THE RAM PRESSURE EFFECT ON STAR FORMATION IN JELLYFISH GALAXIES

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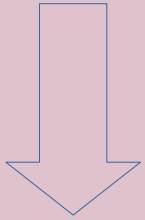
Outline

- Introduction:
  - RAM pressure stripping phenomena
  - Jellyfish galaxies
  - GASP program
  - SINOPSIS
- The work done in this Thesis
  - SFR in Jellyfish galaxies of GASP (global and local analysis)
  - Analysis of asymmetries in Jellyfish galaxies
  - SFH in Jellyfish galaxies
- Conclusions

RAM pressure

- Is a pressure exerted on a body that is moving through a fluid medium.

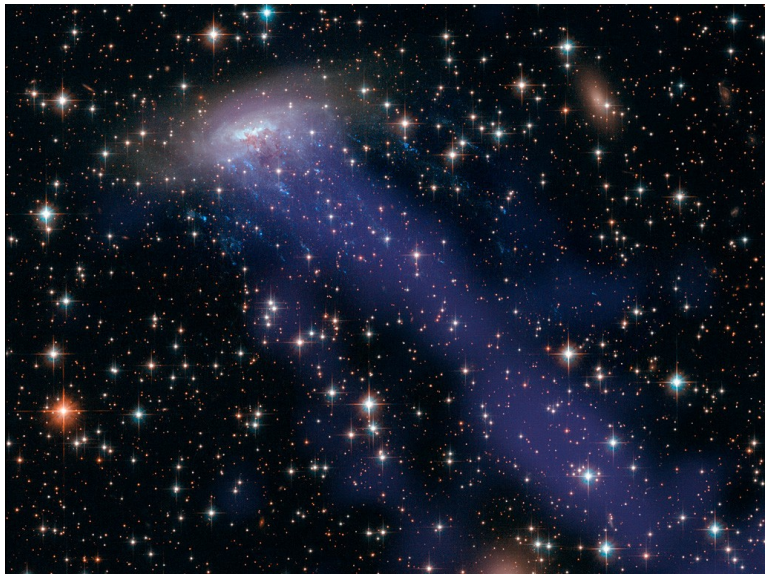


- It causes a strong drag force to be exerted on the body.

Gunn & Gott (1972)

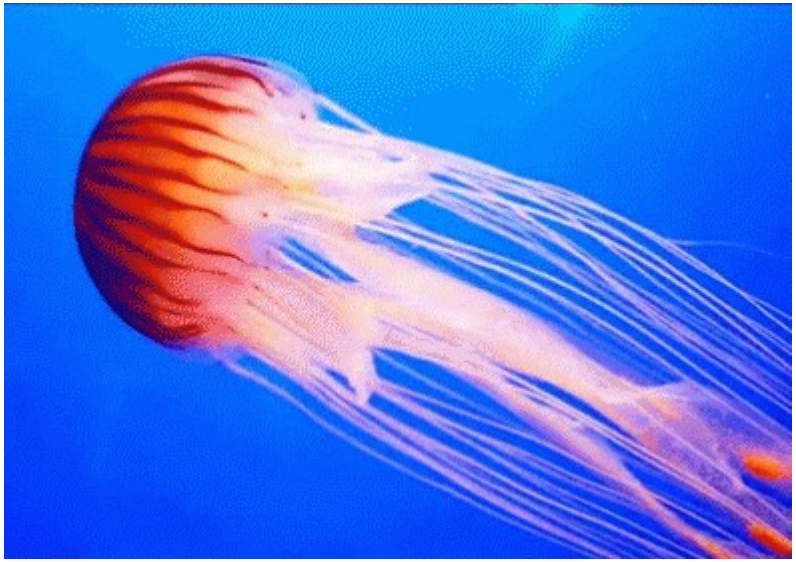
$$P_{RAM} = \rho v^2$$

What is a jellyfish galaxy?



ESO-137-001 in A3627

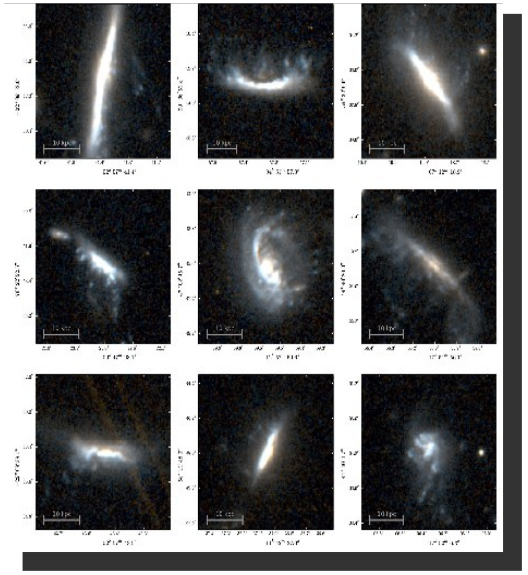
(Credits: NASA/CX-C/UAH/M).



- Jellyfish galaxies: are suffering RAM Pressure Stripping (Smith et al. 2010)

At higher z:

- In clusters at z>0.3



McPartland+2016

Ebeling+2014

Galaxy stripping

Observations

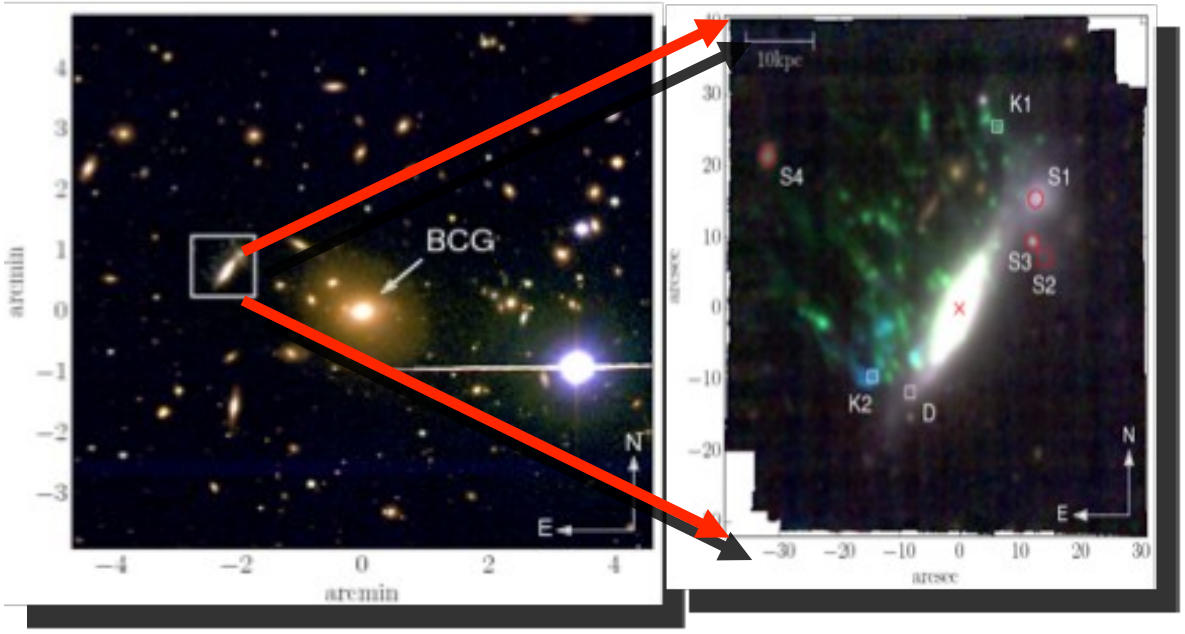


Fig. Image of a galaxy suffering stripping (Gullieuszik+2017).

