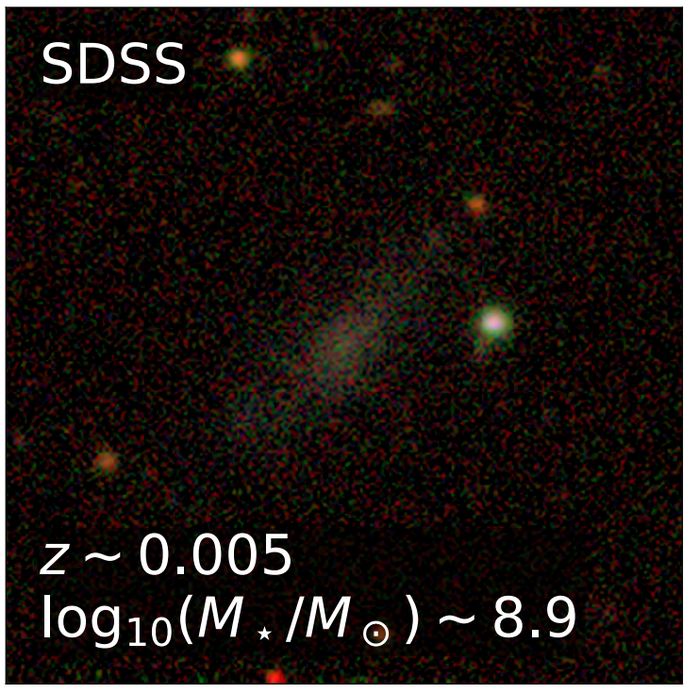
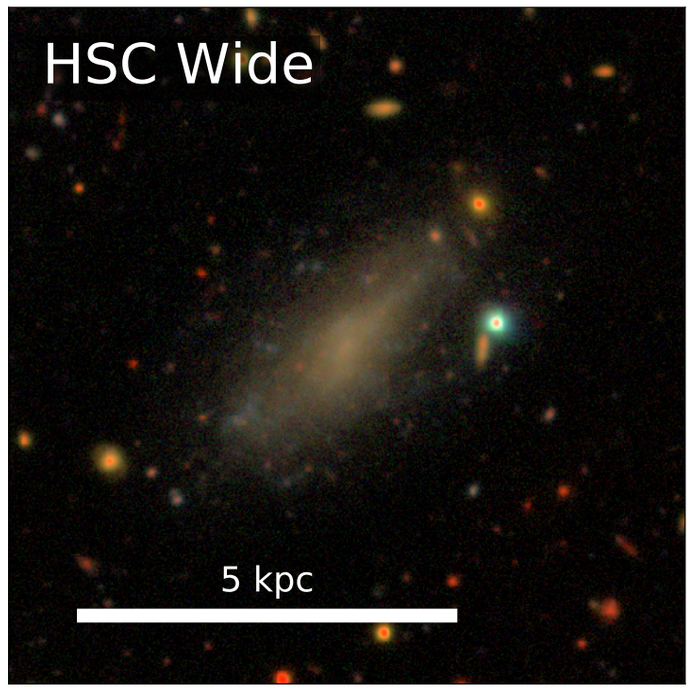
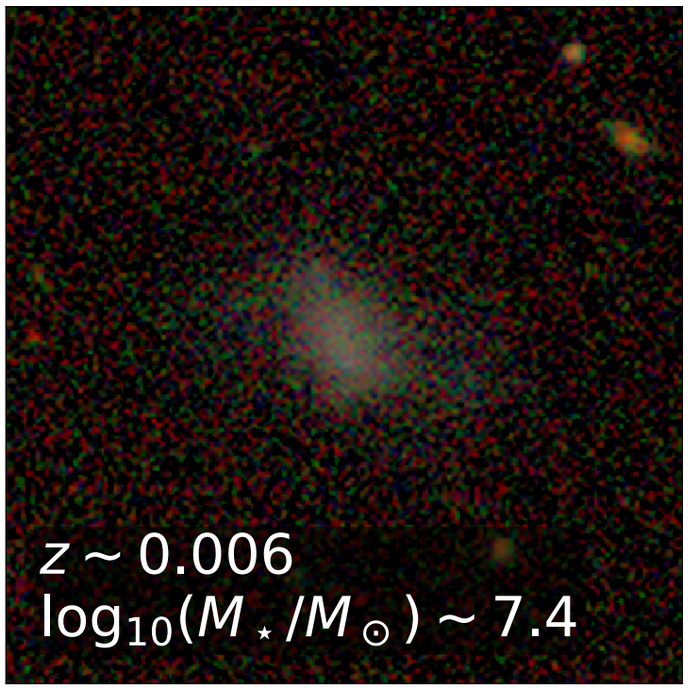
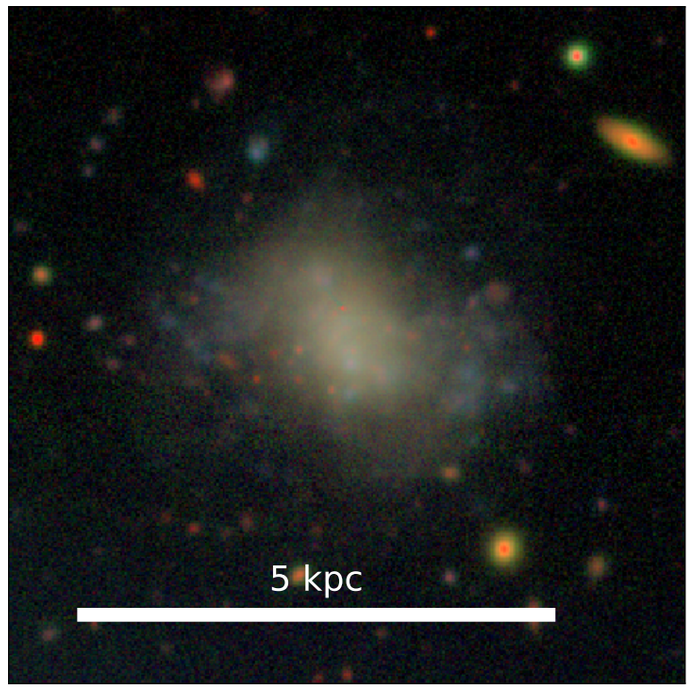


