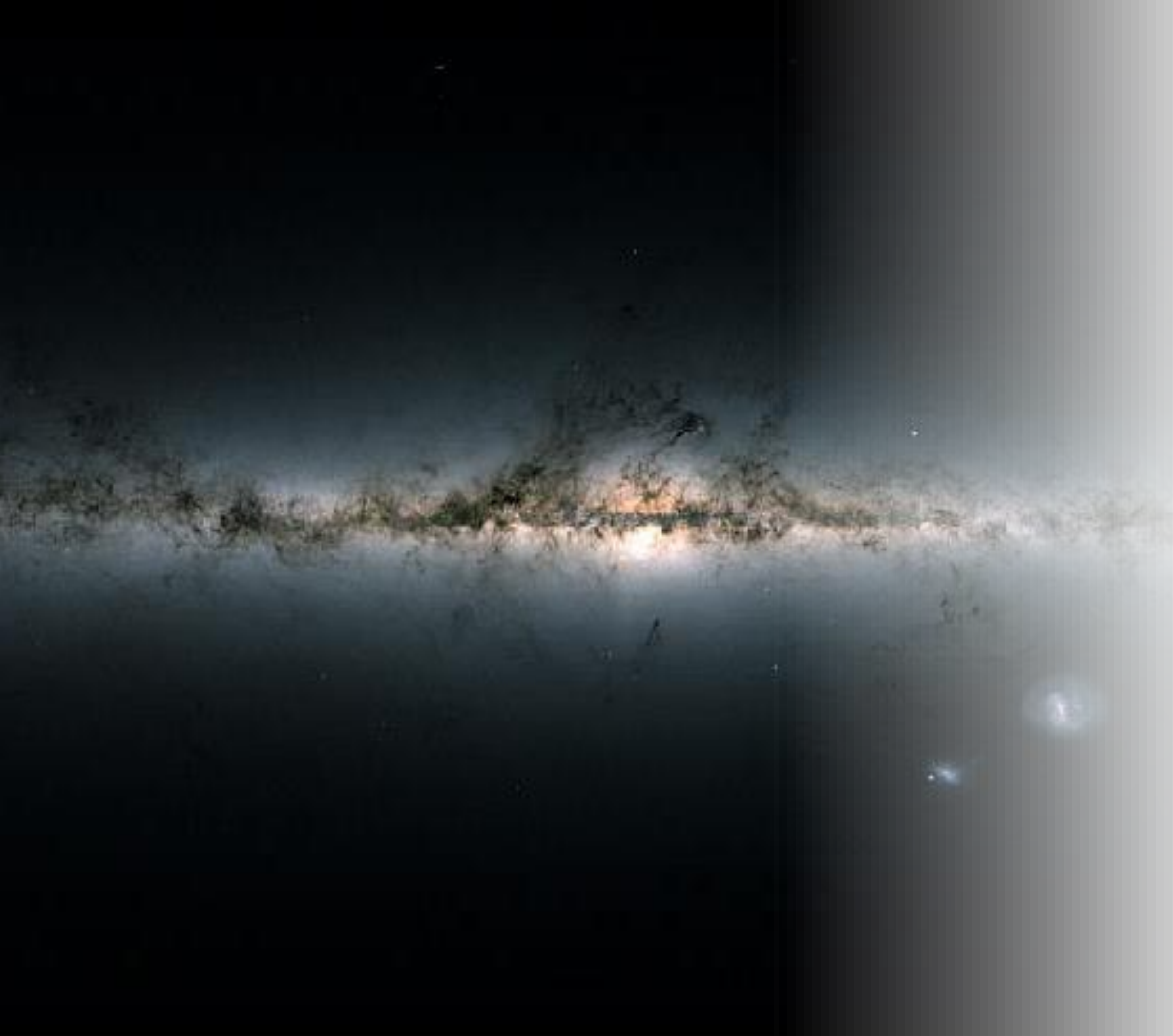


The chemistry of dwarf galaxies in simulated Milky Way-mass systems

and how it relates to merger histories

Andreea Font (LJMU, UK)

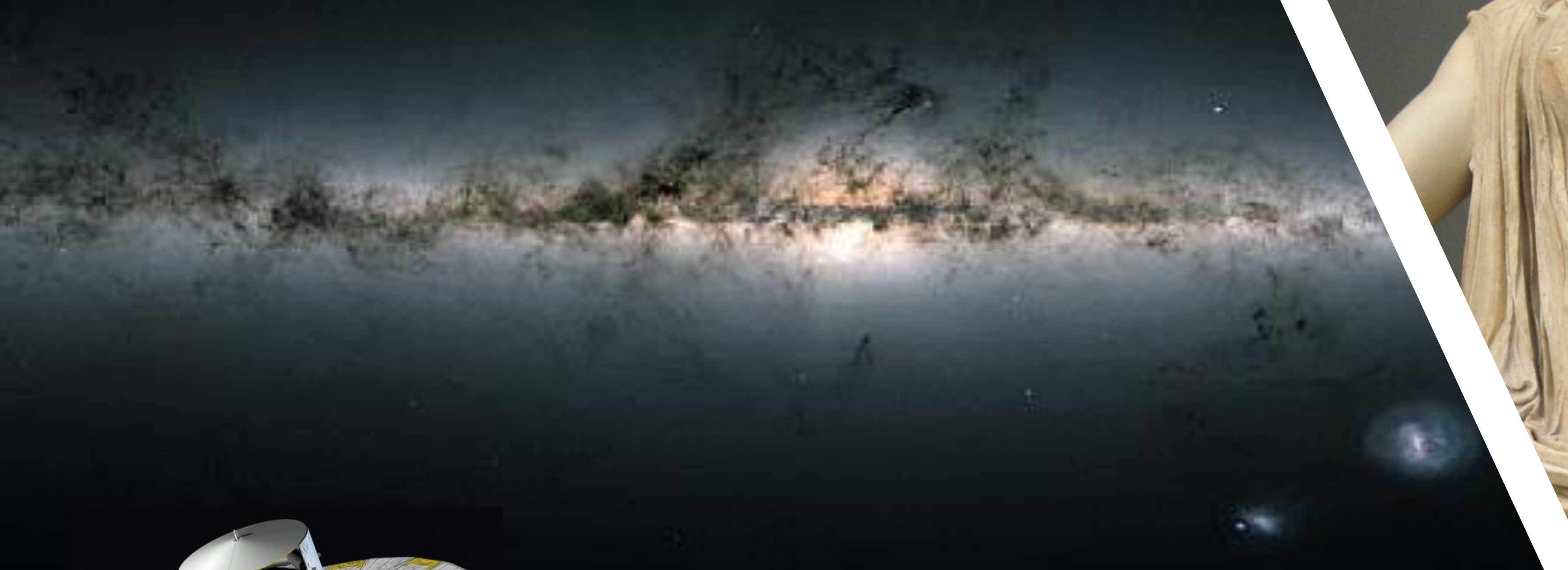
<u>Collaborators:</u>

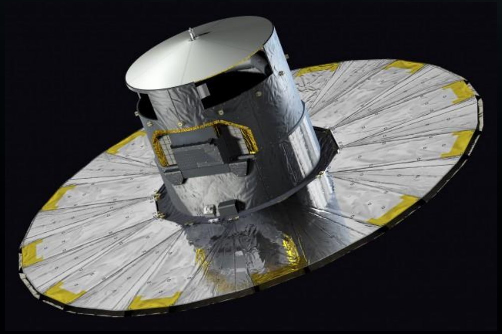
Salvador Grimozzi,
Maria Emilia de Rossi (U. Buenos Aires)

+ EAGLE Team

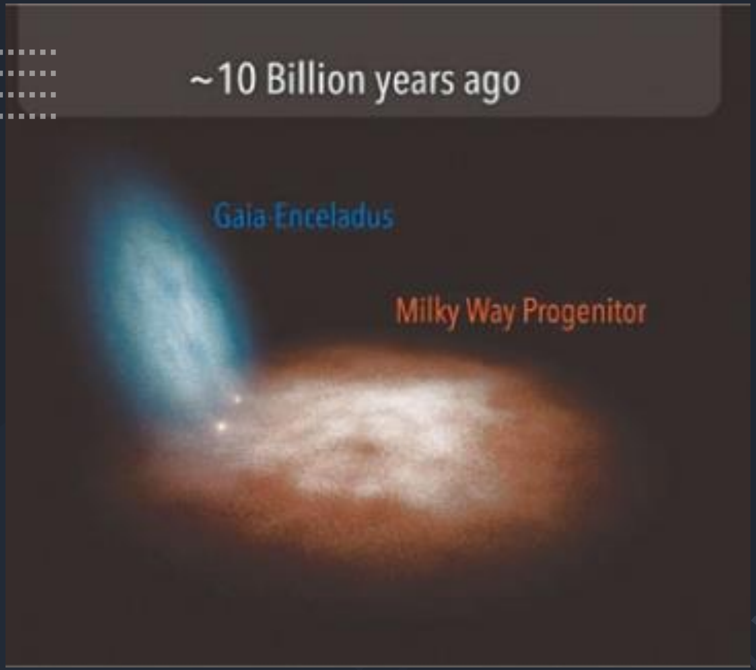
How did the Milky Way form?