Simulations

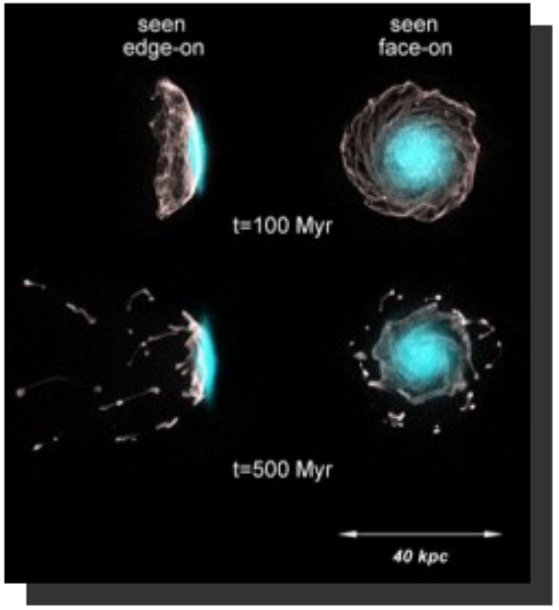


Fig. Simulation of a galaxy suffering stripping (Kronberger+2008).

SF activity & Simulations

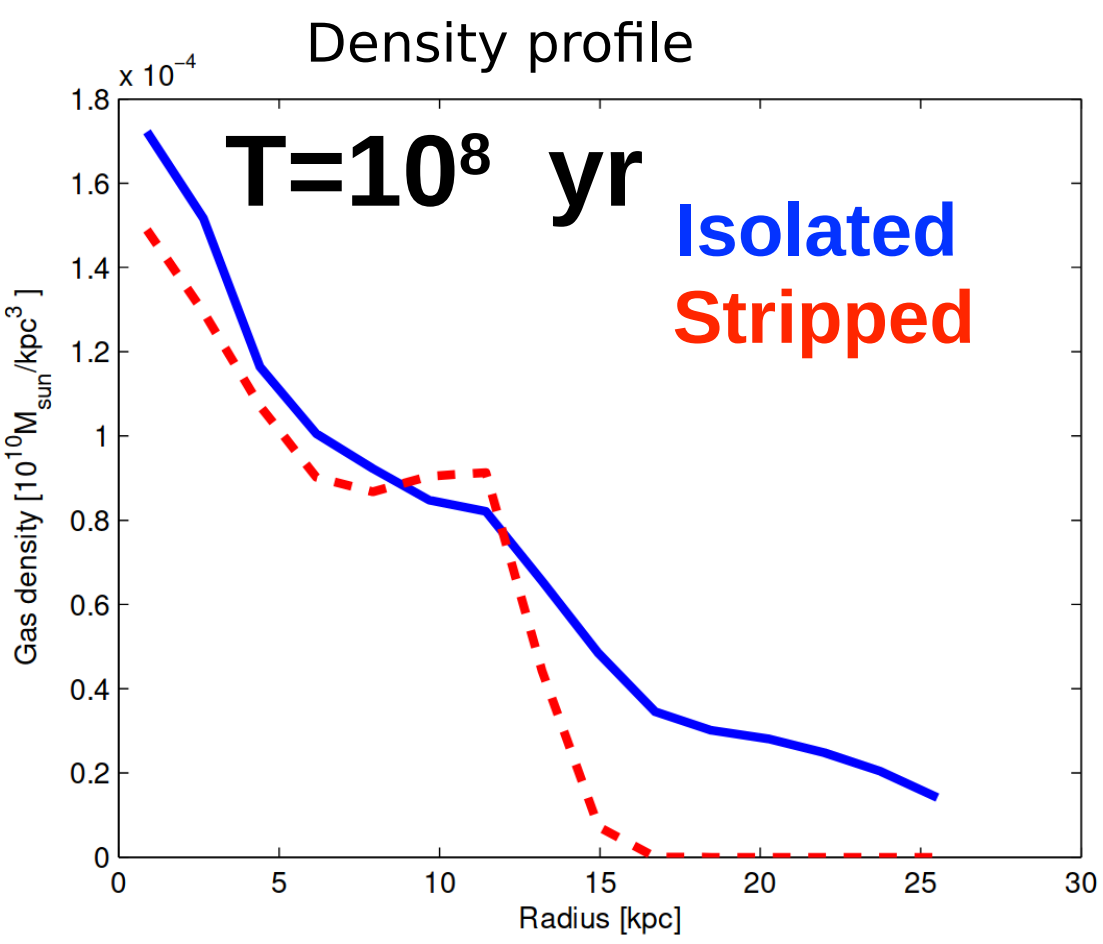
- By compressing the gas RAM pressure can enhance star formation by a factor of ~2 or more
- As the galaxy approaches the center of the cluster SF drops

  (Fujita & Nagashima+1999)
- This generates a double effect...