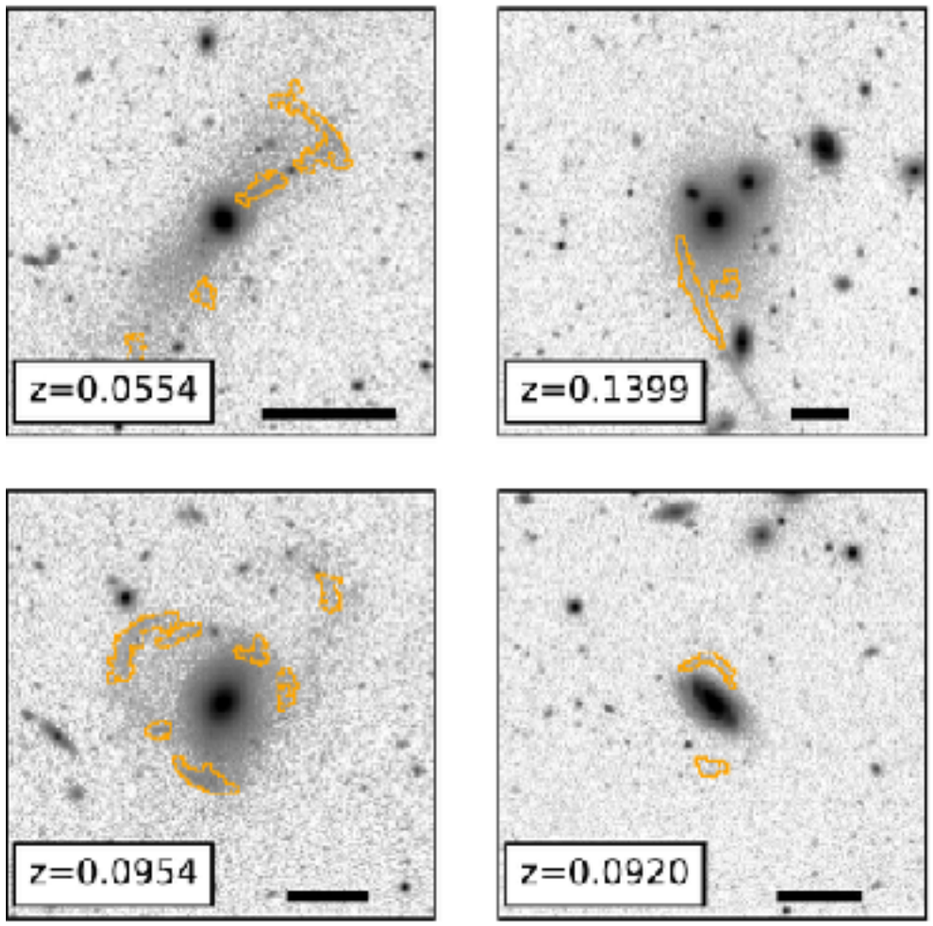



# How to find merging dwarfs in HSC

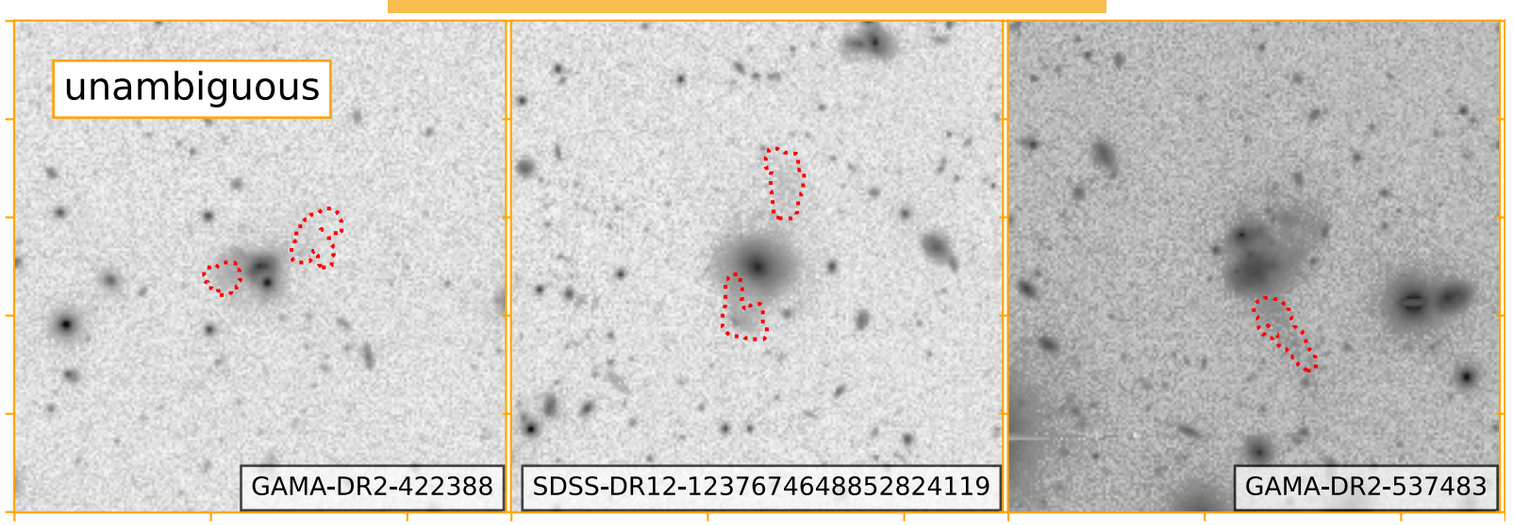
Massive galaxy sample




Kado-Fong et al. 2018

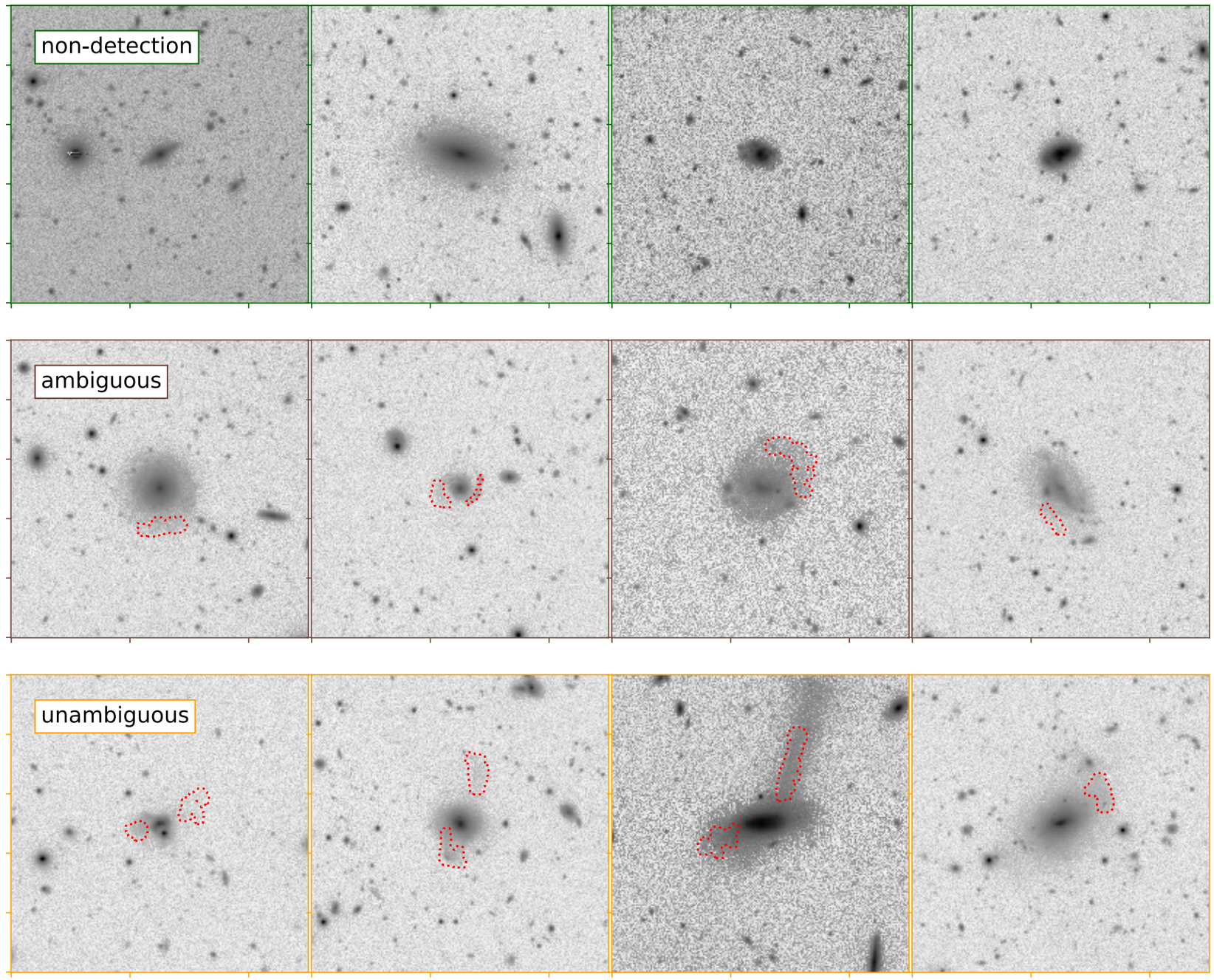
Automated detection of tidal debris via multiscale spatial decomposition