- Can we use the properties of ***surviving*** *and/***or disrupted satellites*** *to understand the formation of our Galaxy?*





ESA/Gaia/DPAC



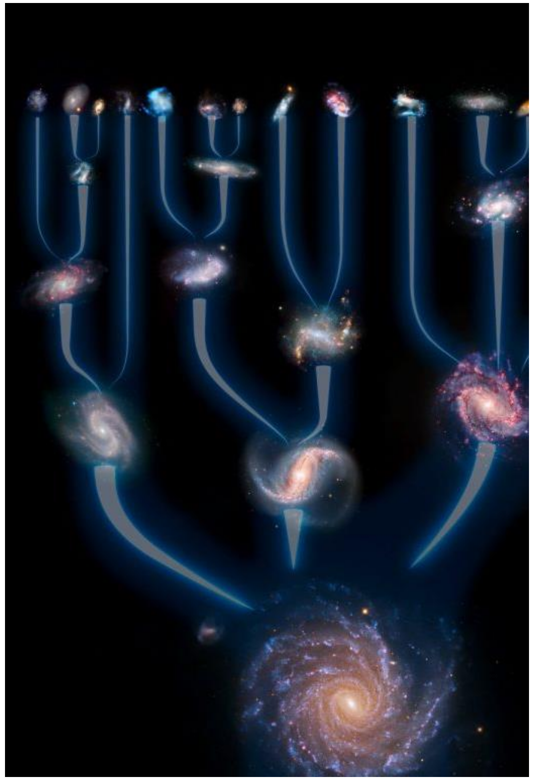
Gaia Discovery: The “Gaia-Enceladus”/”Sausage”

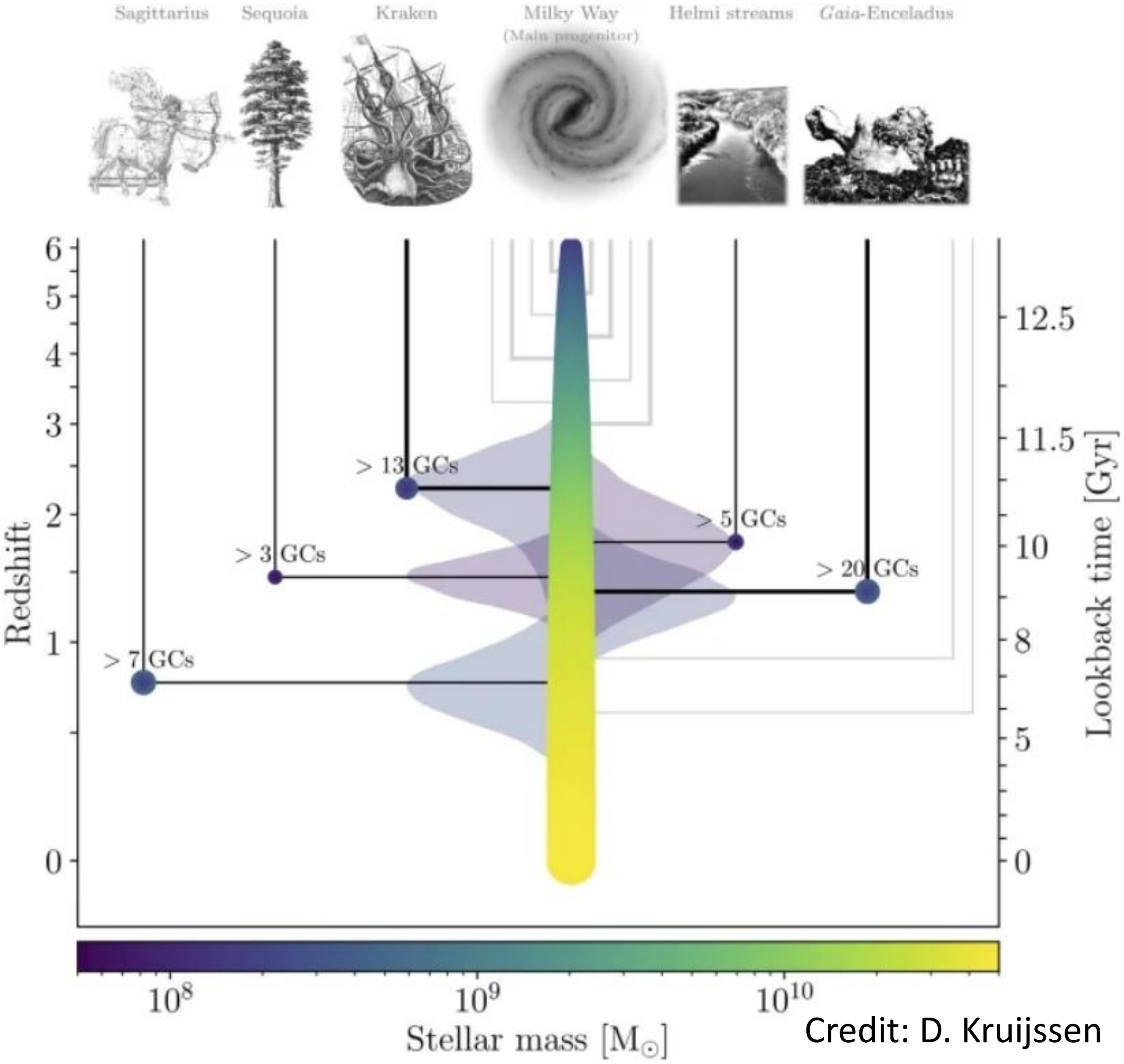
- **an ancient merger with another galaxy of LMC-mass, ~ 9 Gyr ago.**

Helmi et al (2018); Belokurov et al (2018).

Milky Way's 'family tree'

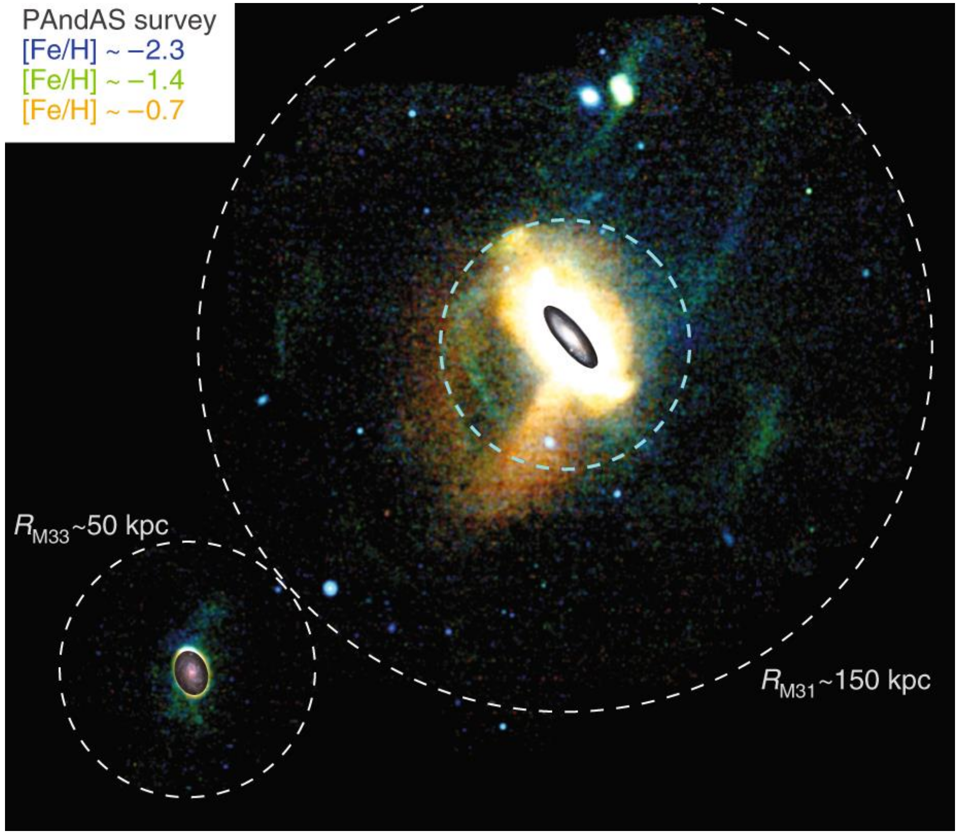
(i.e., the **merger tree**)