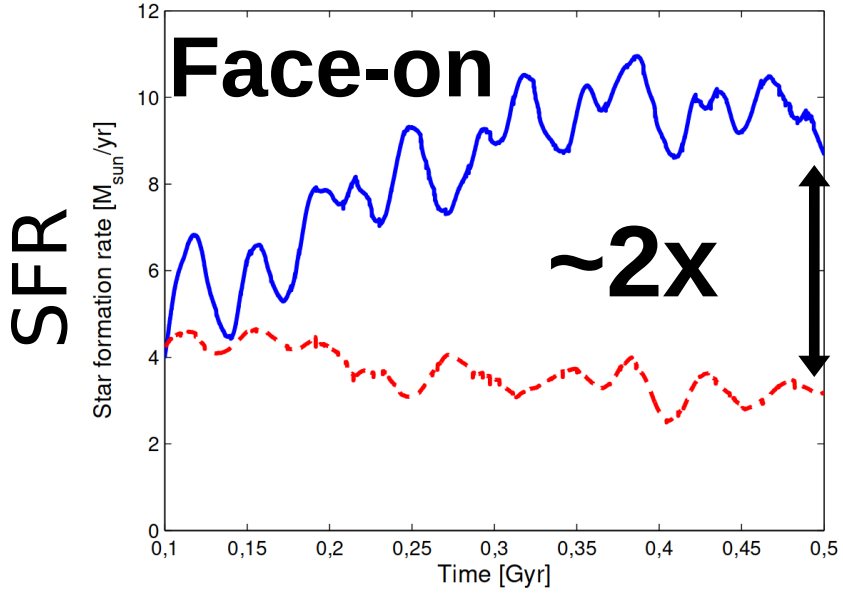
  (Kronberger+2008)

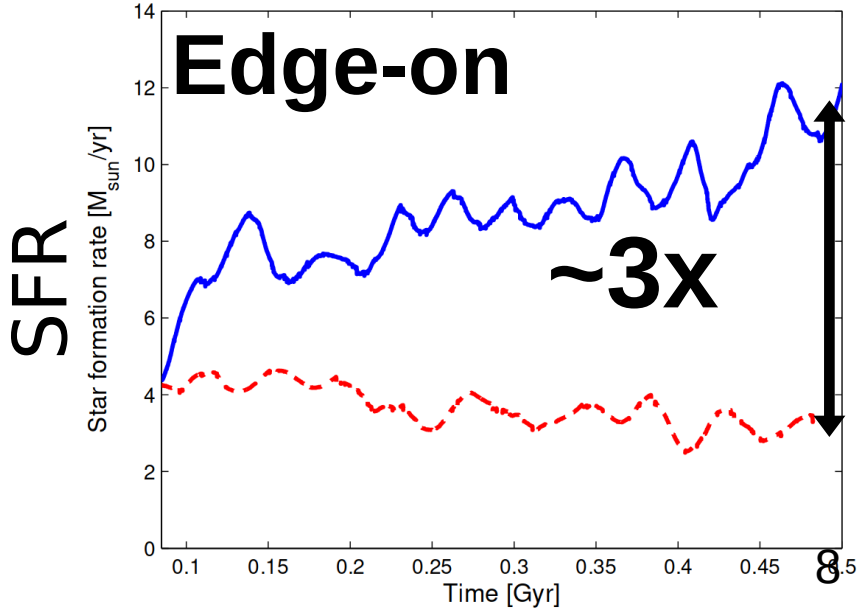
RAM pressure models

Isolated
Stripped



(Kronberger+2008)





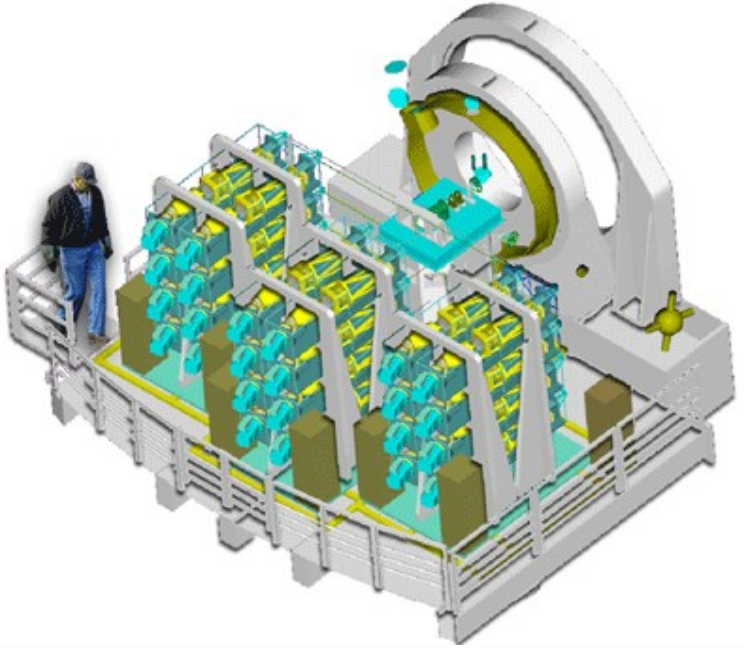
GASP

- This project deals with Jellyfish galaxies (JF)

MUSE OBSERVATIONS

Characteristics:

- Field of view of 1’x1’
- 330x330x3681
- Wavelength coverage (4600-9000Å)
- Exposure time: 2700 s



muse
multi unit spectroscopic explorer

GASP sample selection

WINGS + OmegaWINGS database

(Fasano+2006) (Gullieuszik+2015)

(clusters)

+

PM2GC database

(Calvi+2011)

(field & group galaxies)

=

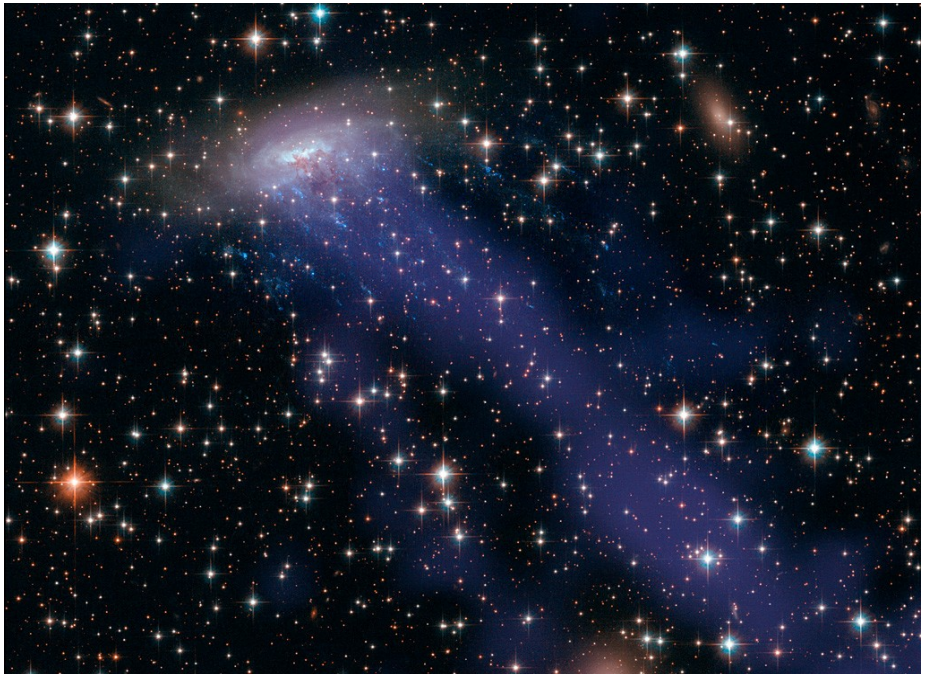
344 candidates in WINGS+OmegaWINGS (70% clusters)

75 candidates in the field or low-mass groups (PM2GC)

- Sample (Poggianti+2016) selected by visual inspection of B-band galaxies.

