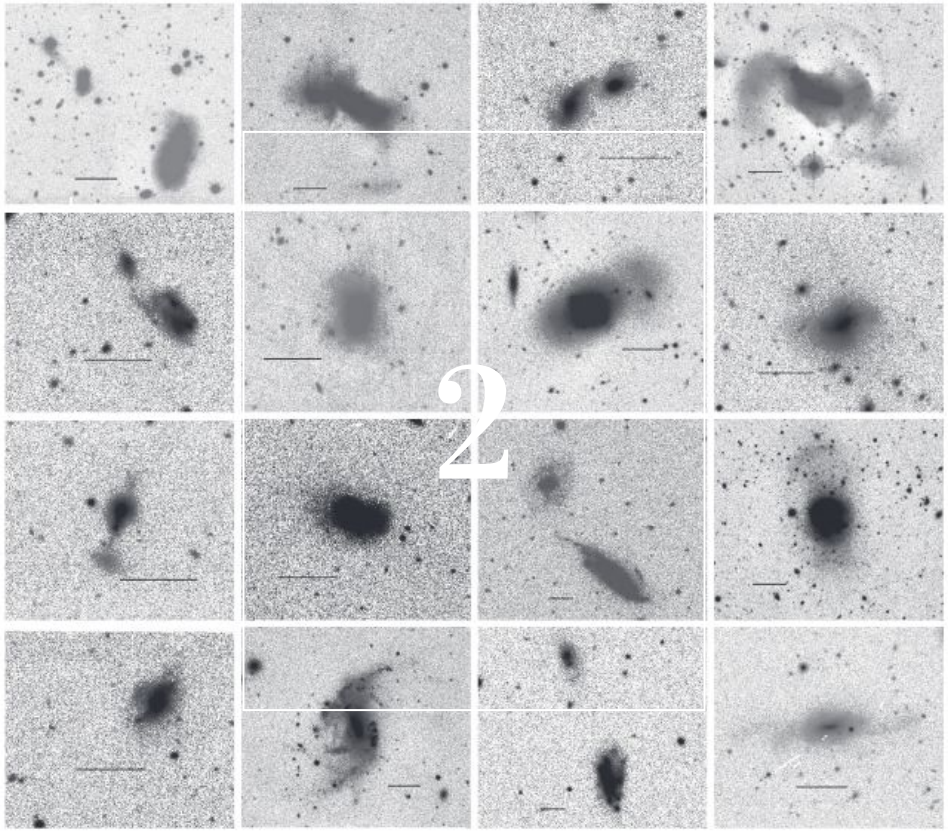
Martin+2021, MNRAS 500, 4, pp 4937–4957;
arXiv:2007.07913

Investigating the role of interactions and mergers in driving the star-forming properties of dwarf galaxies in field and group environments

Garreth Martin (University of Nottingham)
Porto Ercole, Italy 26th September 2023



Examples of interacting or merging dwarfs from **Paudel+18**'s catalogue

Mergers and interactions in the dwarf regime

➔ Like all galaxies, dwarfs galaxies can exhibit low surface brightness (**LSB**) features or disturbed morphologies that can reveal information about their interaction history (e.g. **Rich+12**; **Martínez-Delgado+12**; **Johnson+2013**; **Paudel & Sengupta 17**; **Besla+18**).