Dwarf galaxy sample

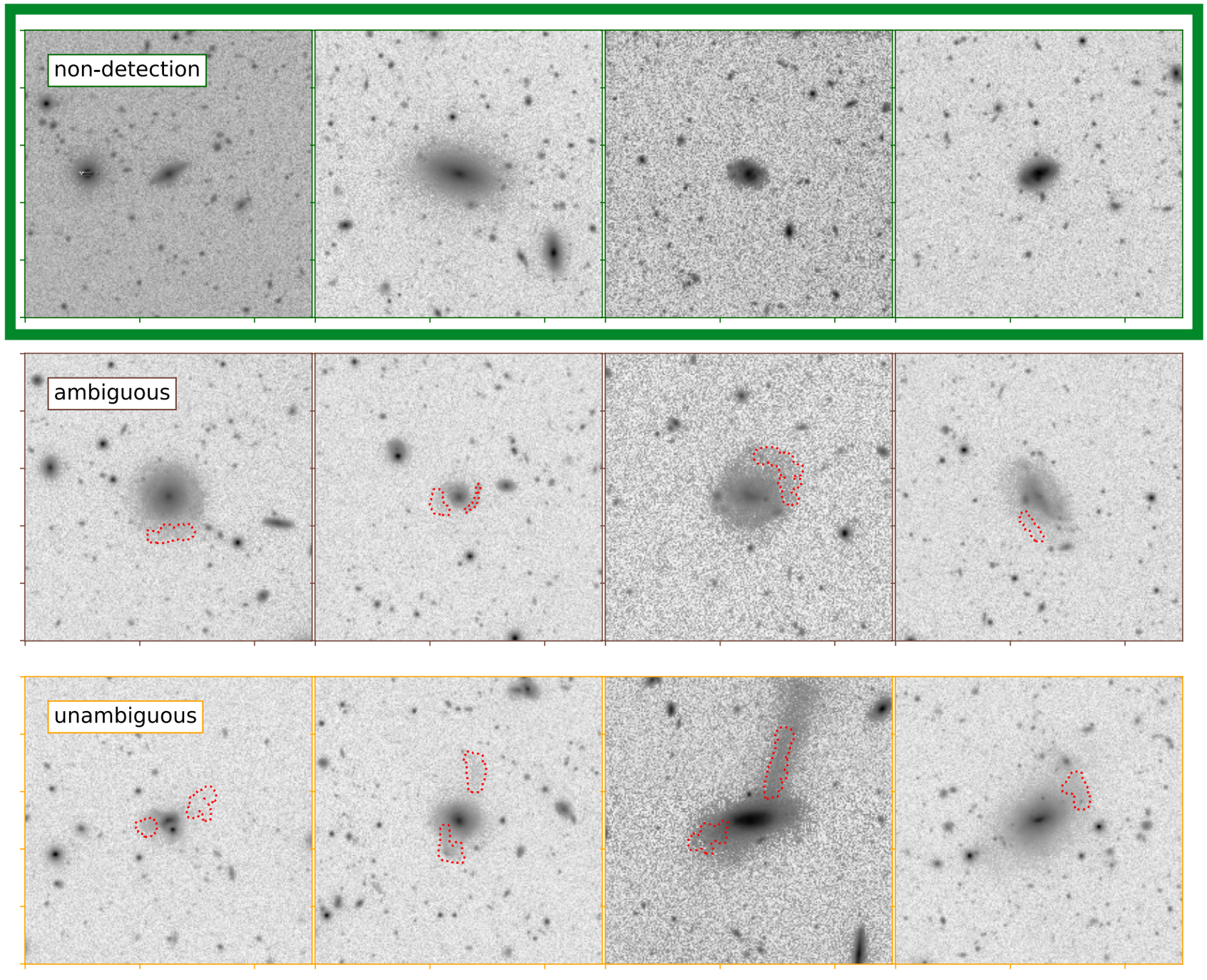



Kado-Fong et al. 2019

However, dwarf mergers can appear ambiguous to both automated and human classifiers