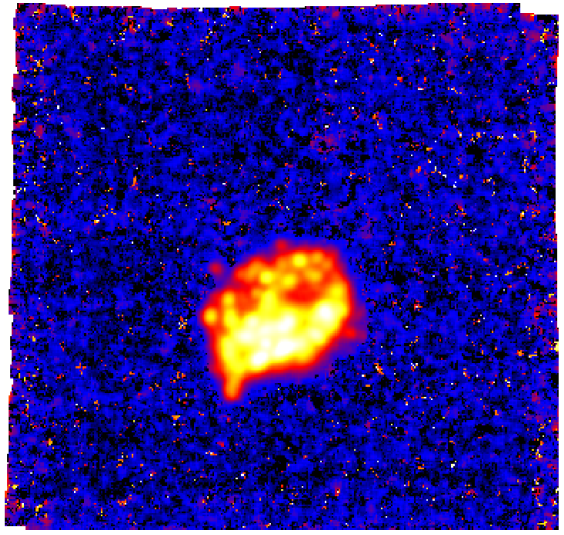
Thesis project

- Study why the star formation rate (SFR) is enhanced on these galaxies
- What is the relation between this enhancement and galaxies and clusters properties.



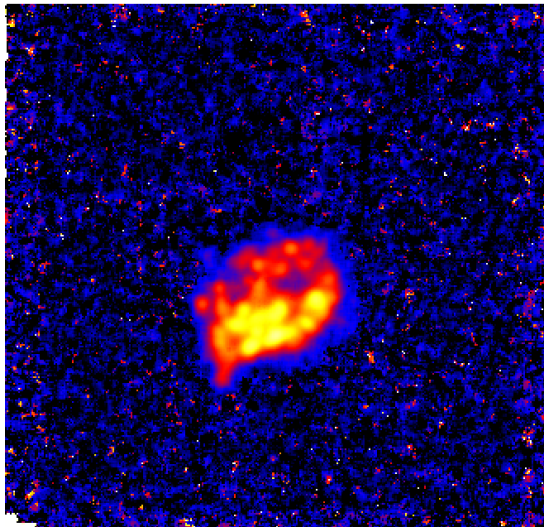
ESO-137-001 in A3627 (Credits: NASA/CX-C/UAH/M).

SFR calculation



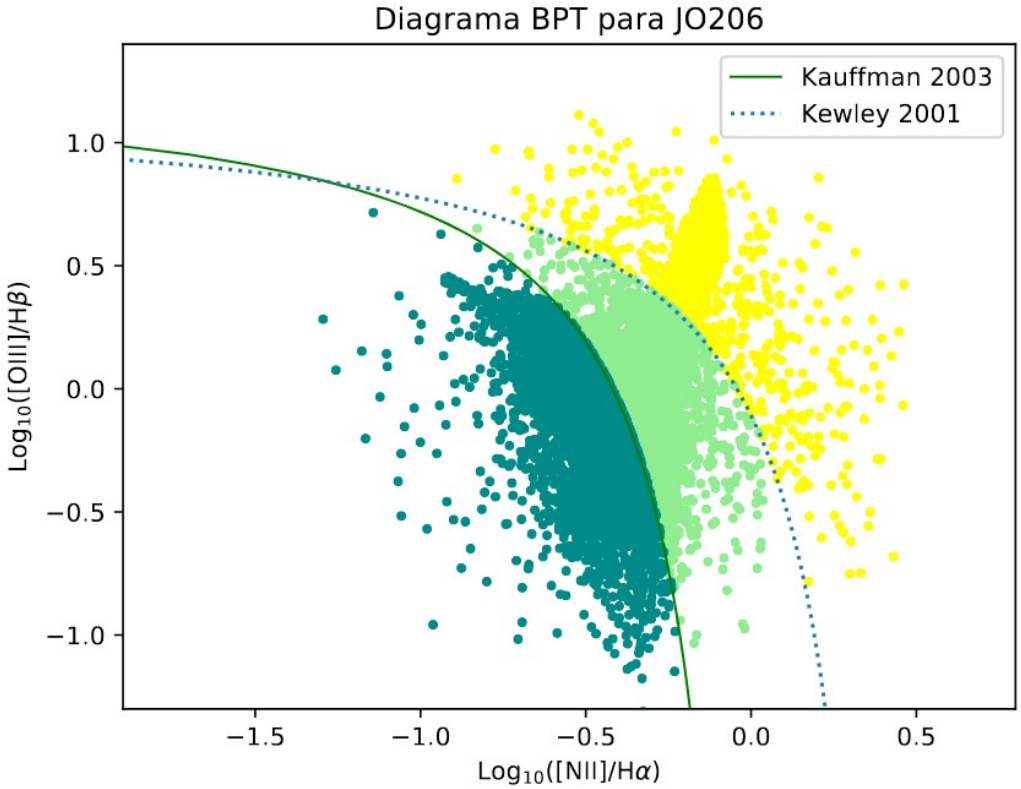
- Hα

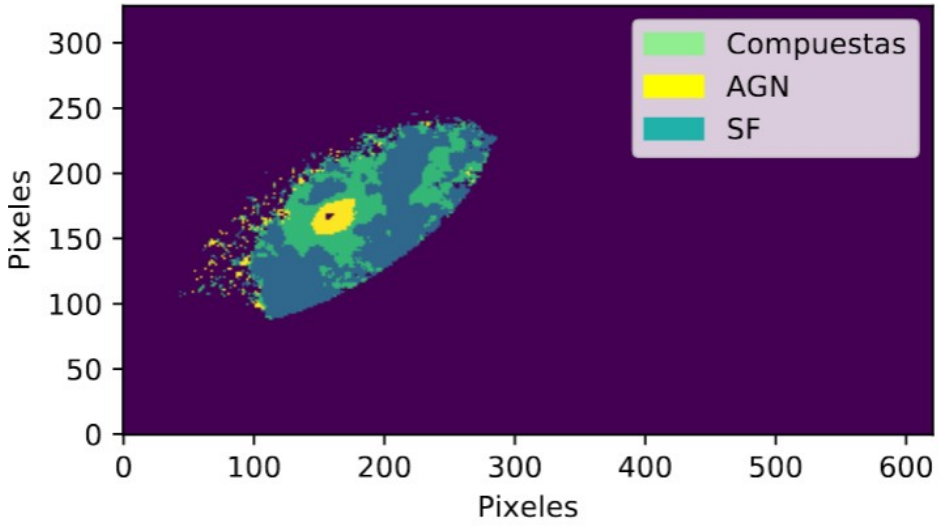
- Hβ



- Calculation of the extinction and correction,
- Hα flux,
- Luminosity,
- SFR

BPT diagrams and maps (JO206)