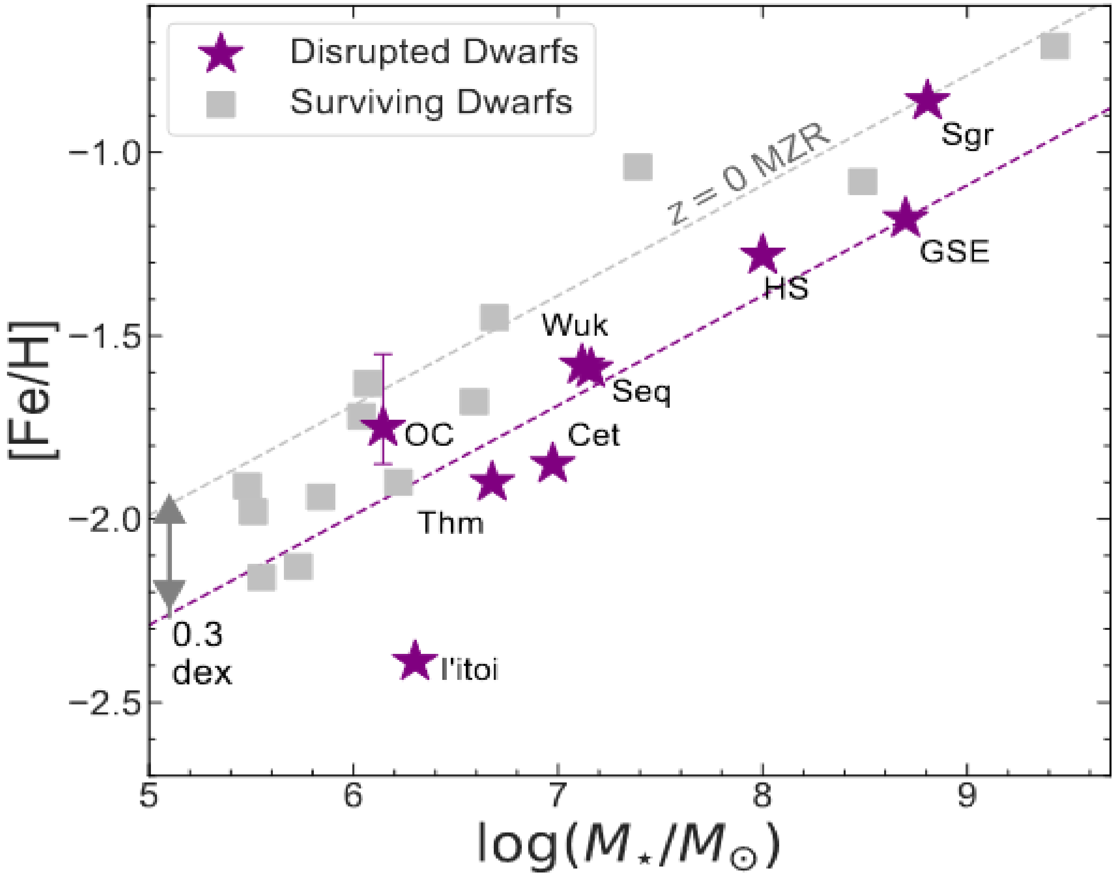


Credit: D. Kruijssen

Tidal debris from disrupted satellites can help constrain the **merger history** of the Galaxy.



M31's stellar halo
PAndAS survey
(Martin et al 2013)

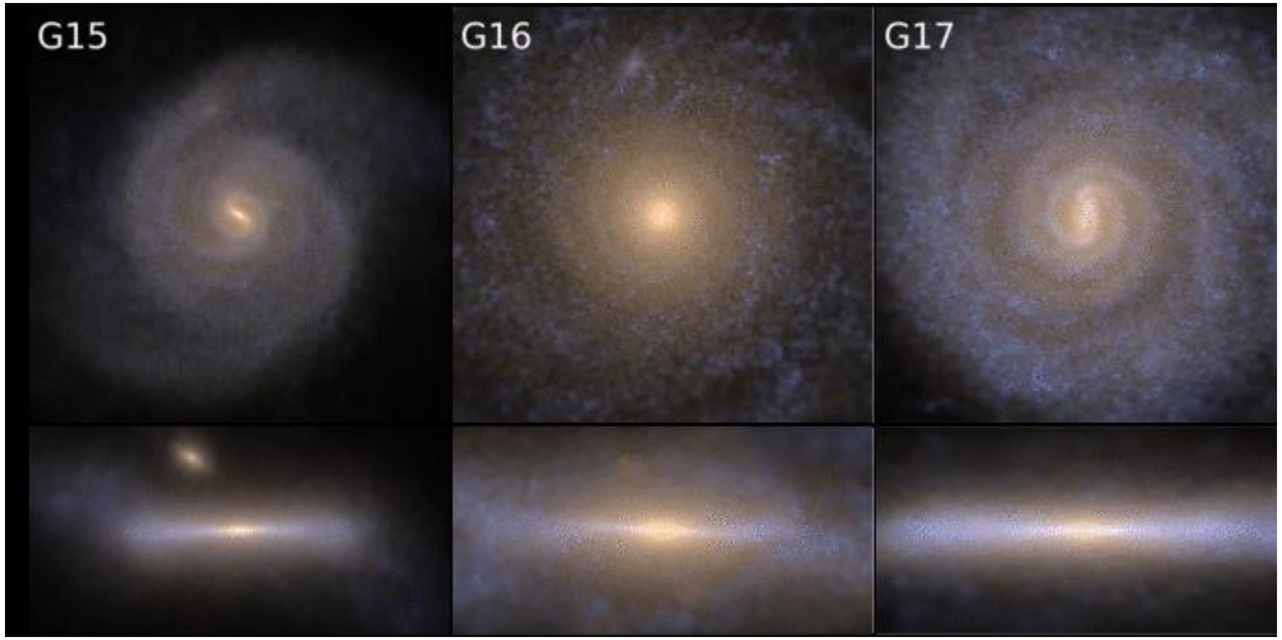


MW satellites: mass – metallicity relation
Gaia DR2 + H3 survey + other obs
(Fig 2 from Naidu et al 2022)

ARTEMIS cosmological simulations

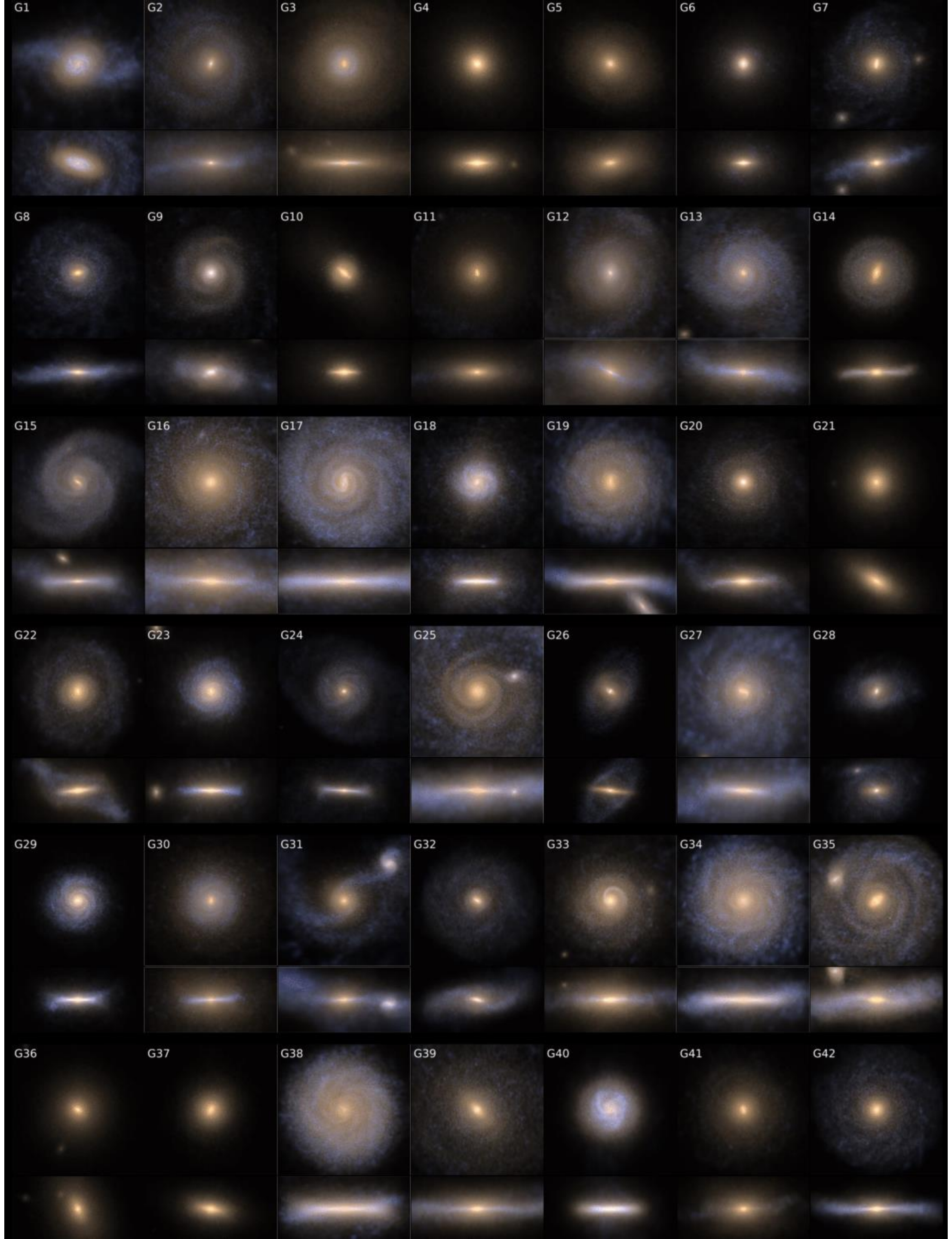
(Assembly of high-ResoluTion Eagle-simulations of MIlky Way-type galaxieS)

- 45 MW analogues simulated in a ΛCDM cosmology
- Milky Way mass range: $M_{200} = 7 \times 10^{11} - 2 \times 10^{12}\ M_{sun}$
- High resolution: $m_{star} \sim 10^4\ M_{Sun}$, $m_{dm} \sim 10^5\ M_{Sun}$