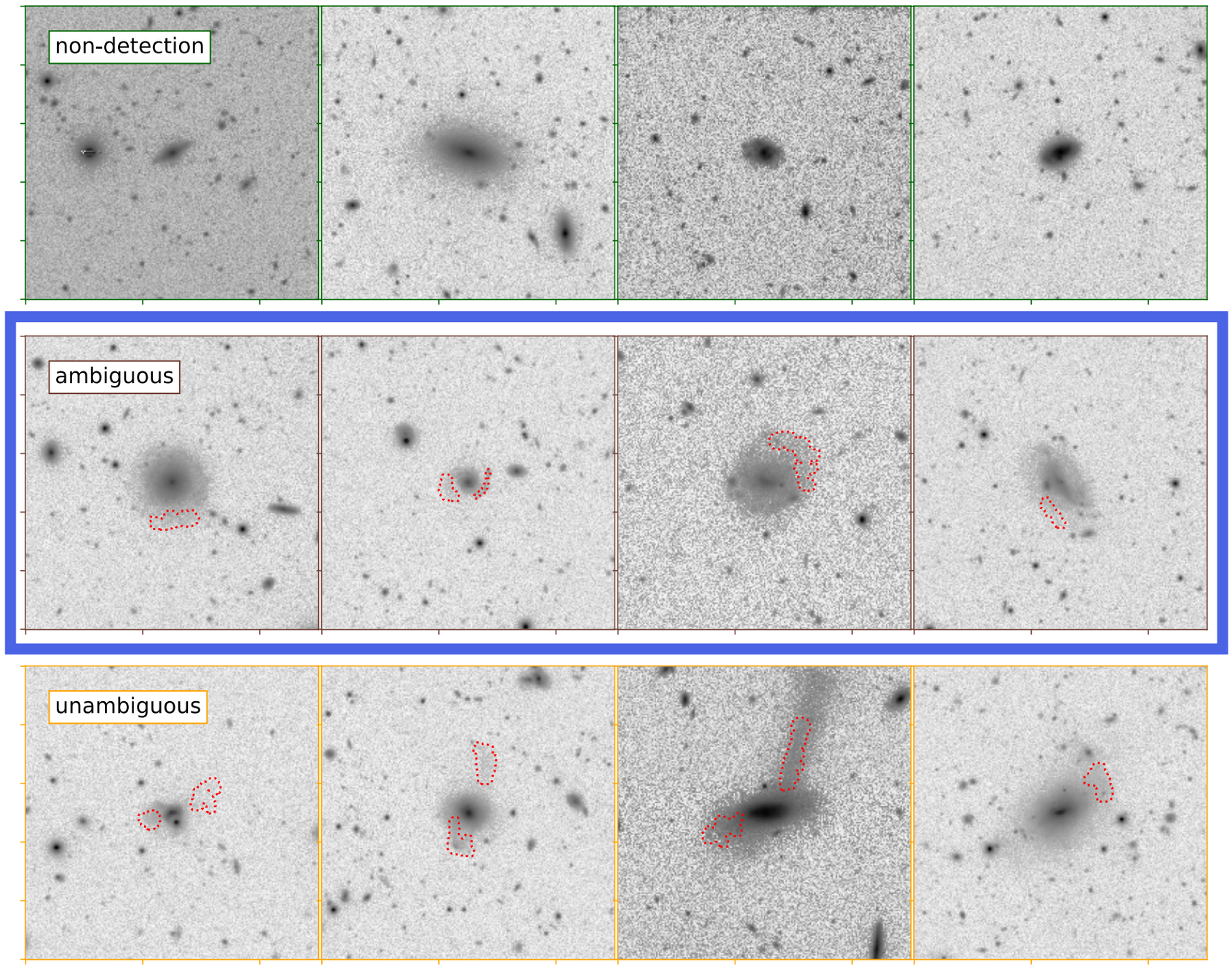


# no detection



no detection

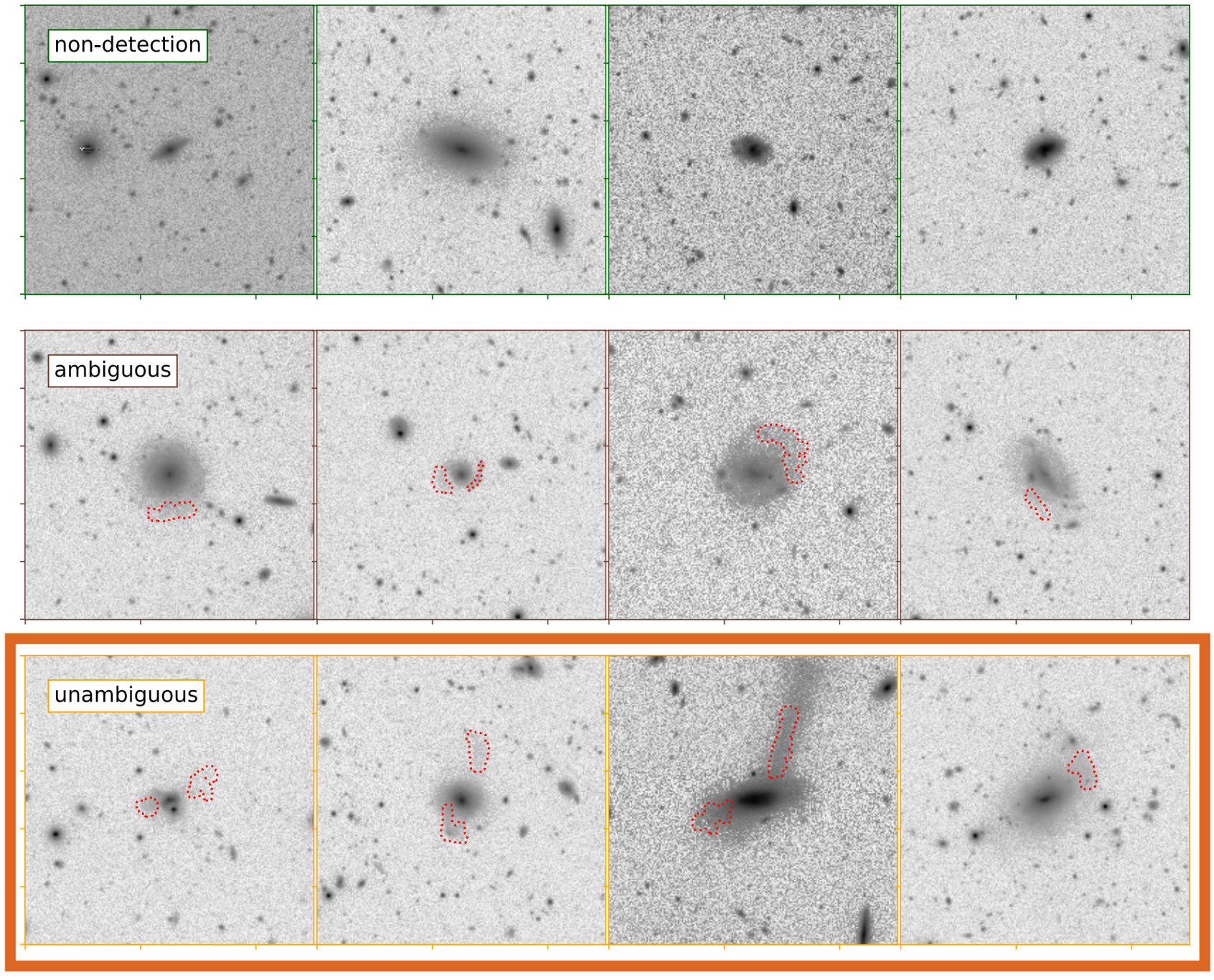
ambiguous
LSB debris



no detection

ambiguous
LSB debris

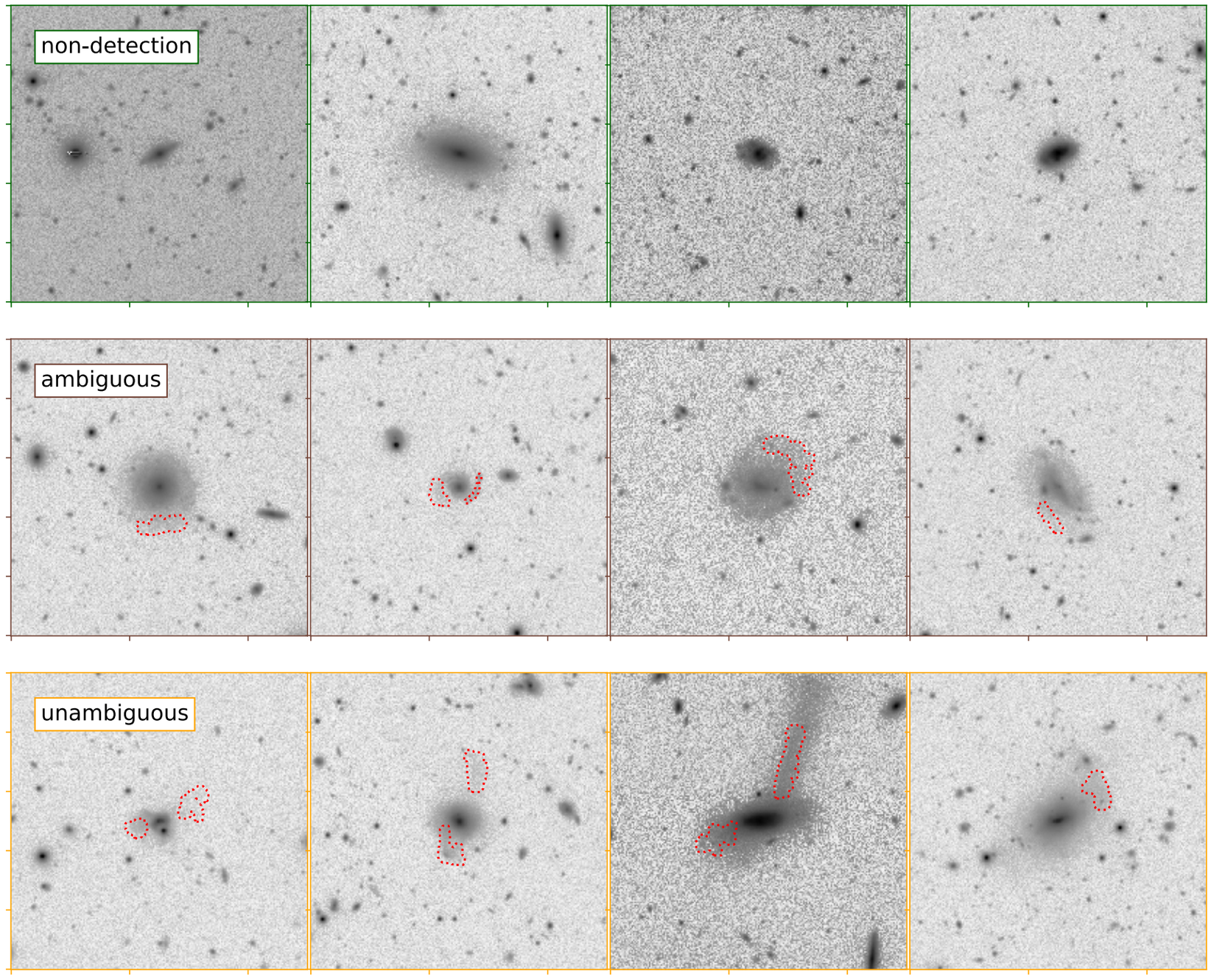
unambiguous
dwarf merger
debris



no detection

ambiguous
LSB debris
(125 dwarfs)

unambiguous
dwarf merger
debris
(101 dwarfs)




(226 total with LSB debris)

# The HSC Dwarf merger sample

$0.01 < z < 0.15$

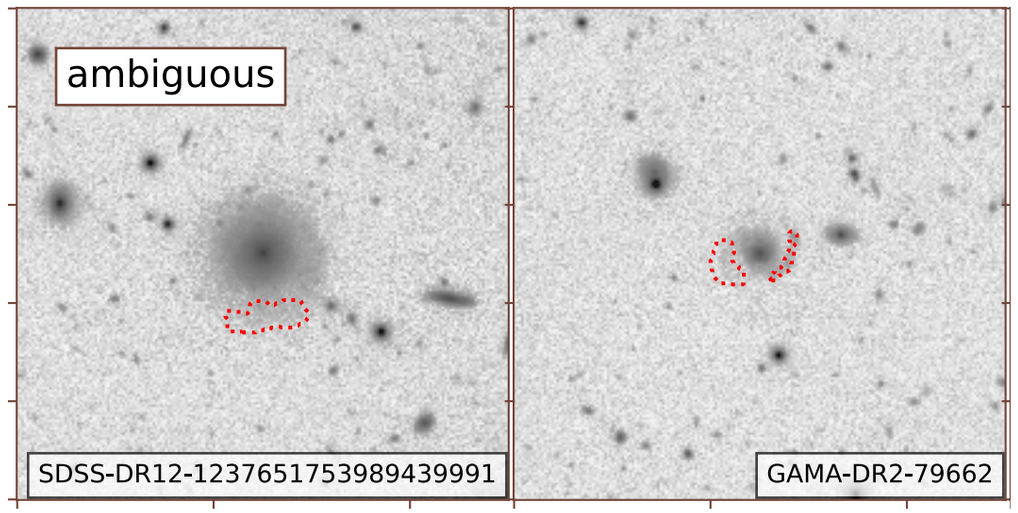
SDSS + GAMA +

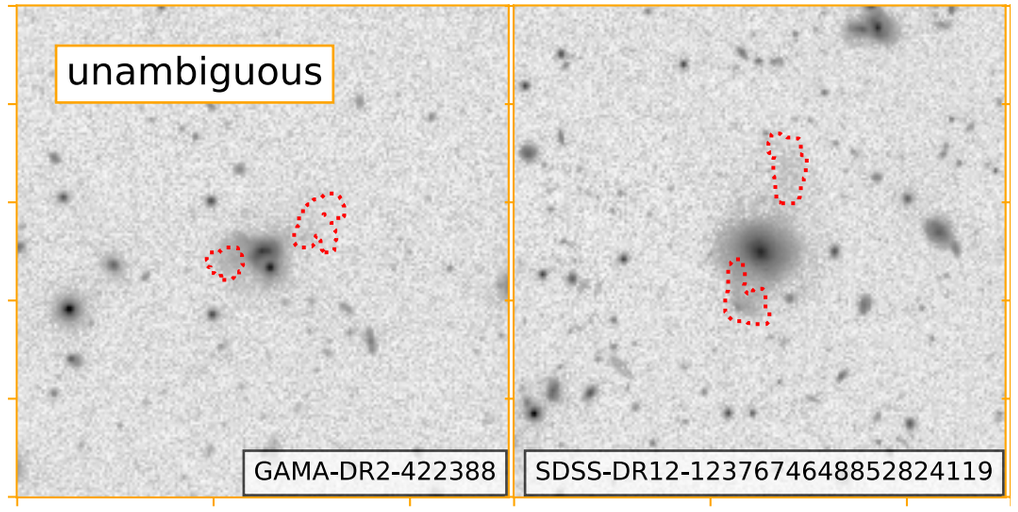
1 Mpc isolation

$$\log_{10}(\frac{M_\star}{M_\odot}) < 9.6$$

~6,900 in parent sample

226 detected tidal feature systems
(101 unambiguous)