- Star formation:

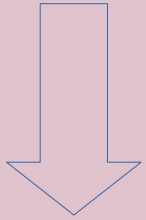
  Cid Fernandes et al (2011)

$$\log([\mathrm{NII}]/\mathrm{H}\alpha) < -0.4 \text{ y } W_{H\alpha} > 3$$

SINOPSIS

Fritz+2007,+2017

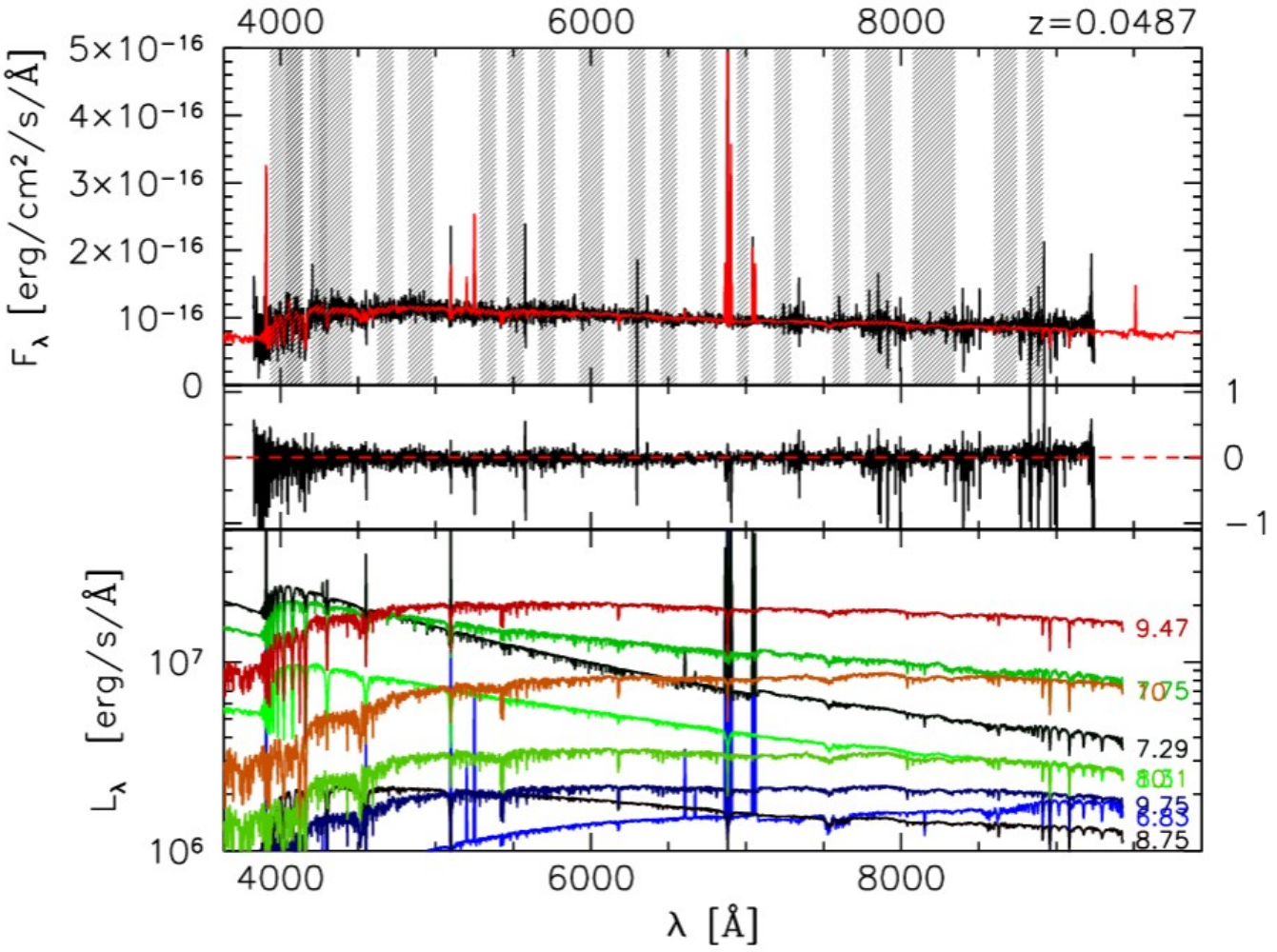
- **SImulatiNg OPtical Spectra wIth population Synthesis** models:



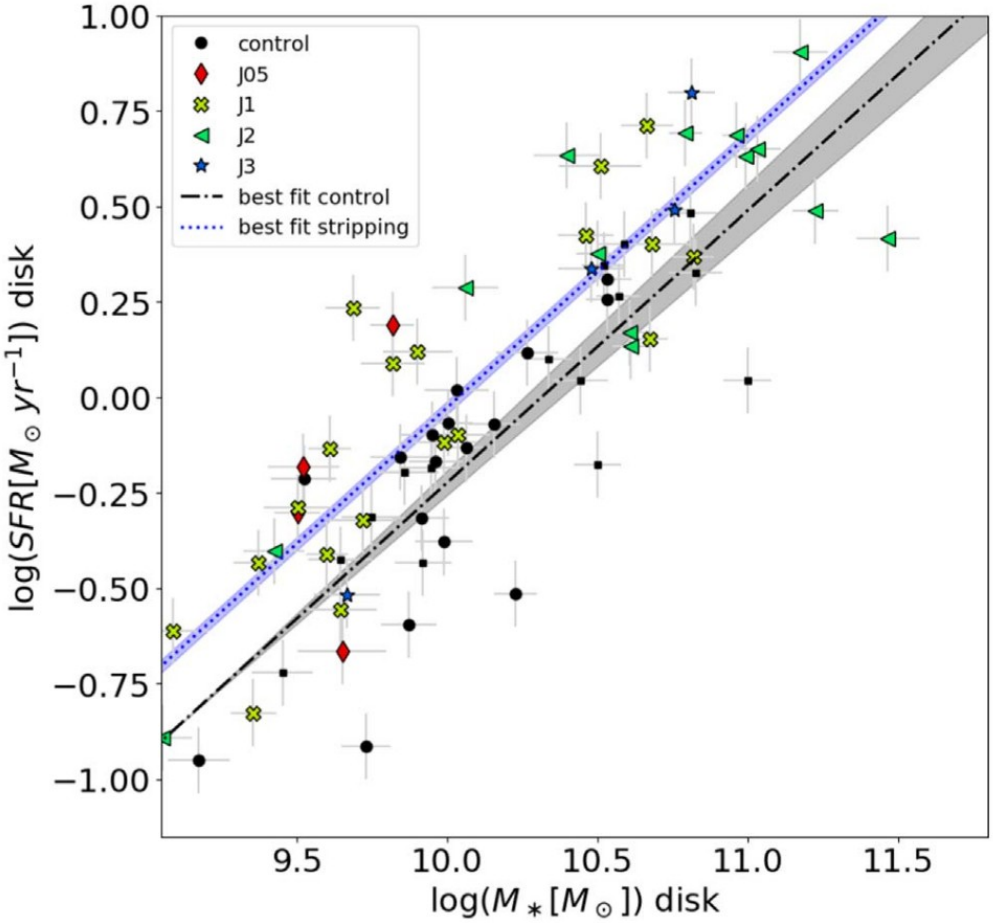
- Model construction:

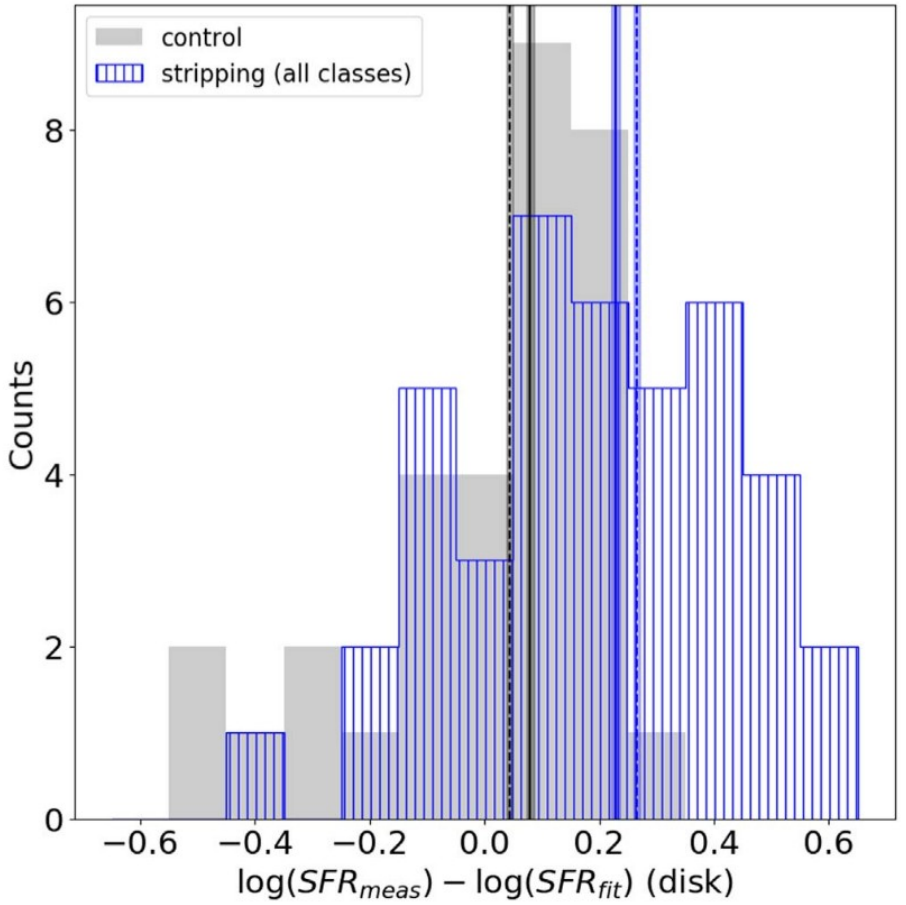
$$F^{mod}(\lambda) = \frac{1}{4\pi D^2} \sum_{i=1}^{N_{SSP}} \left[L_i(\lambda) \times M_i \times 10^{-0.4 \cdot E(B-V)_i R_V A_\lambda / A_V} \right]$$