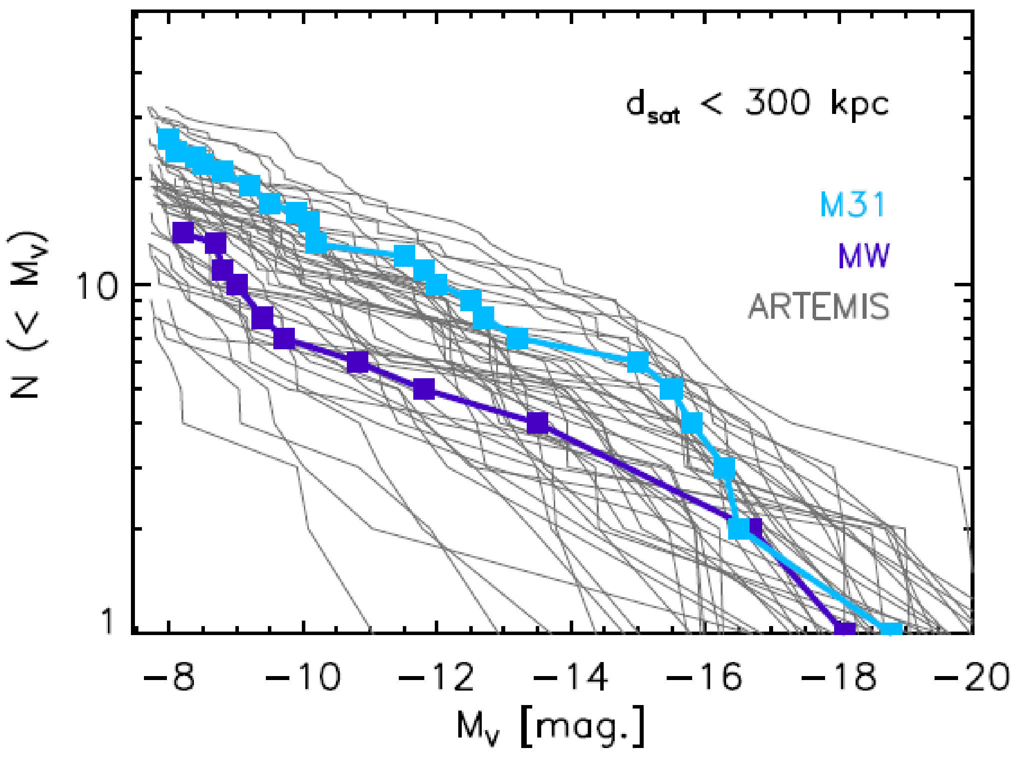
- ran with the 'EAGLE' hydrodynamical code (Schaye et al 2015)

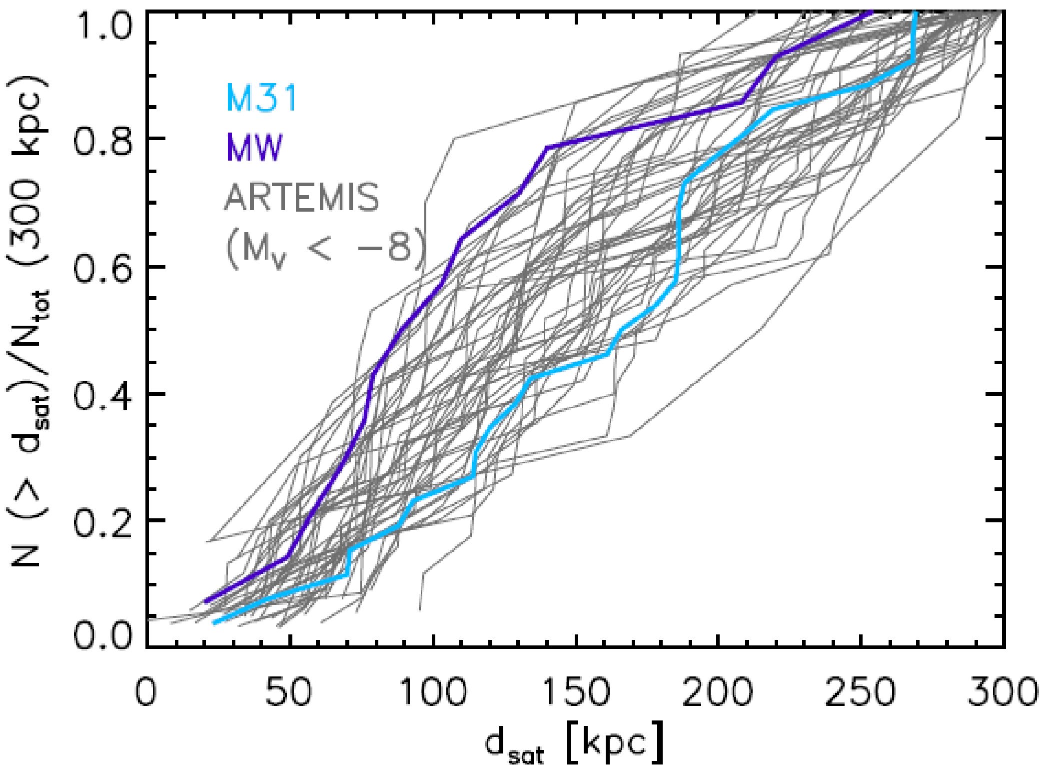
Include prescriptions for star formation, supernova feedback, stellar winds, reionization, AGN feedback, black hole growth.



Font et al. 2020
MNRAS, 498, 1765

ARTEMIS:
Luminosity functions (LFs) and radial distributions of surviving satellites

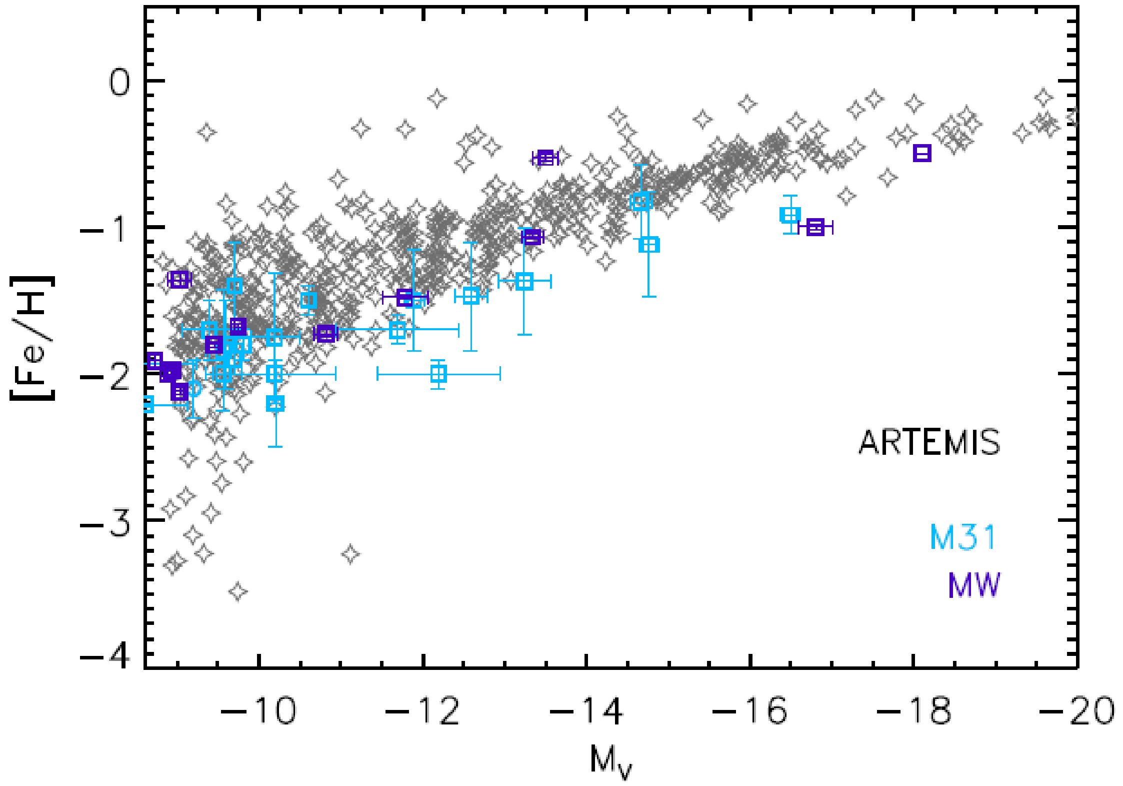




Observations:
McConnachie 2012 + PAndAS survey.