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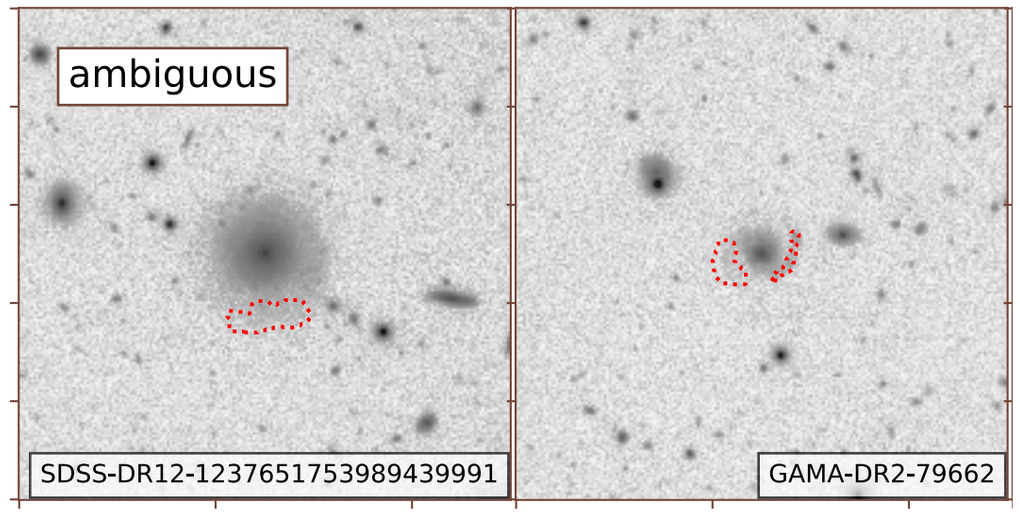


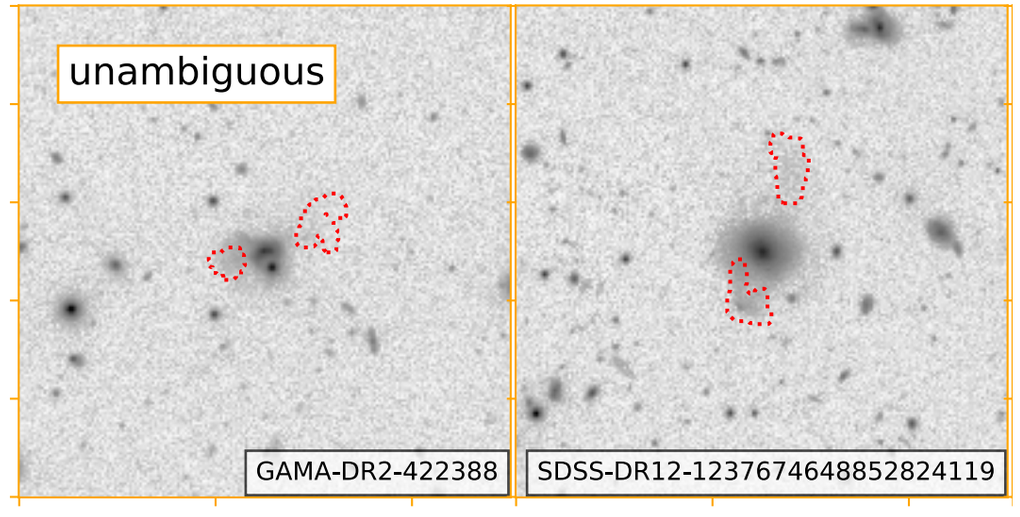


At least ~3% of isolated field dwarf sample hosts merger debris

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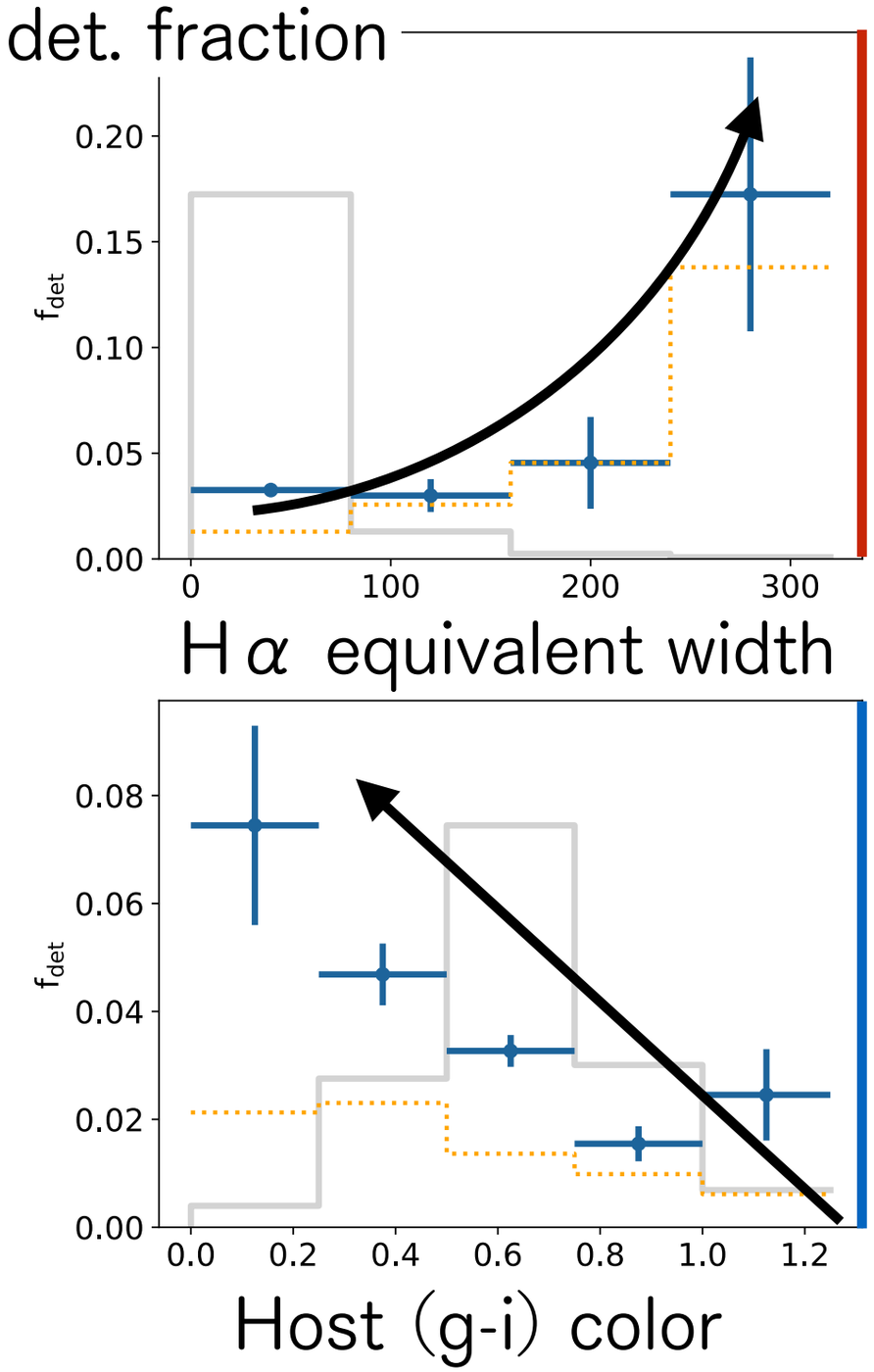
# Dwarf mergers trigger star formation