SINOPSIS: example



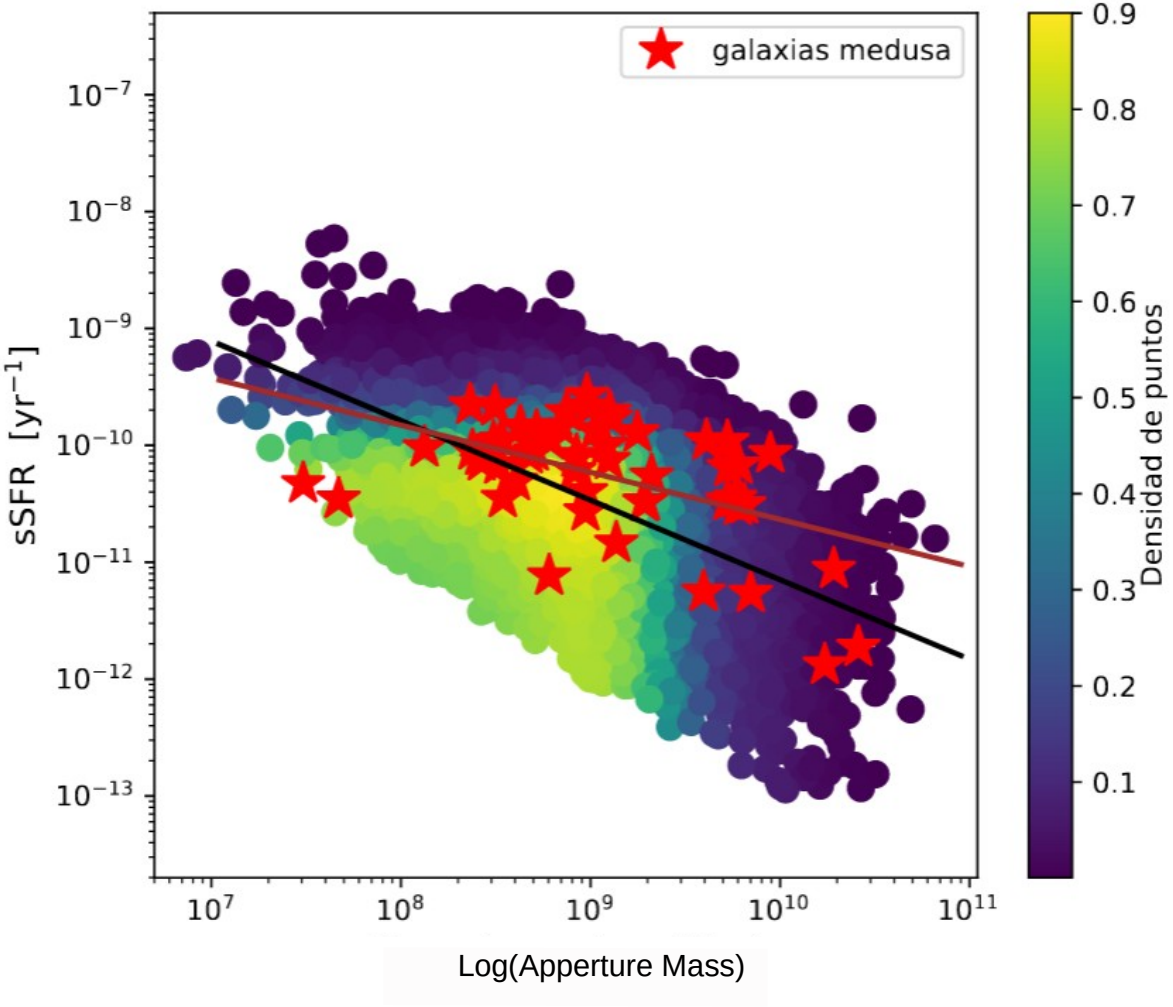
Cluster galaxies vs Jellyfish galaxies





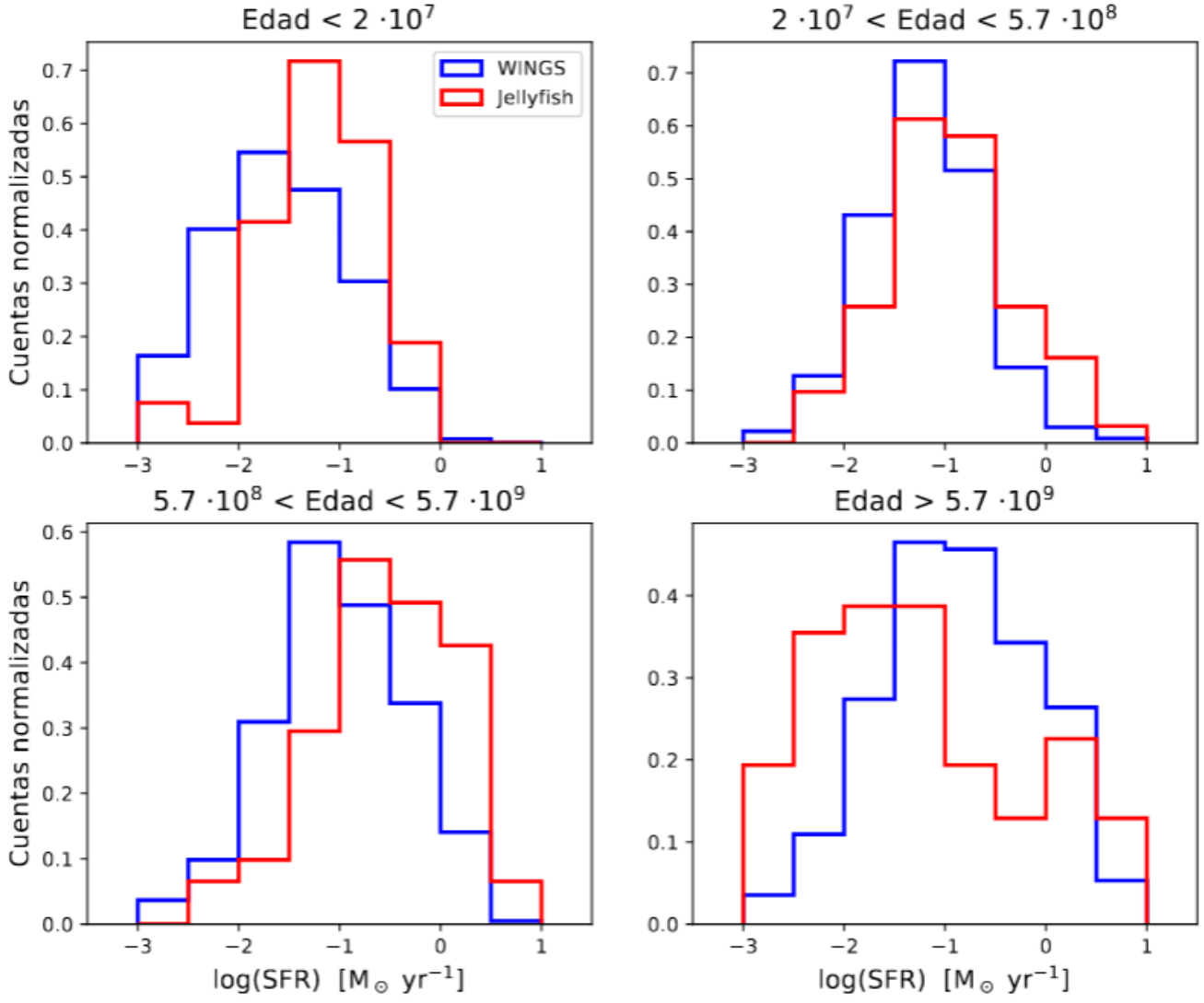
GASP. XIV. Vulcani+18

Total mass vs sSFR

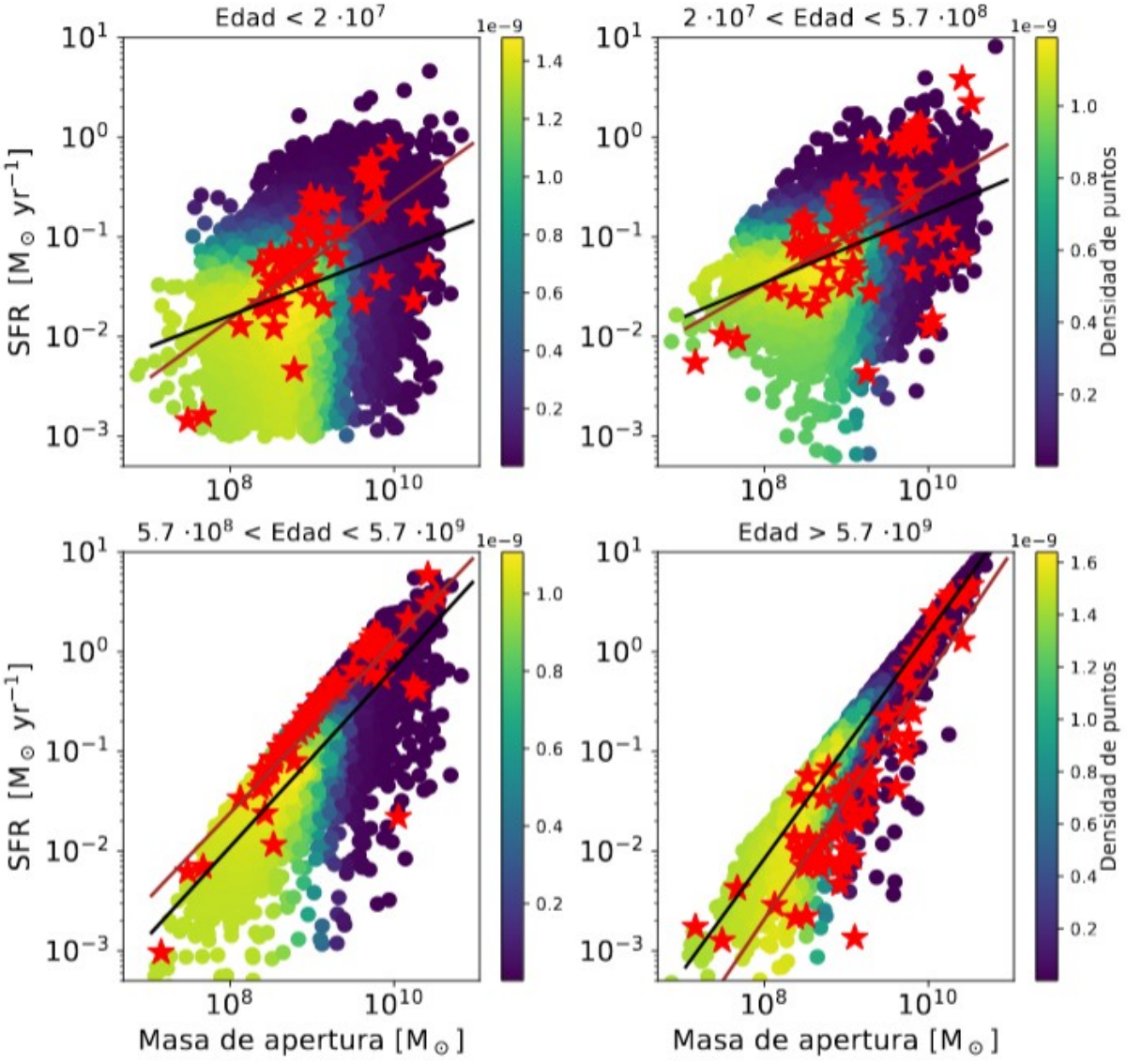