Font, McCarthy & Belokurov (2021)

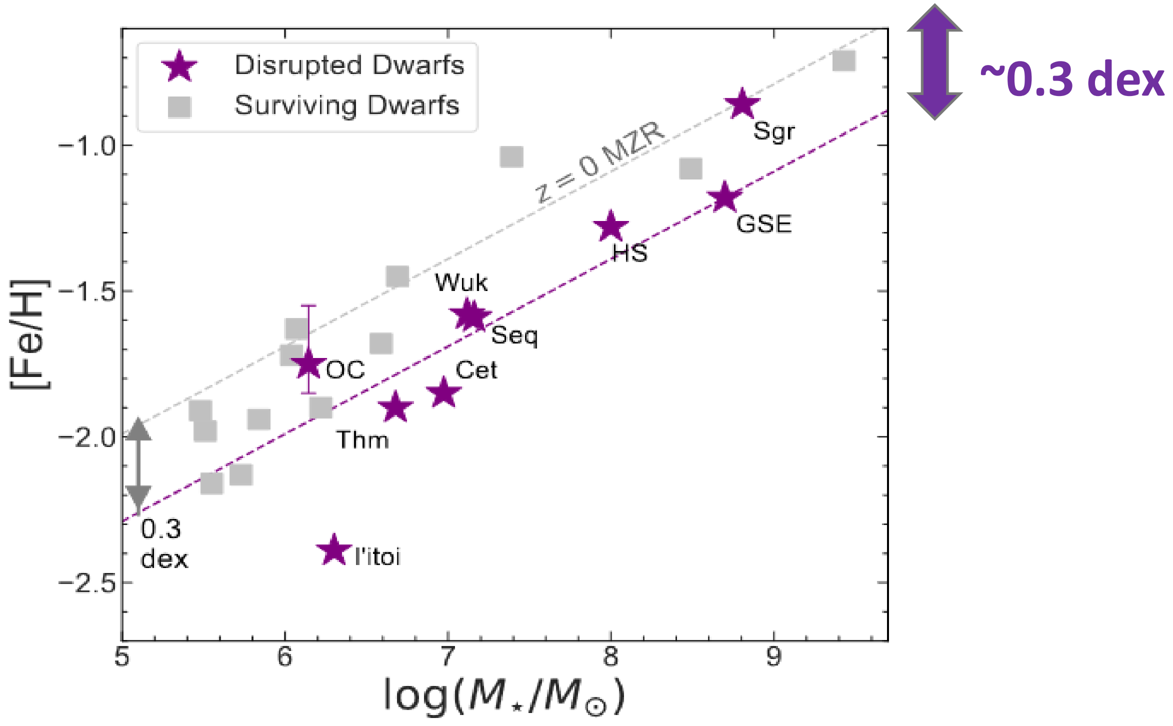
Artemis:
The M_V – [Fe/H] relation of surviving satellites



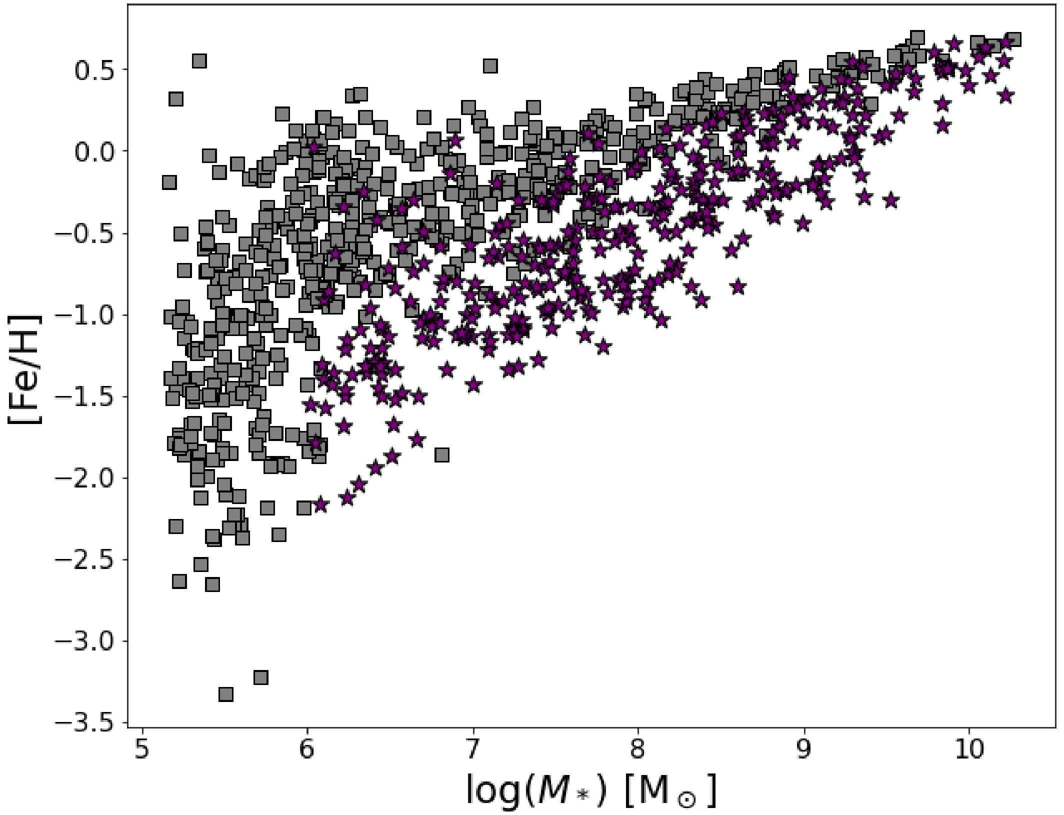
Simulated satellites vs the dwarf galaxies in the Local Group

Observations from Simon 2019, Kirby 2013, Collins et al 2014, Martin et al 2014, Kirby et al 2020.

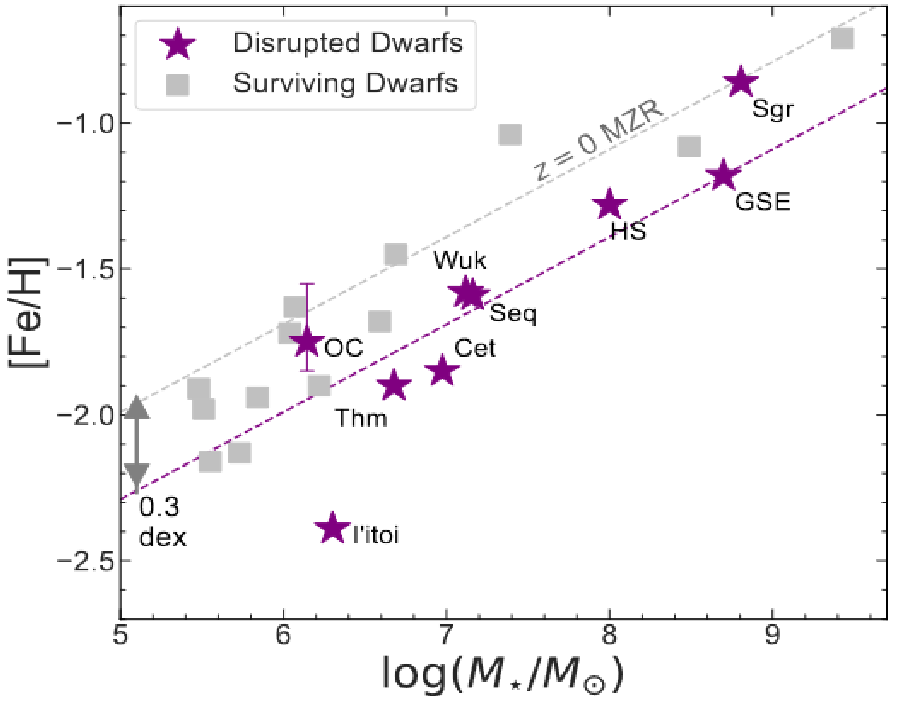
Disrupted vs surviving dwarf galaxies:
[Fe/H] – M_* relation



In the Milky Way
(Naidu et al 2022)



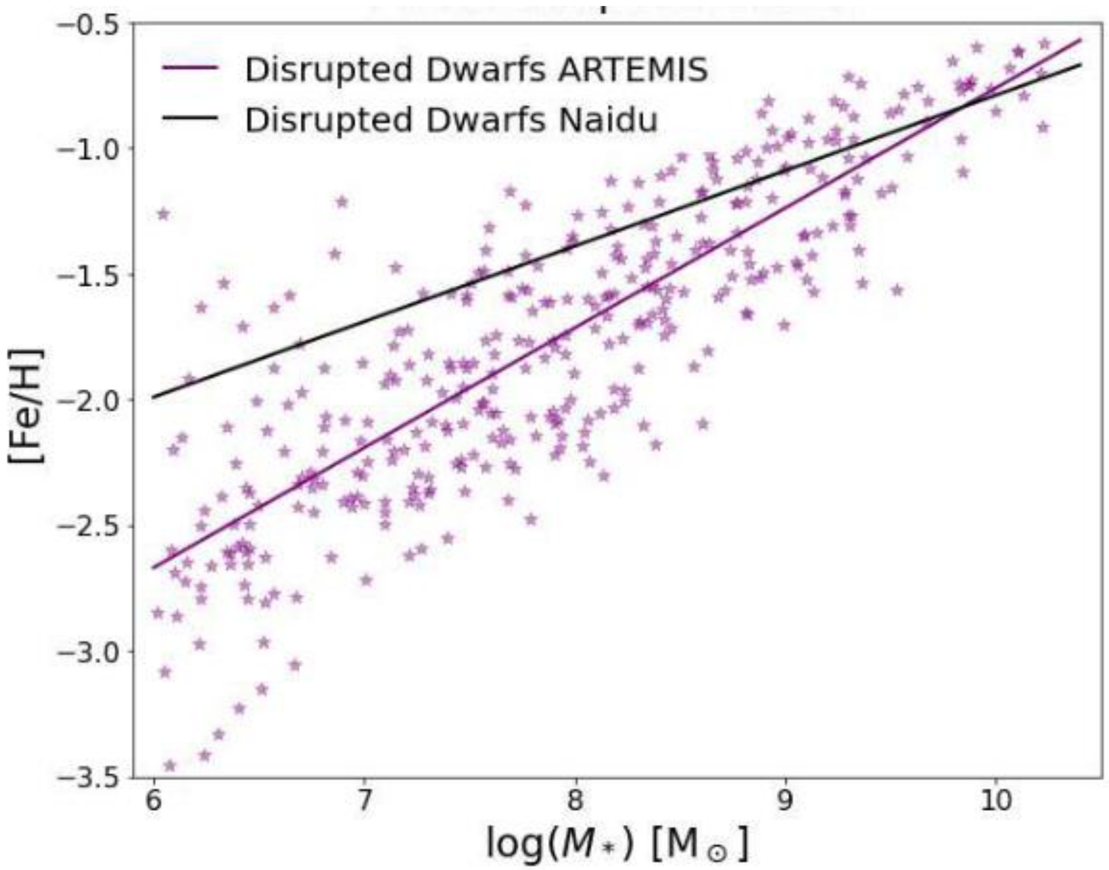
In the Artemis simulations; 45 MW-mass systems
(Gramozzi, AF, de Rossi in prep)