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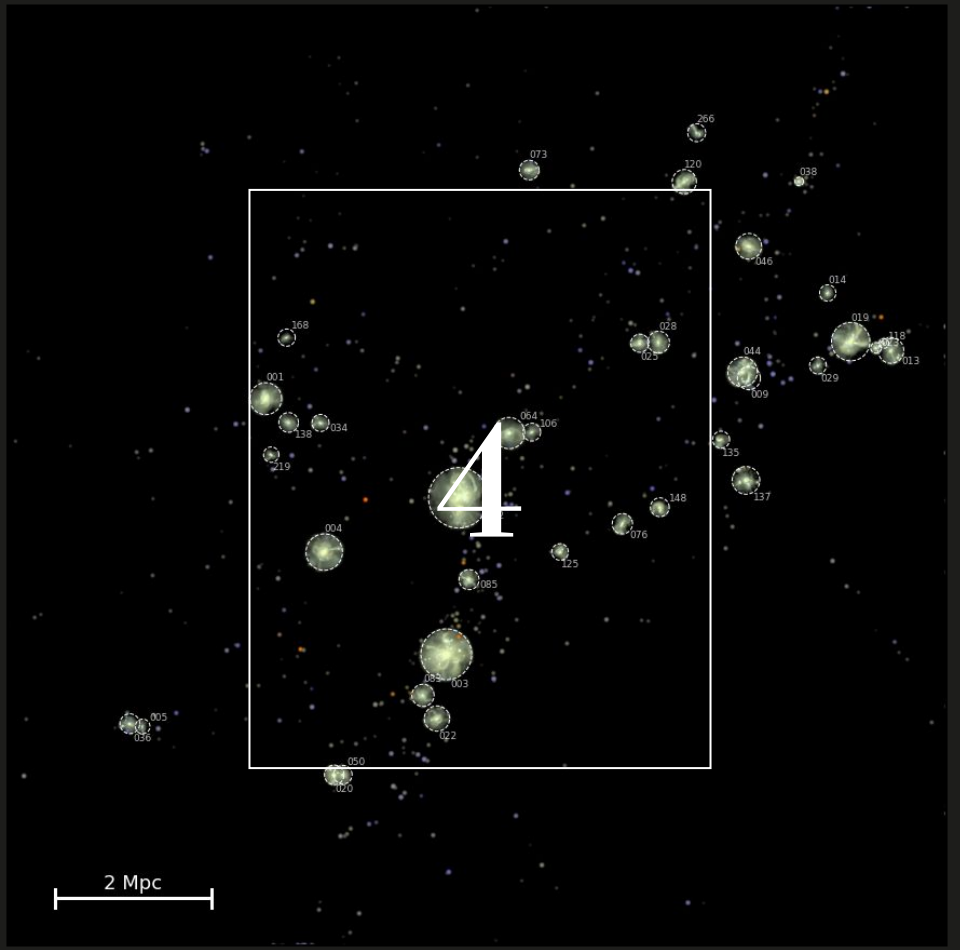
The Vera Rubin Observatory under construction at Cerro Pachon in Chile.

➔ Deeper observations available from e.g. The Vera C. Rubin Observatory, JWST and Euclid will allow us to discover large samples of merging and interacting dwarf galaxies.

➔ It will be possible to study how mass assembled in the dwarf regime and the processes that trigger star formation is triggered by interactions and mergers?

Left: Tidal features visible with SDSS, Decals (2 mag deeper), HSC (4 mag deeper)

Right: SDSS vs HSC 30 min exposure (**Montes+2021**)



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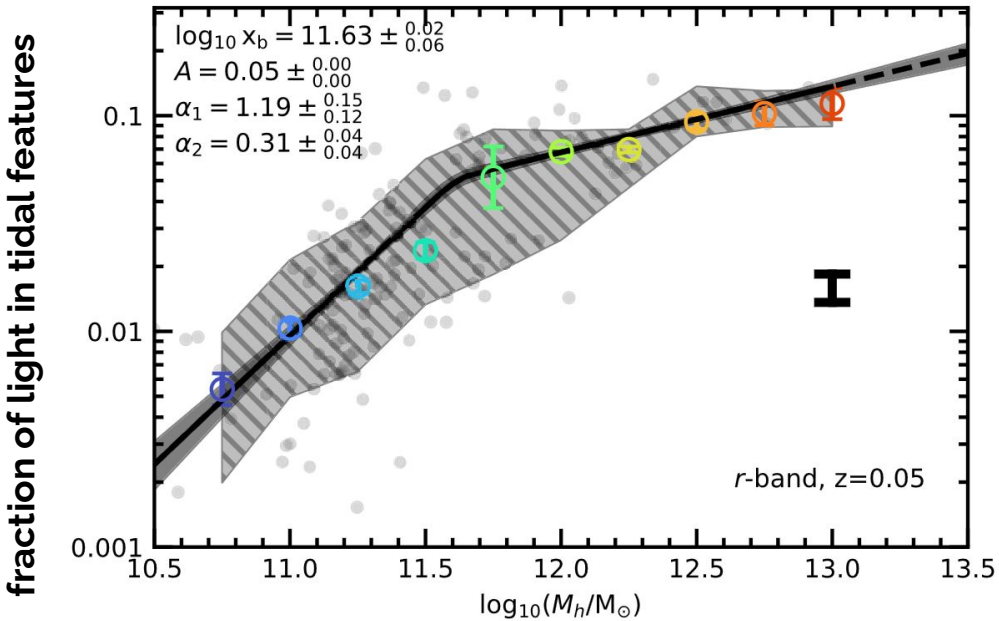
- It will be possible to study how mass assembled in the dwarf regime and the processes that trigger star formation is triggered by interactions and mergers?