Dwarfs with

higher Hα equivalent width

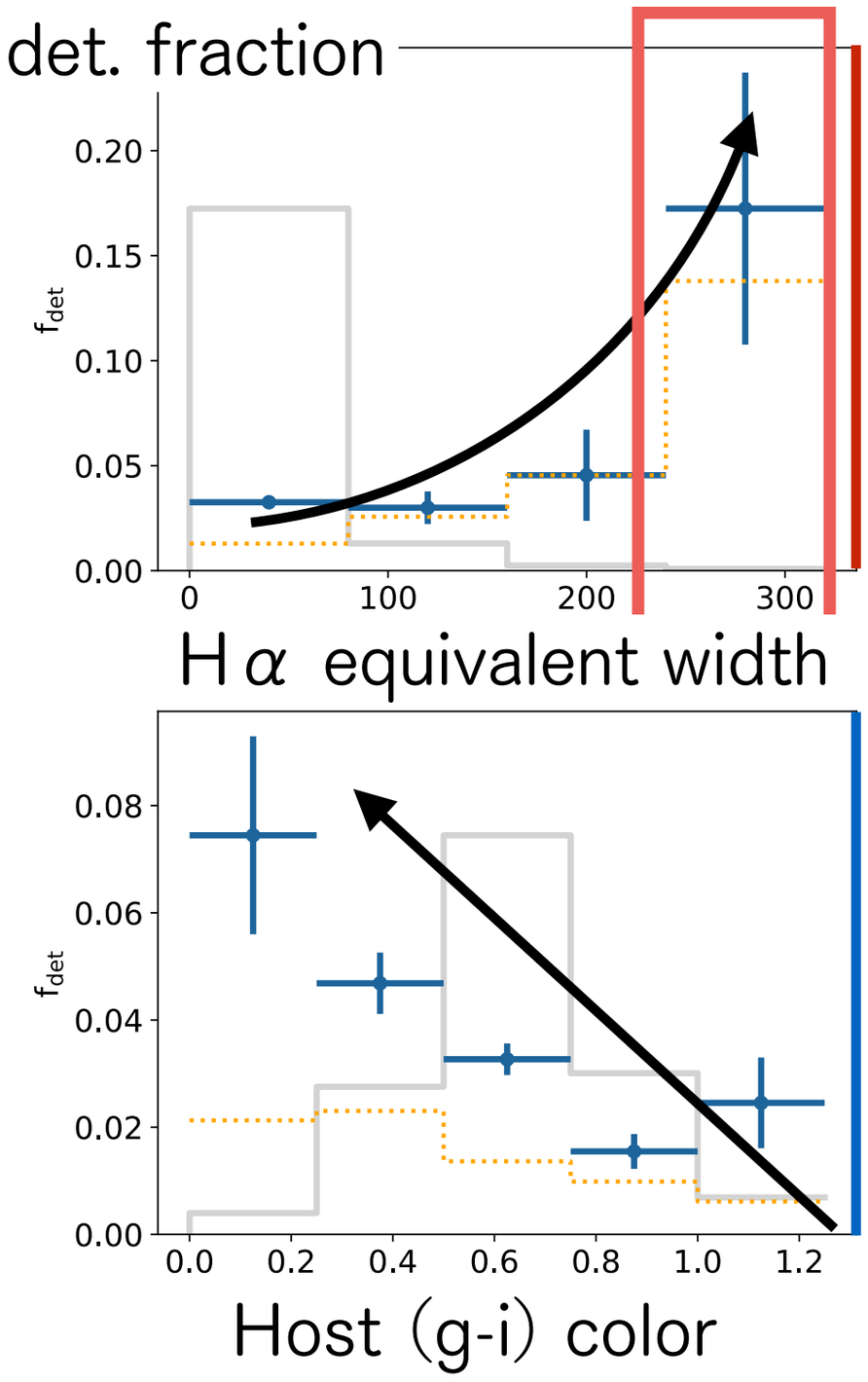
or

bluer host colors

more likely to be undergoing a merger

Kado-Fong et al. 2019

# Dwarf mergers trigger star formation




Kado-Fong et al. 2019

Dwarfs with

higher H$\alpha$ equivalent width

or

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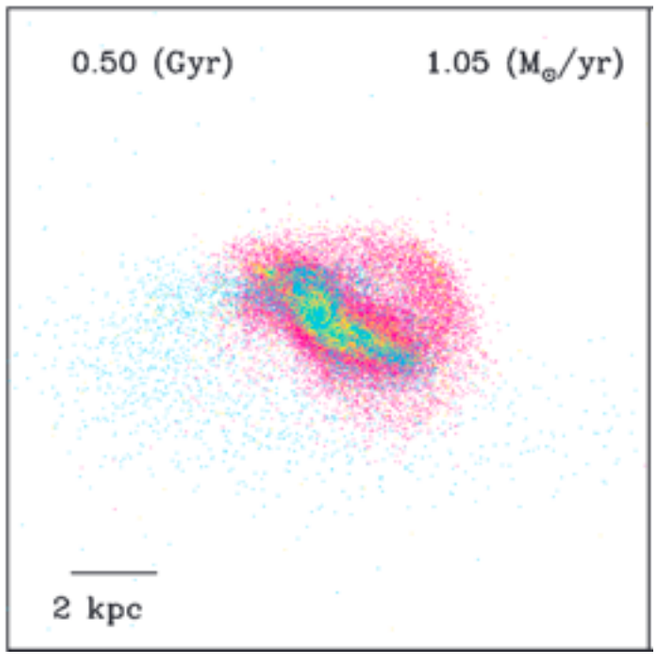
~15-20% of strongest starbursts host tidal features

# Mergers as a trigger for BCD formation

Dwarf major mergers predicted as blue compact dwarf formation pathway

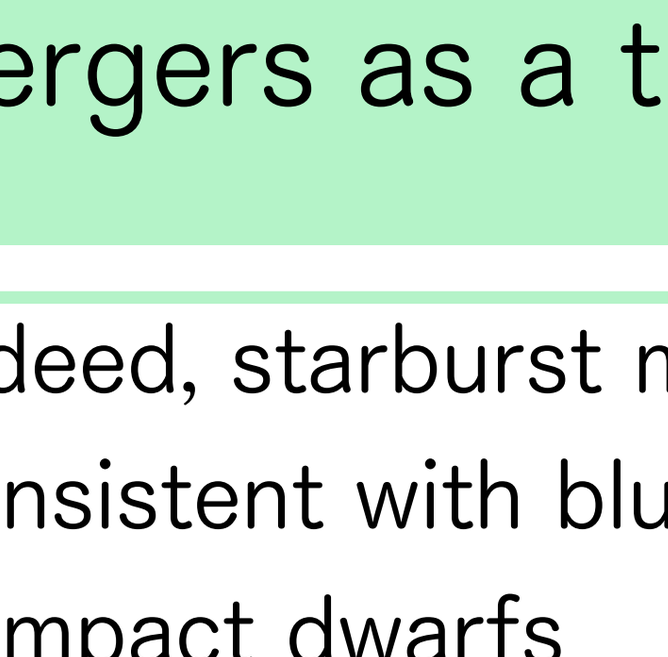



**Young stars**
**Old stars**
**Gas**

Bekki 2008

# Mergers as a trigger for BCD formation

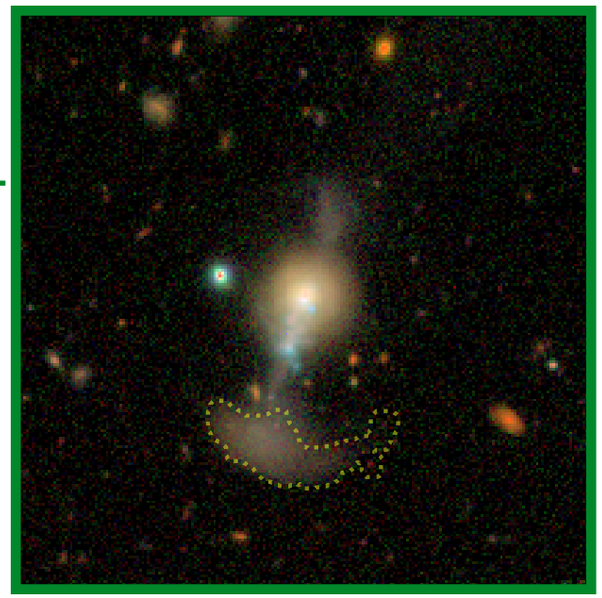
Indeed, starburst mergers consistent with blue compact dwarfs