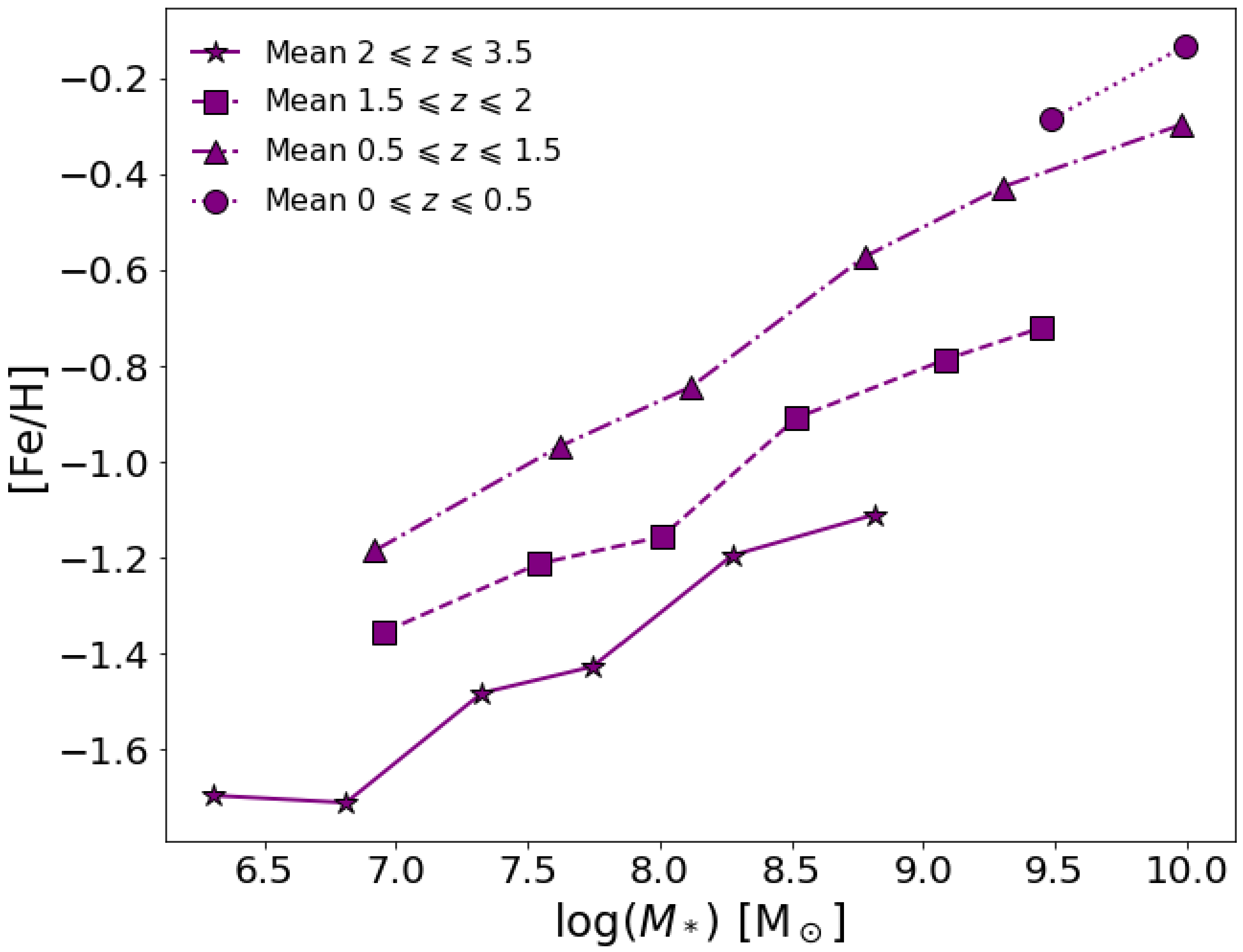
Naidu et al 2022

Simulations agree but predict a **different slope!** *

(*for a *typical* MW-mass system in ΛCDM)