- High resolution simulations like NewHorizon **(Dubois+21)** allow us to make predictions

Left: Tidal features visible with SDSS, Decals (2 mag deeper), HSC (4 mag deeper)

Right: SDSS vs HSC 30 min exposure (**Montes+2021**)

Do dwarf galaxies routinely host tidal features?

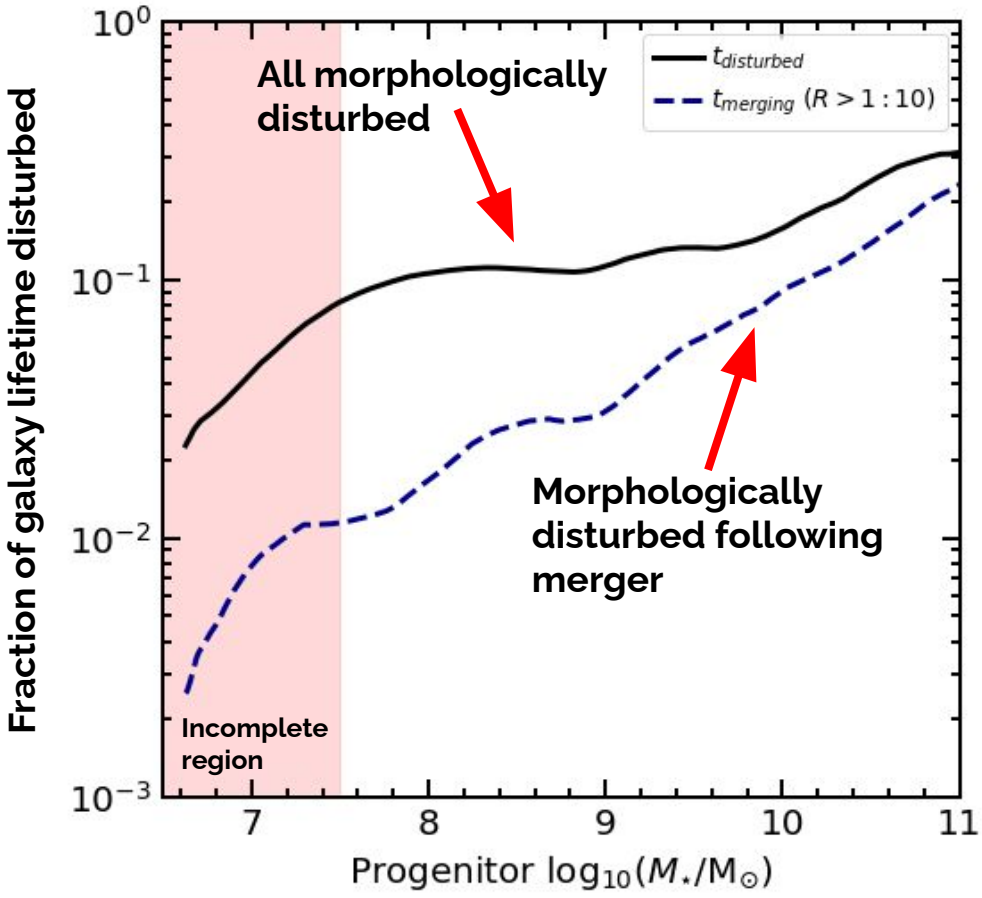


Plot: fraction of *r*-band flux found in tidal features as a function of halo mass **(Martin+2022)**

➔ Increasingly small fractions of light are found in the tidal features of simulated galaxies at low masses

- Possible break found corresponding with the crossover mass at which elliptical galaxies begin to dominate and mergers become the dominant process driving the evolution of galaxies (**e.g. Huertas-Company et al. 2010; Robotham et al. 2014; Thanjavur et al. 2016**).

Martin+2022, MNRAS 513, 1, pp 1459–1487



Plot: fraction of galaxy lifetime spent in a morphologically disturbed state as a function of stellar mass

What drives the production of tidal features in dwarfs?

➔ Galaxies exist in a **disturbed state for 10% - 30% of their lifetime** on average.