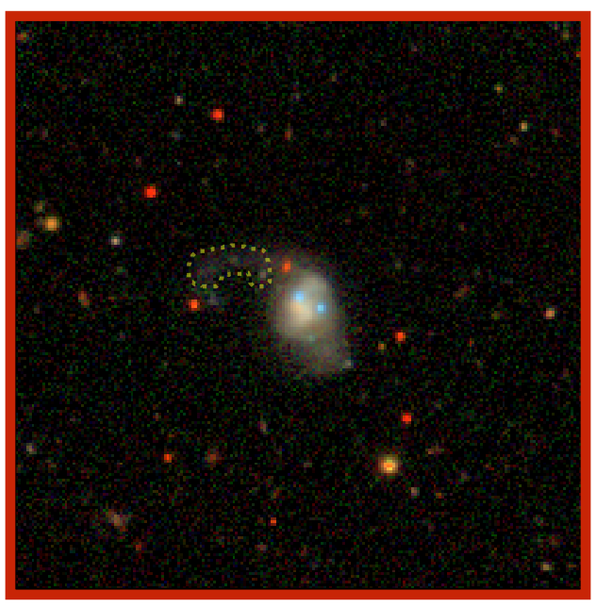


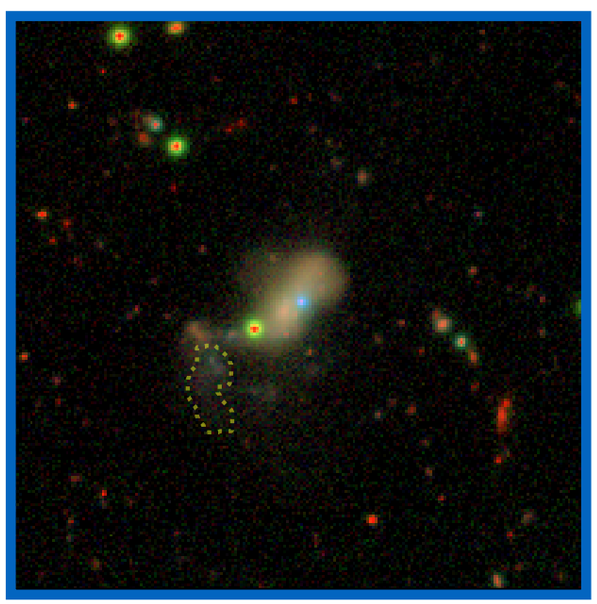

Bekki 2008

Young stars
Old stars
Gas

Classified BCD by Salzer et al. 1989

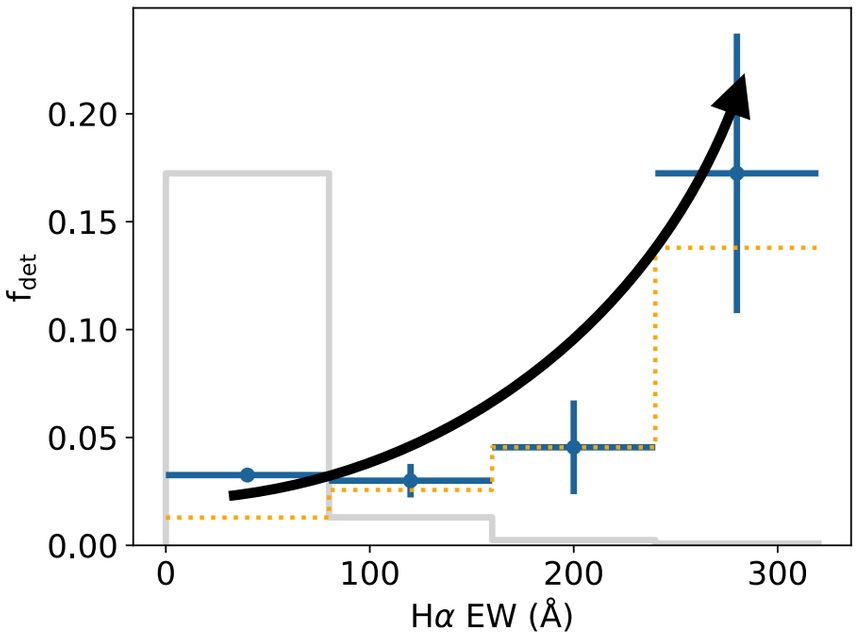


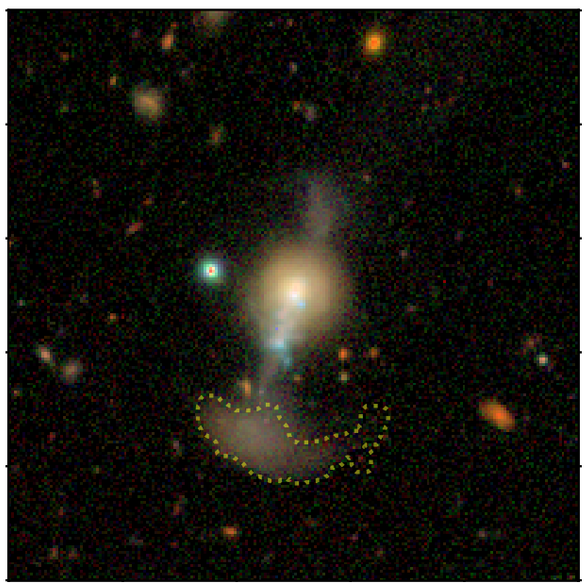




Kado-Fong et al. 2019

# Dwarf-dwarf mergers after coalescence

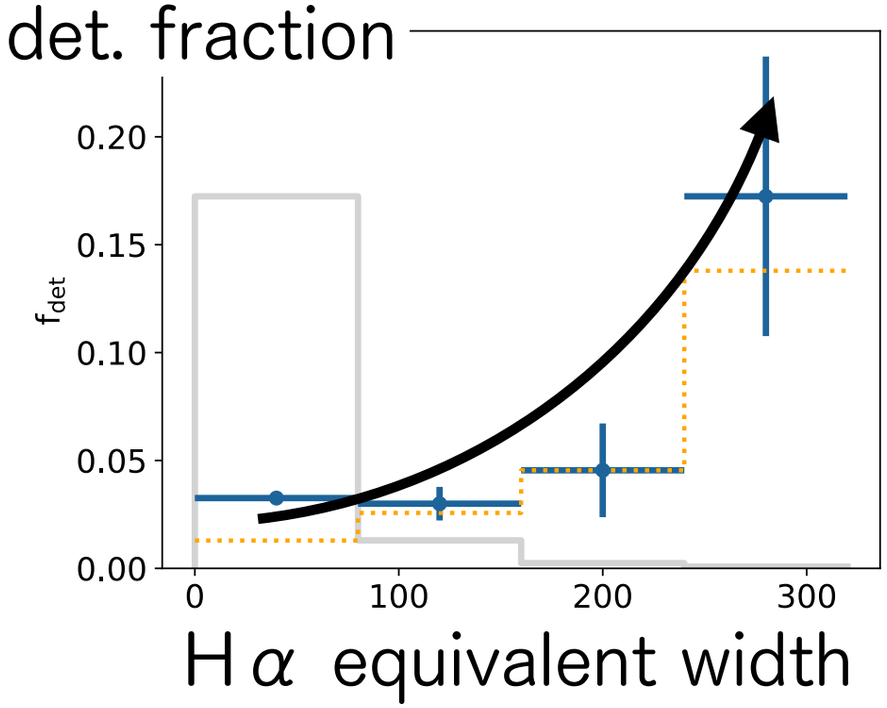


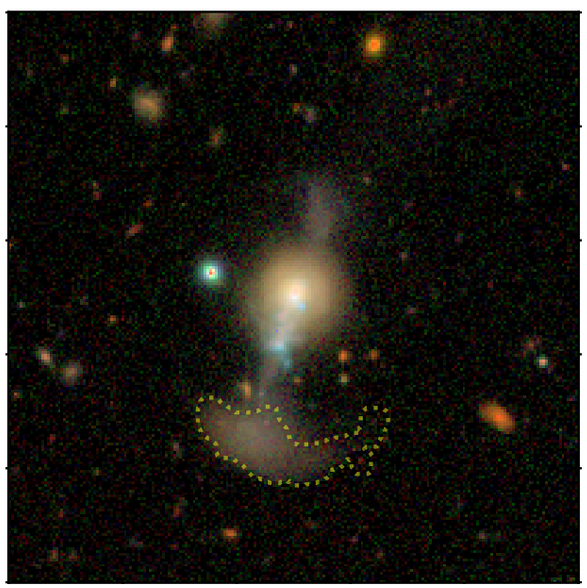



But does this picture of triggered star formation differ from the massive galaxy merging sequence?

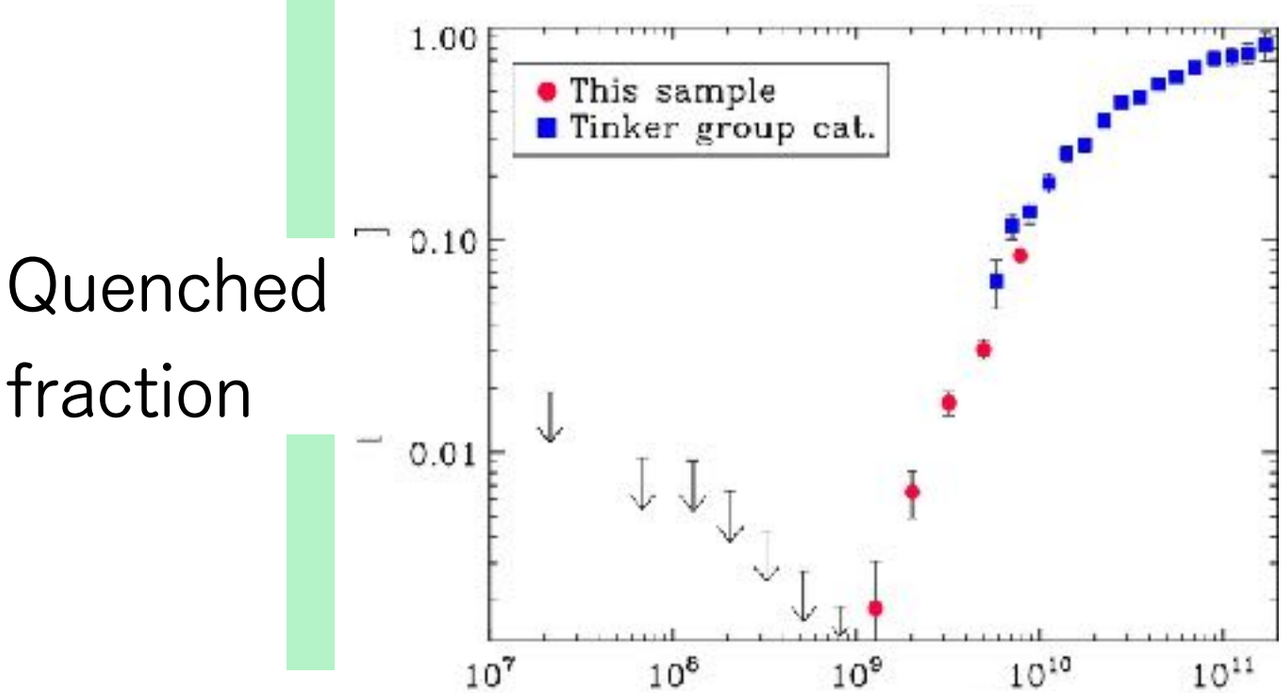
Geha et al. 2012

# Dwarf-dwarf mergers after coalescence



3-6% of sample are mergers, but <1% of dwarfs in the field are quenched — unlike massive galaxies, dwarf-dwarf mergers unable to quench the host