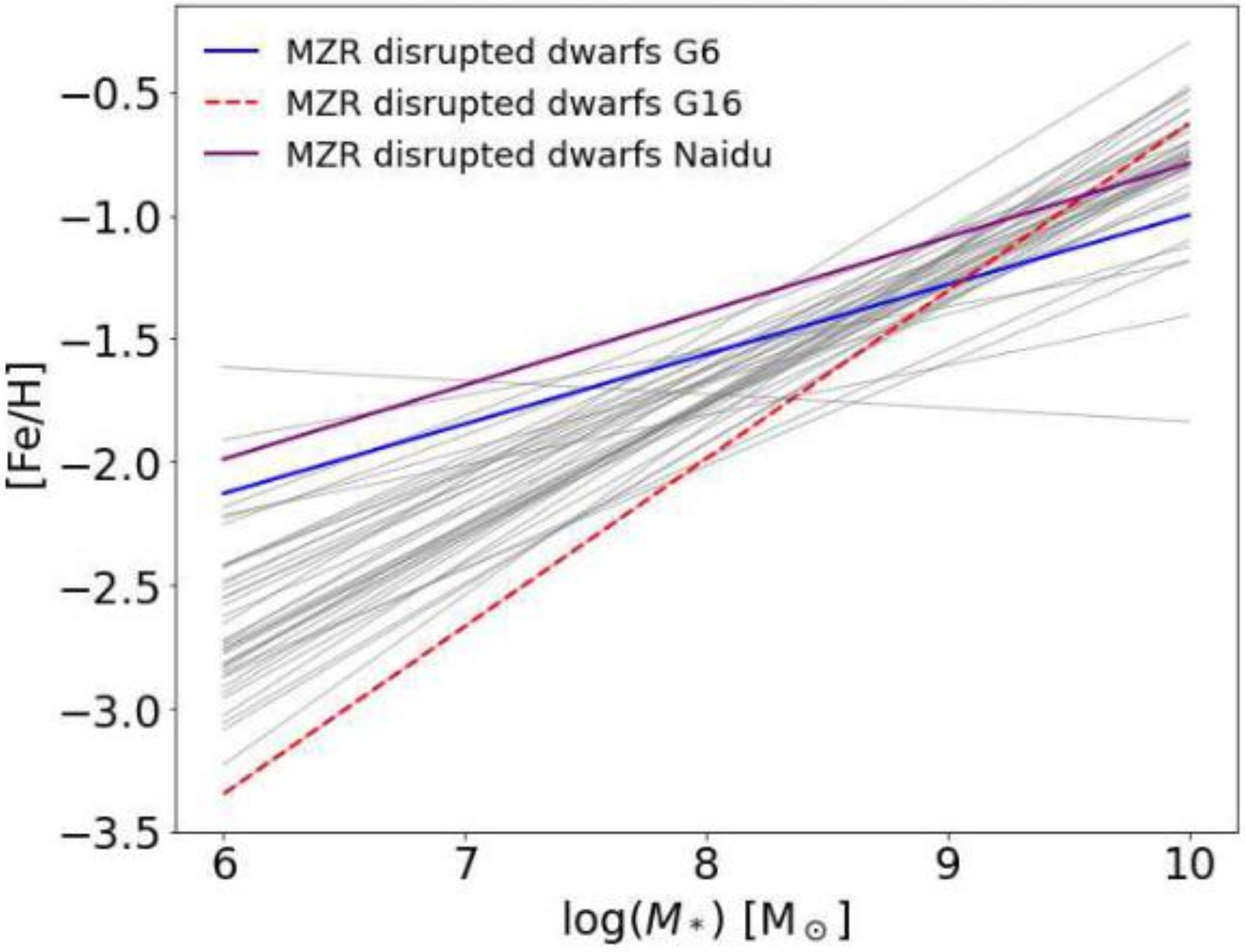
Grimozzi, AF, de Rossi + in prep



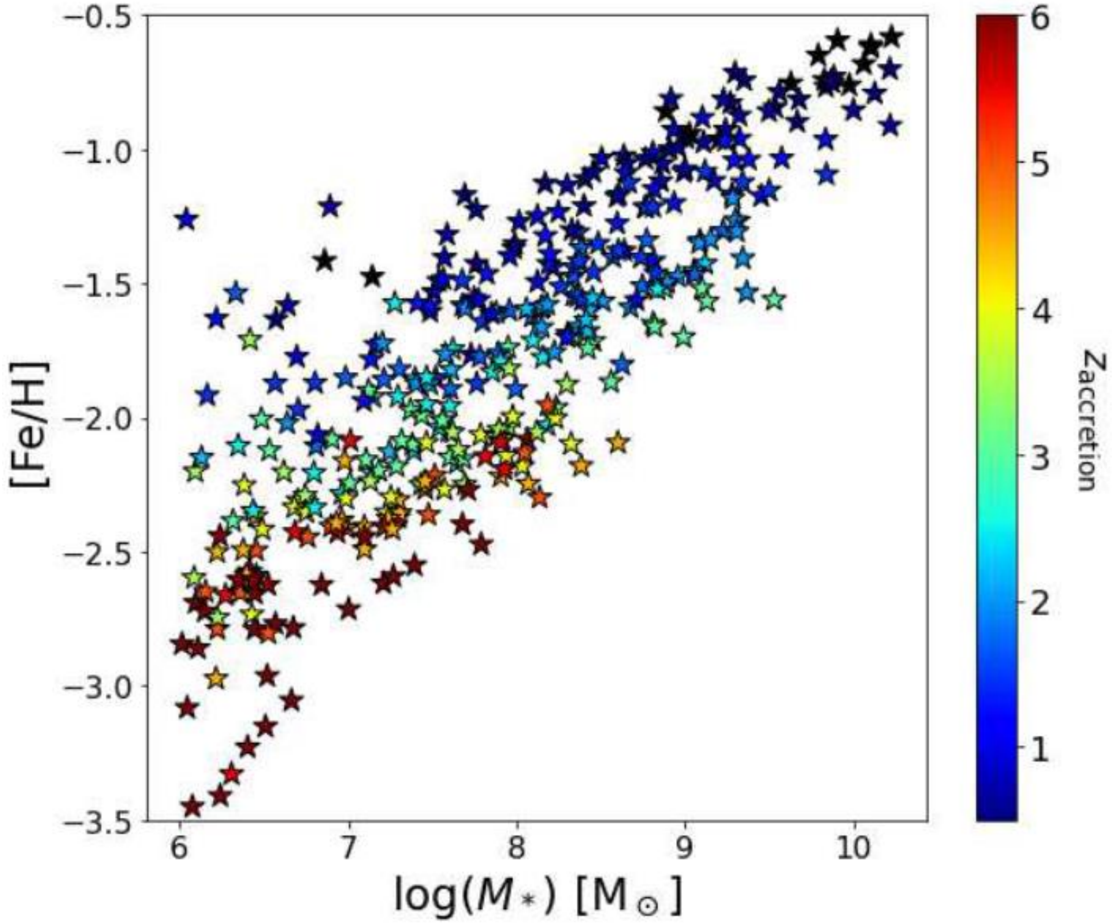
Grimozzi, AF, de Rossi + in prep

Is Milky Way typical?