➔ Fly-bys become the dominant mechanism producing morphological disturbances **below $10^{9.5}$ M_{sun}**

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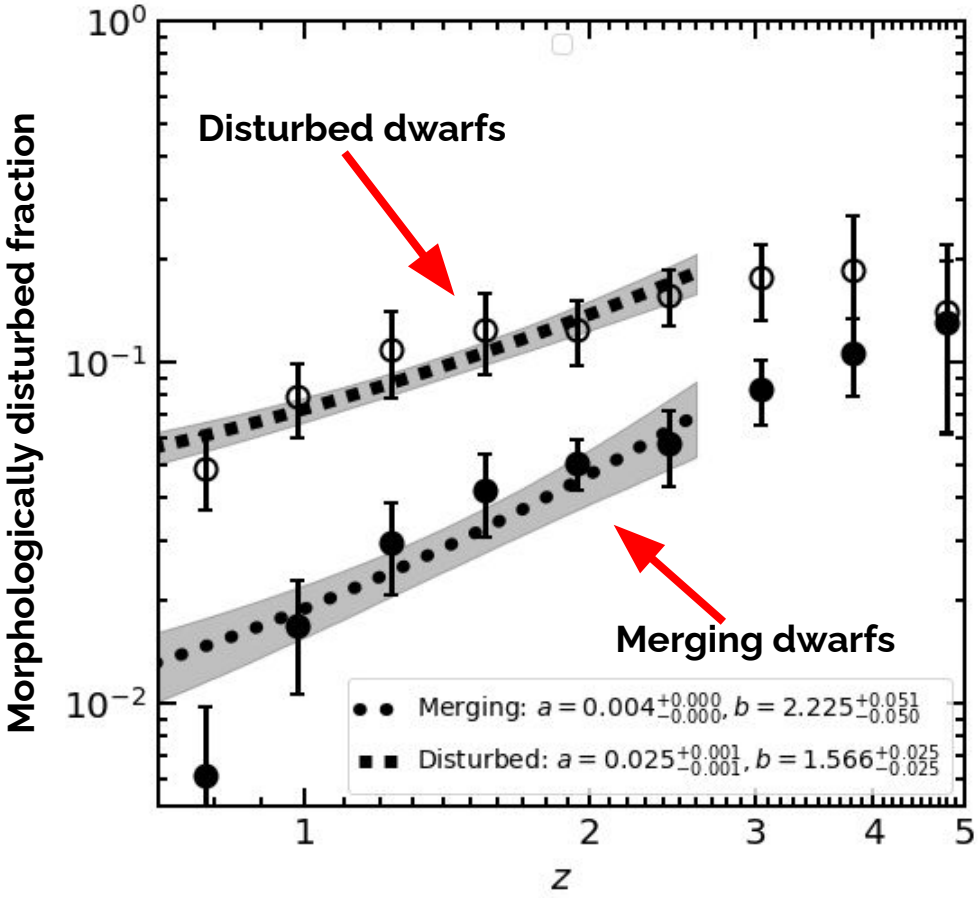
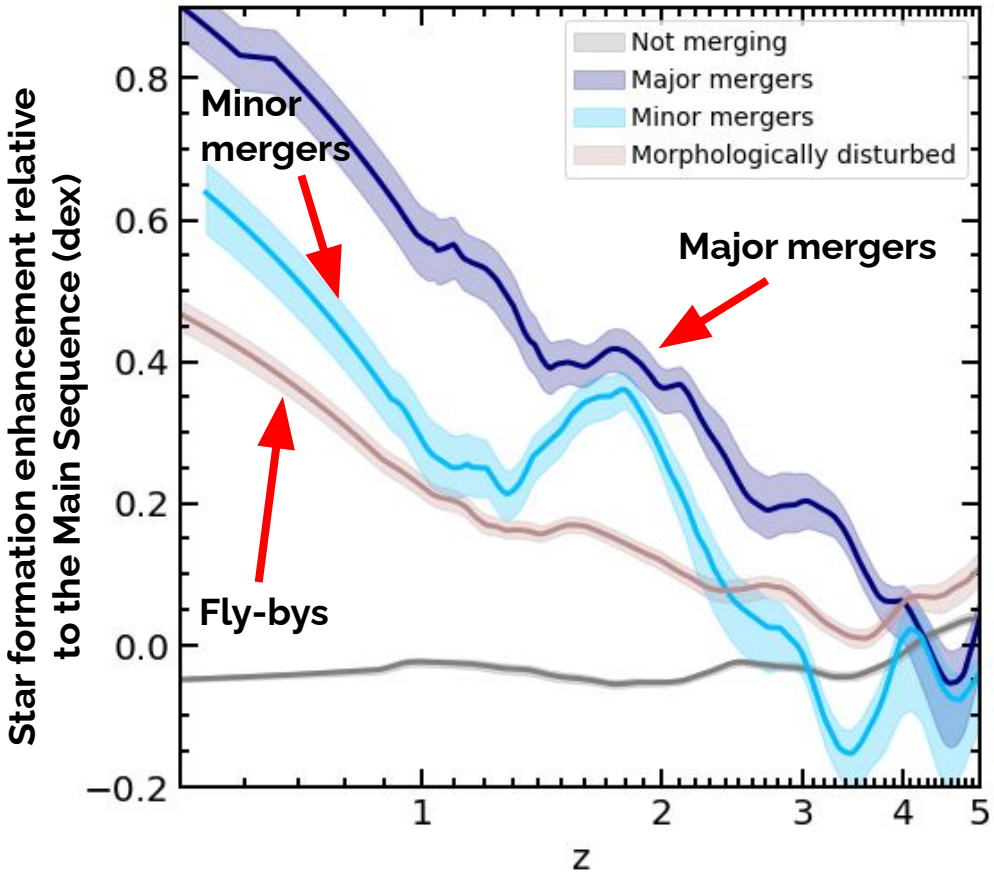