Geha et al. 2012

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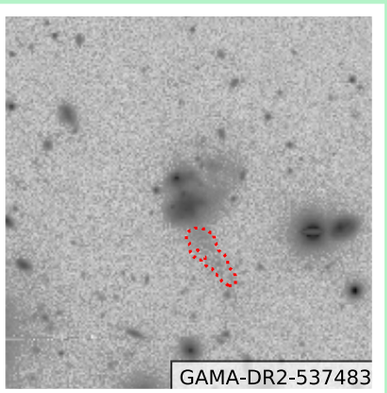


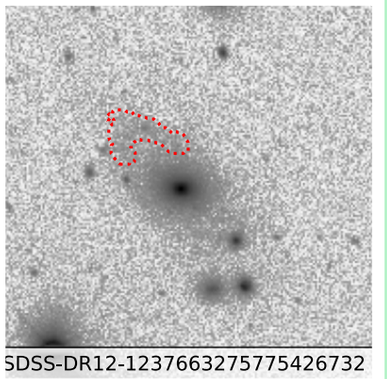


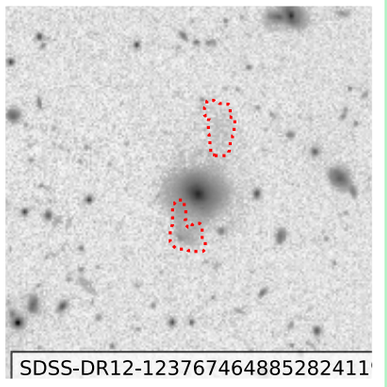


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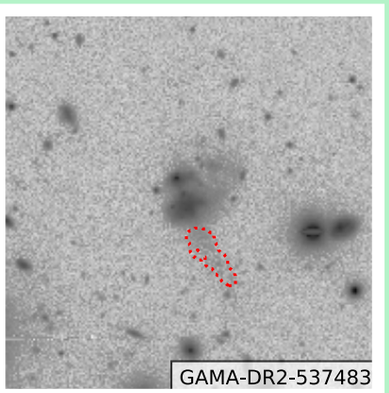


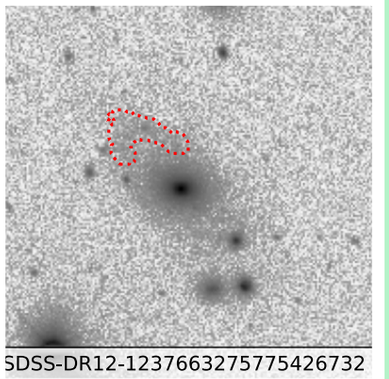


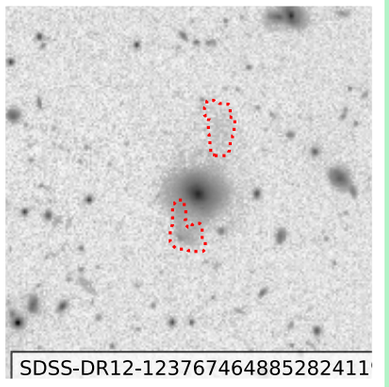


- Hierarchical assembly is a likely (but not exclusive) pathway for starbursts & BCD formation
- Can we use HSC-SSP to search for dwarf-dwarf mergers?
- How does recent accretion affect star formation in dwarfs?

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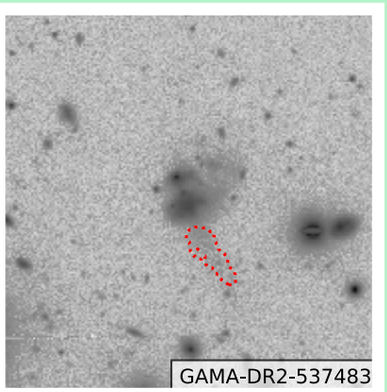
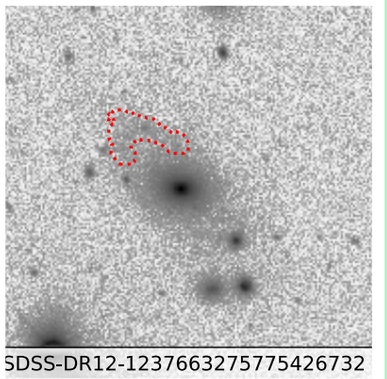
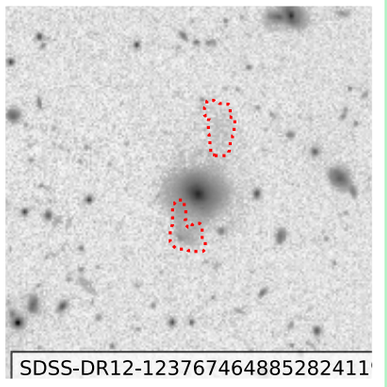
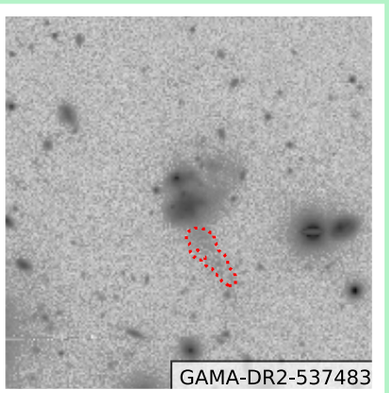


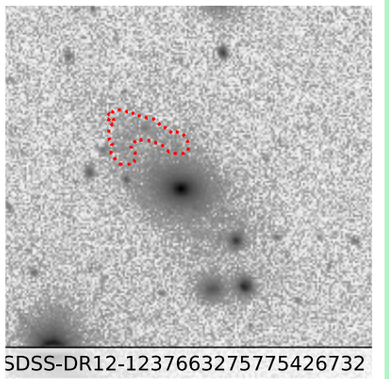



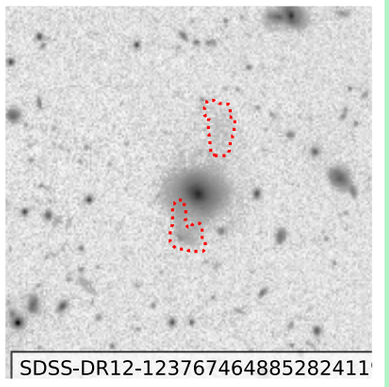




- Hierarchical assembly is a likely (but not exclusive) pathway for starbursts & BCD formation
- HSC-SSP has breadth, depth, and spatial resolution necessary for large-volume dwarf merger searches
- How does recent accretion affect star formation in dwarfs?

# Three Questions

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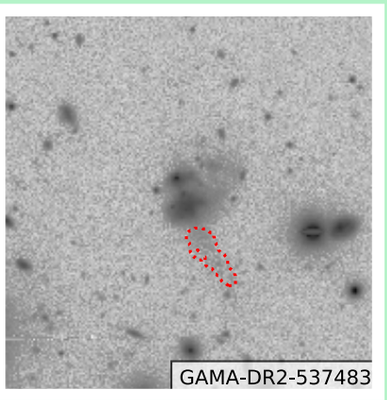
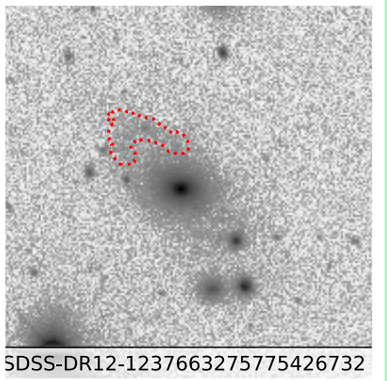
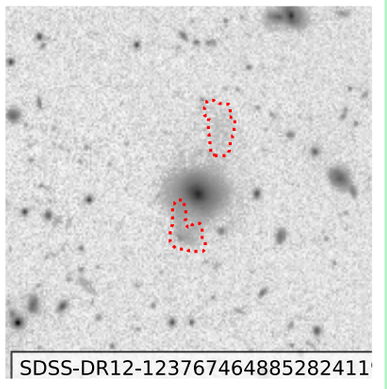
- HSC-SSP has breadth, depth, and spatial resolution necessary for large-volume dwarf merger searches
- Dwarf-dwarf mergers can trigger concentrated star formation, but cannot permanently quench the host

# Three Questions

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