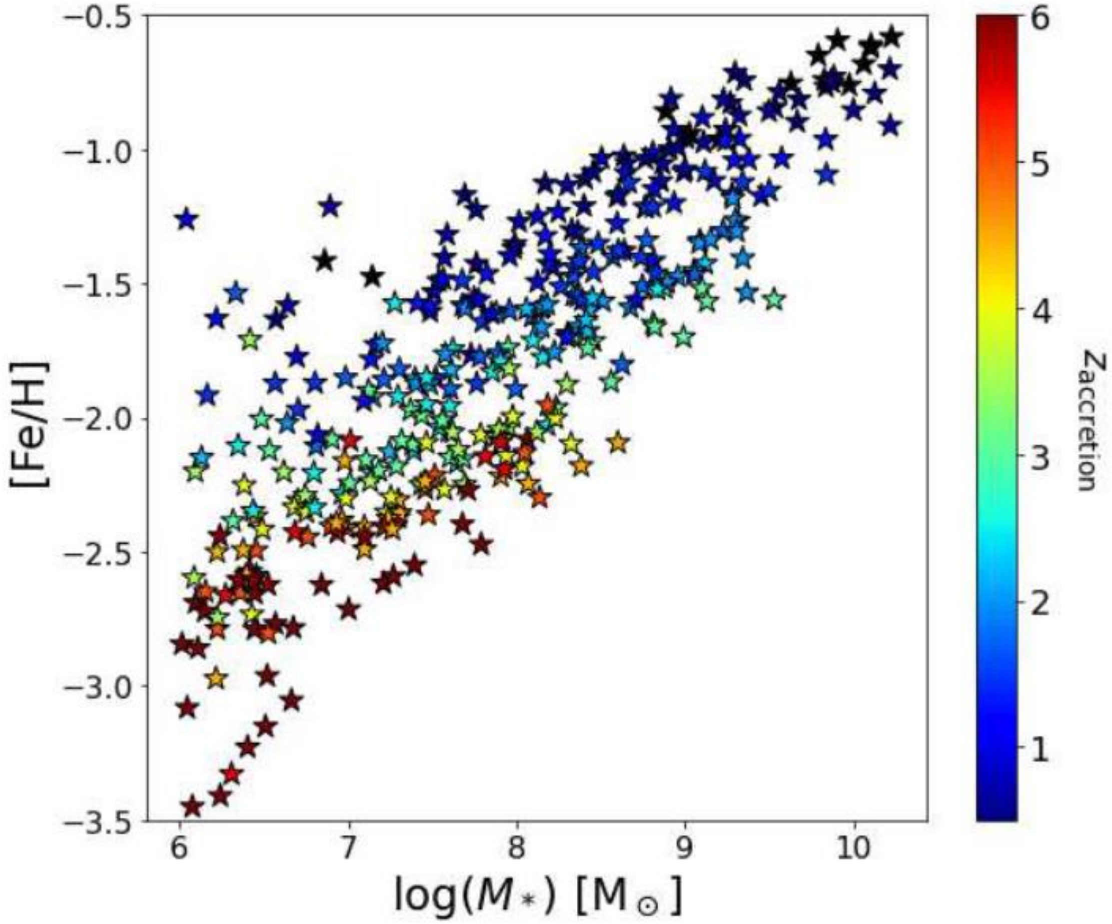
… not necessarily

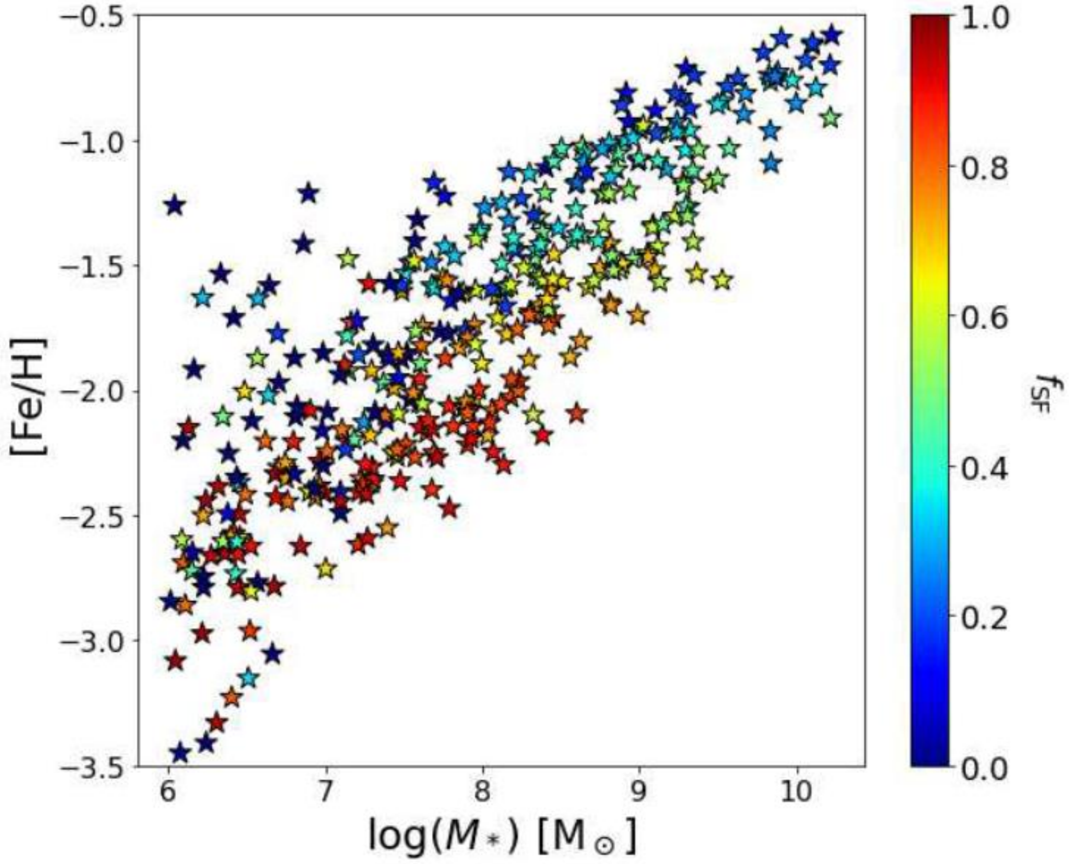


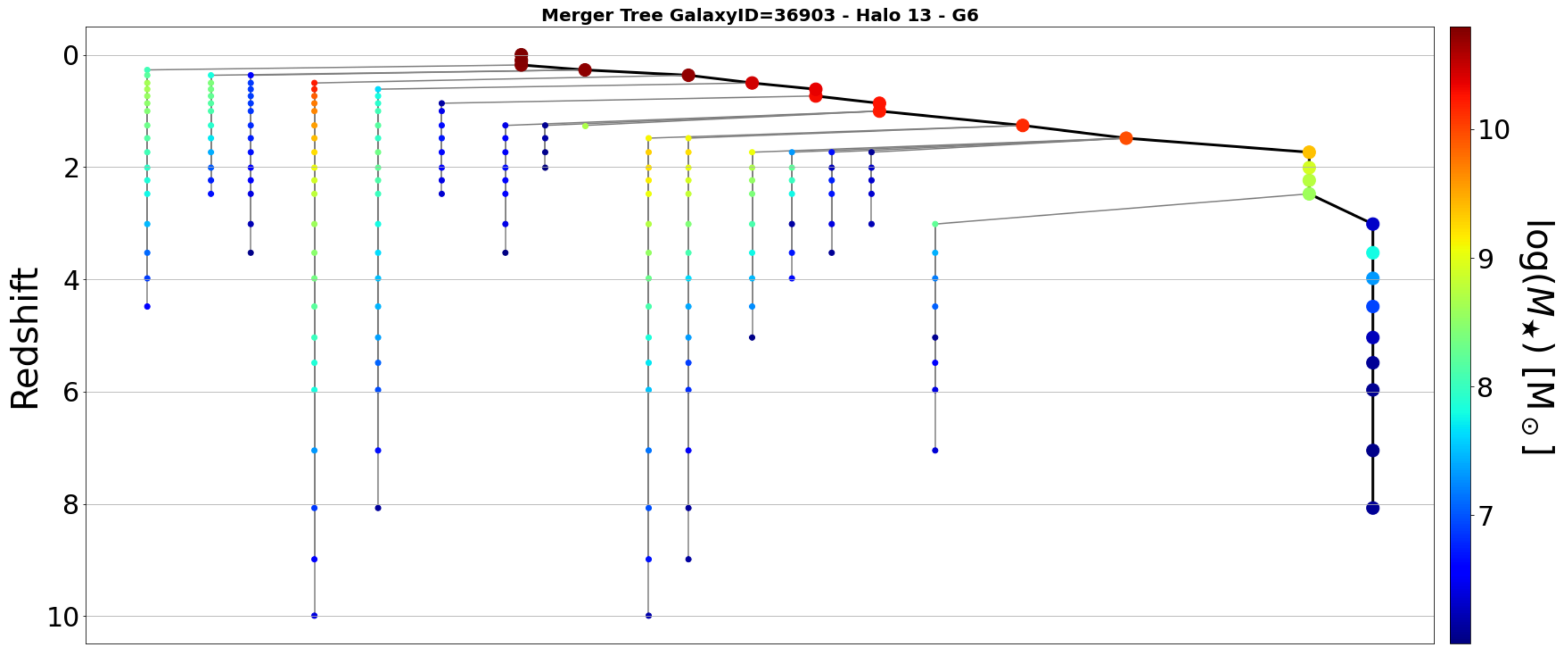
The scatter in the [Fe/H] – M* relation

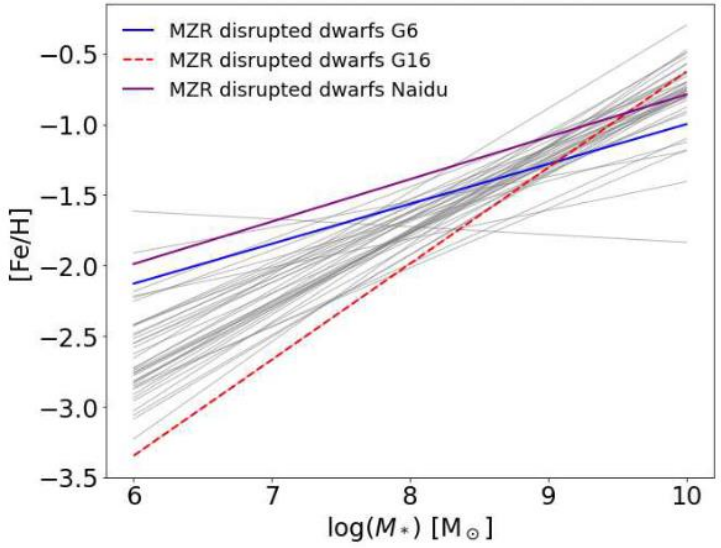


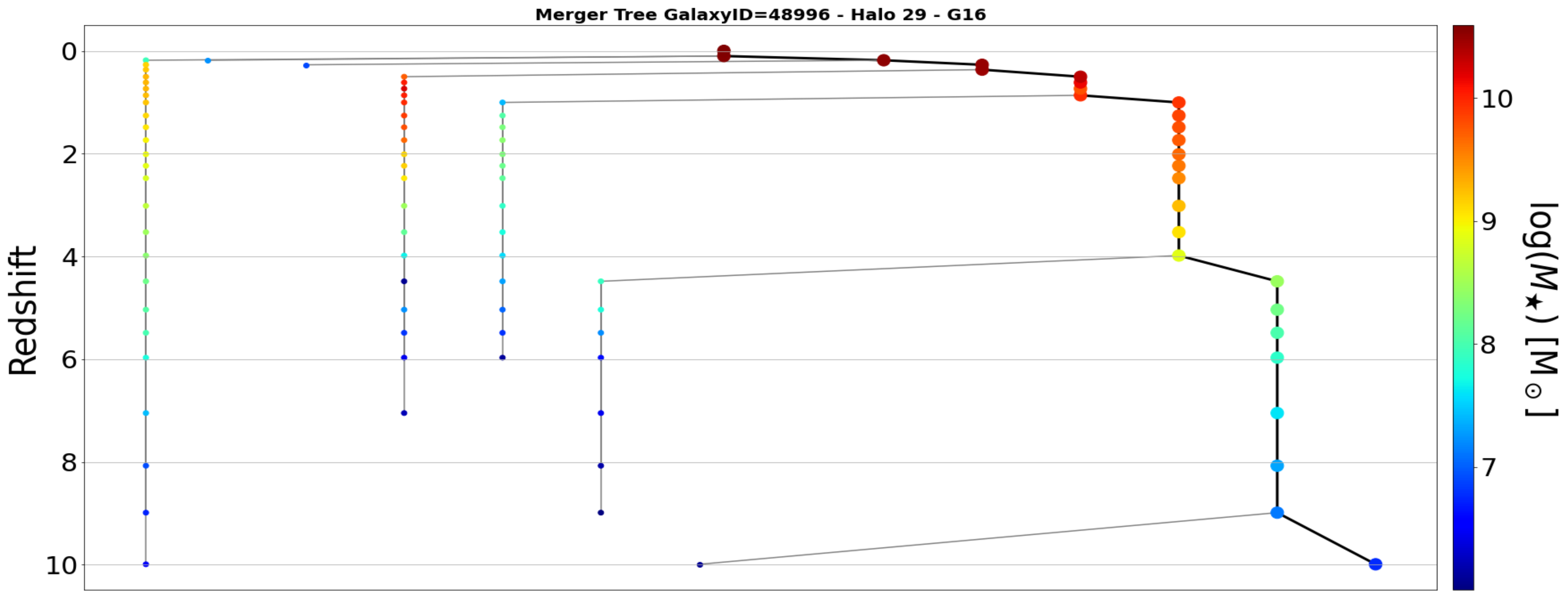
The scatter in the [Fe/H] – M* relation



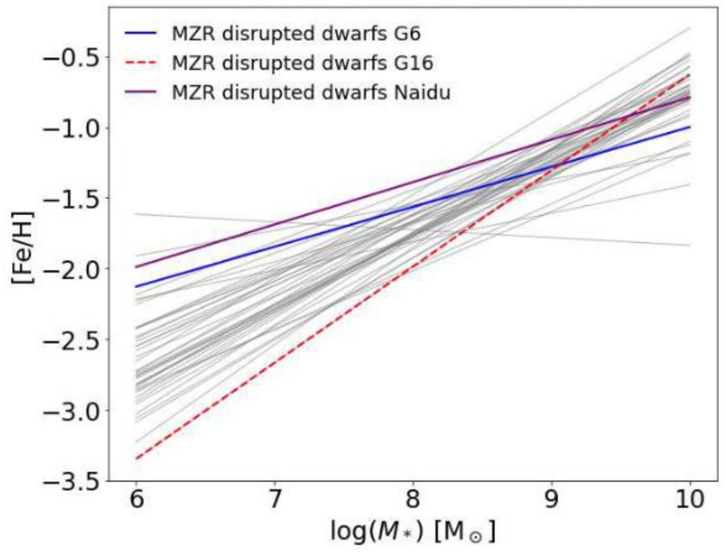



Merger Tree GalaxyID=36903 - Halo 13 - G6
Redshift
0
2
4
6
8
10
log($M_\star$) [$M_\odot$]
7
8
9
10


MZR disrupted dwarfs G6
MZR disrupted dwarfs G16
MZR disrupted dwarfs Naidu
[Fe/H]
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
log(M_*) [$M_\odot$]
6
7
8
9
10



Merger Tree GalaxyID=48996 - Halo 29 - G16
Redshift
0
2
4
6
8
10
log(M⋆) [M⊙]
7
8
9
10



MZR disrupted dwarfs G6
MZR disrupted dwarfs G16
MZR disrupted dwarfs Naidu
[Fe/H]
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
6
7
8
9
10
log(M*) [M⊙]

Conclusions

- ΛCDM models predictions for **surviving dwarf** satellite galaxies agree well with observations

i.e., LFs, radial distributions, [Fe/H] – M* relation.

- The [Fe/H] – M* relation for **disrupted satellites** in ΛCDM is offset compared with the relation for surviving satellites, in agreement with observations. However, the slope depends on the merger history of the MW-mass system.

- The MW is **not quite typical** for a galaxy for its mass: **Recent merging history is less active than for a typical galaxy of its mass.**