Plot: fraction of merging galaxies and disturbed galaxies vs redshift

What drives the production of tidal features in dwarfs?

- ➔ Galaxies exist in a **disturbed state for 10% - 30% of their lifetime** on average.
- ➔ Fly-bys become the dominant mechanism producing morphological disturbances **below $10^{9.5}$ M_{sun}**
- ➔ Mergers become unimportant in the dwarf regime at low redshift, but disturbed morphologies as a result of **fly-bys could remain significant**.

Martin+2021, MNRAS 500, 4, pp 4937–4957



Plot: average displacement from the star forming main sequence

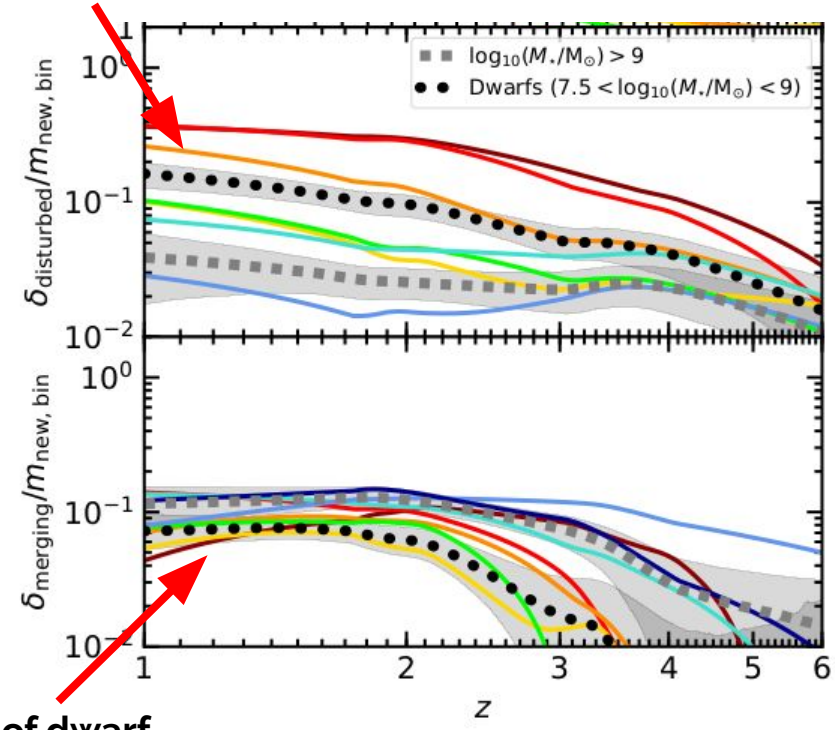
Do mergers drive starbursts and star formation in dwarf galaxies?

➔ At **lower redshifts**, merging and disturbed galaxies are **consistently more star forming** than average for all masses. There is a somewhat smaller enhancement due to interactions, but they are a lot more numerous than mergers.

➔ While interactions are not important as triggers of star formation in the early Universe (e.g. **Mihos+1997**; **Brosch+04**), they appear to become increasingly important in the low-z Universe.

Martin+2021, MNRAS 500, 4, pp 4937–4957

Fraction of dwarf SFR budget driven by fly-bys



Fraction of dwarf SFR budget driven by mergers

Contribution to the mass budget

- ➔ Fly-bys drive an increasingly large proportion of the total star formation budget towards lower redshifts
  - 10% of the total SF budget over cosmic time
  - Similar to direct accretion from ex-situ sources – also around 10%.
- ➔ Mergers drive a relatively steady proportion as the merger rate falls rapidly, but is balanced against growing SF enhancement
  - Only 5% of the total SF budget over cosmic time

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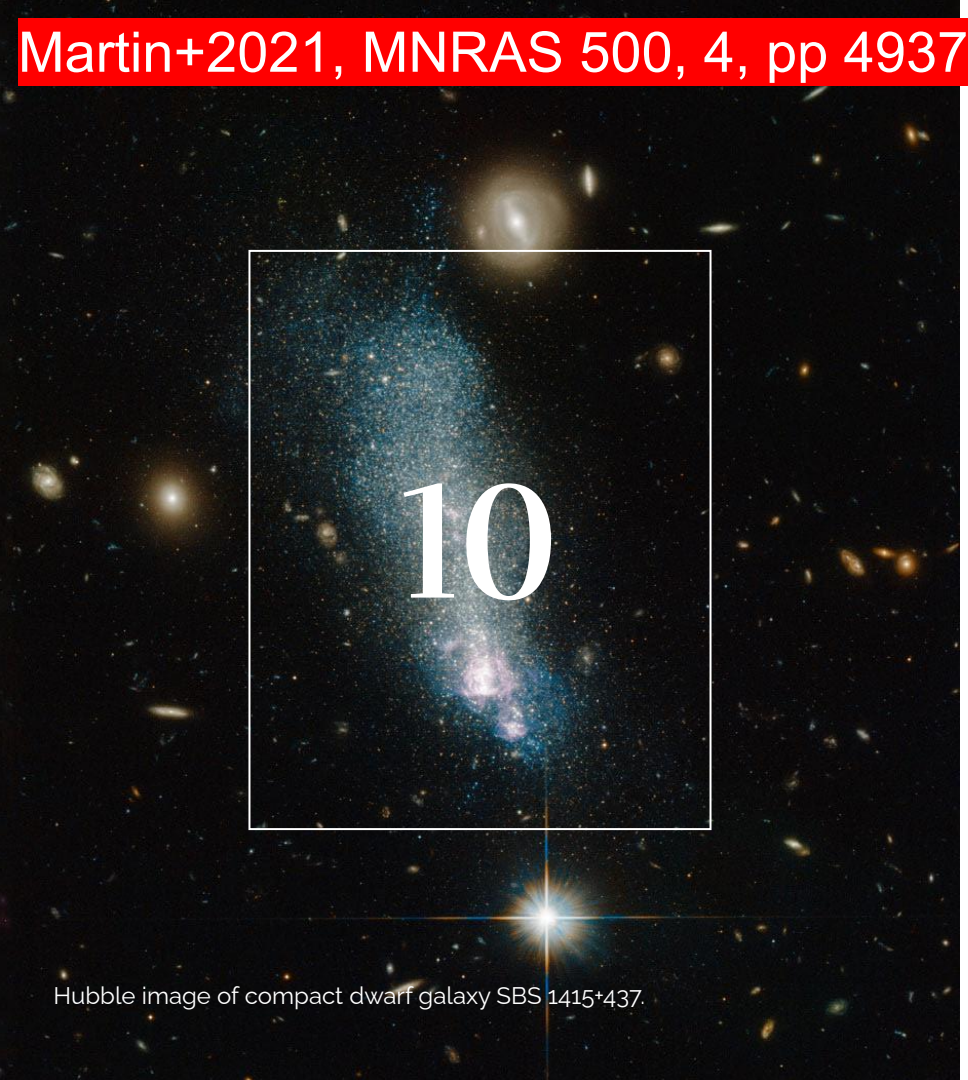

Hubble image of compact dwarf galaxy SBS 1415+437.

Conclusion

- ➔ Tidal features are increasingly rare in galaxies towards lower mass
  - ◆ Rather than mergers, fly-bys become the dominant driver of the visible morphological disturbances in galaxies below $10^{9.5}$ M_{sun}
  - ◆ Apparent merger signatures are likely to be driven by other kinds of interaction in the dwarf regime.
- ➔ Enhancement of star formation by mergers and interactions drive is non-negligible fraction of mass assembly in the dwarf regime
  - ◆ Star formation enhancement from mergers – 5%
  - ◆ Star formation enhancement from fly-bys – 10%.

email: garreth.martin@nottingham.ac.uk