- sSRF vs Mass comparing WINGS and OmegaWINGS sample with JF galaxies.

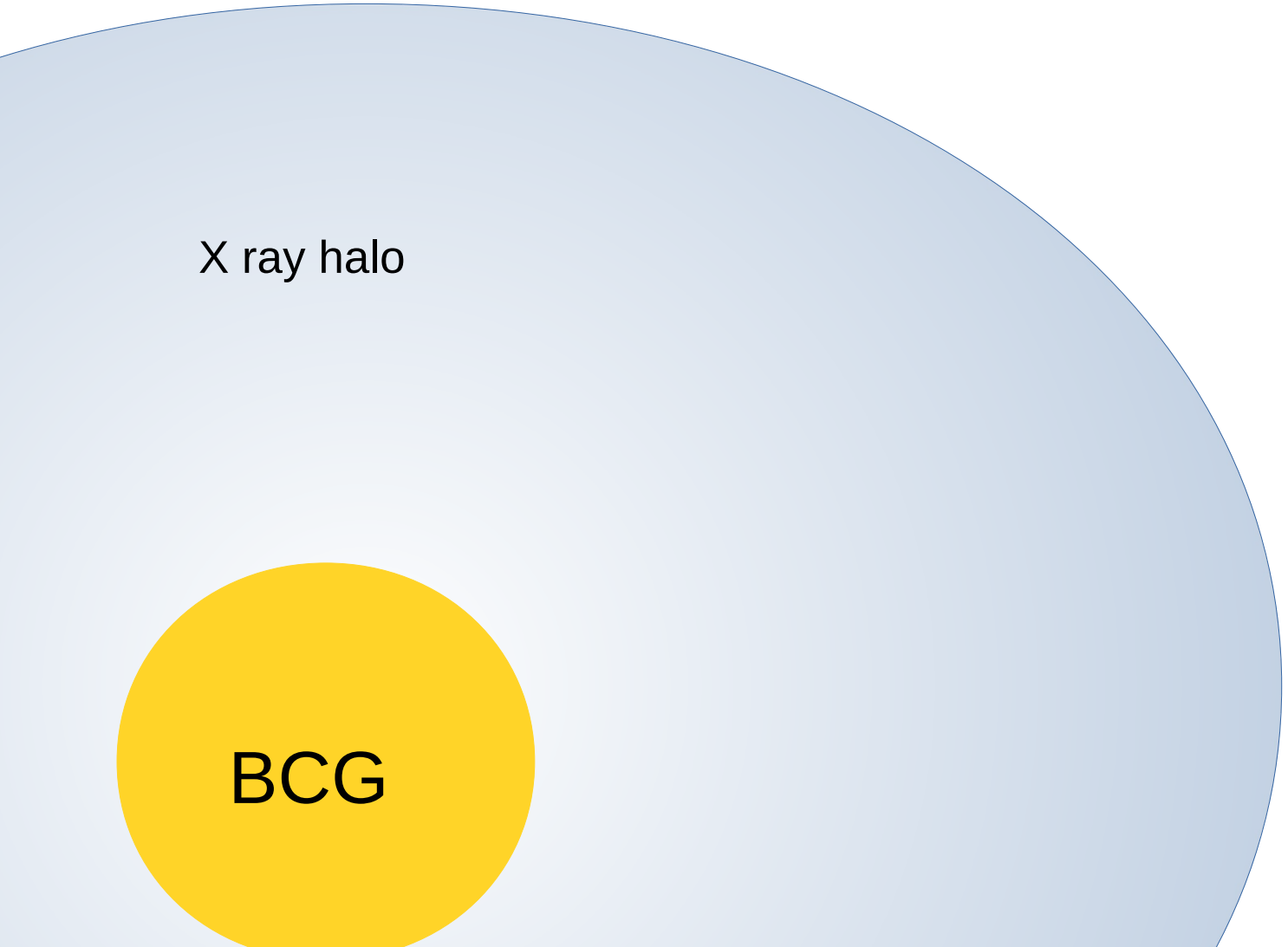
The stellar populations

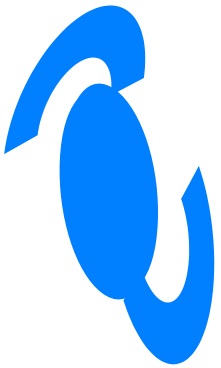


SFR at different ages

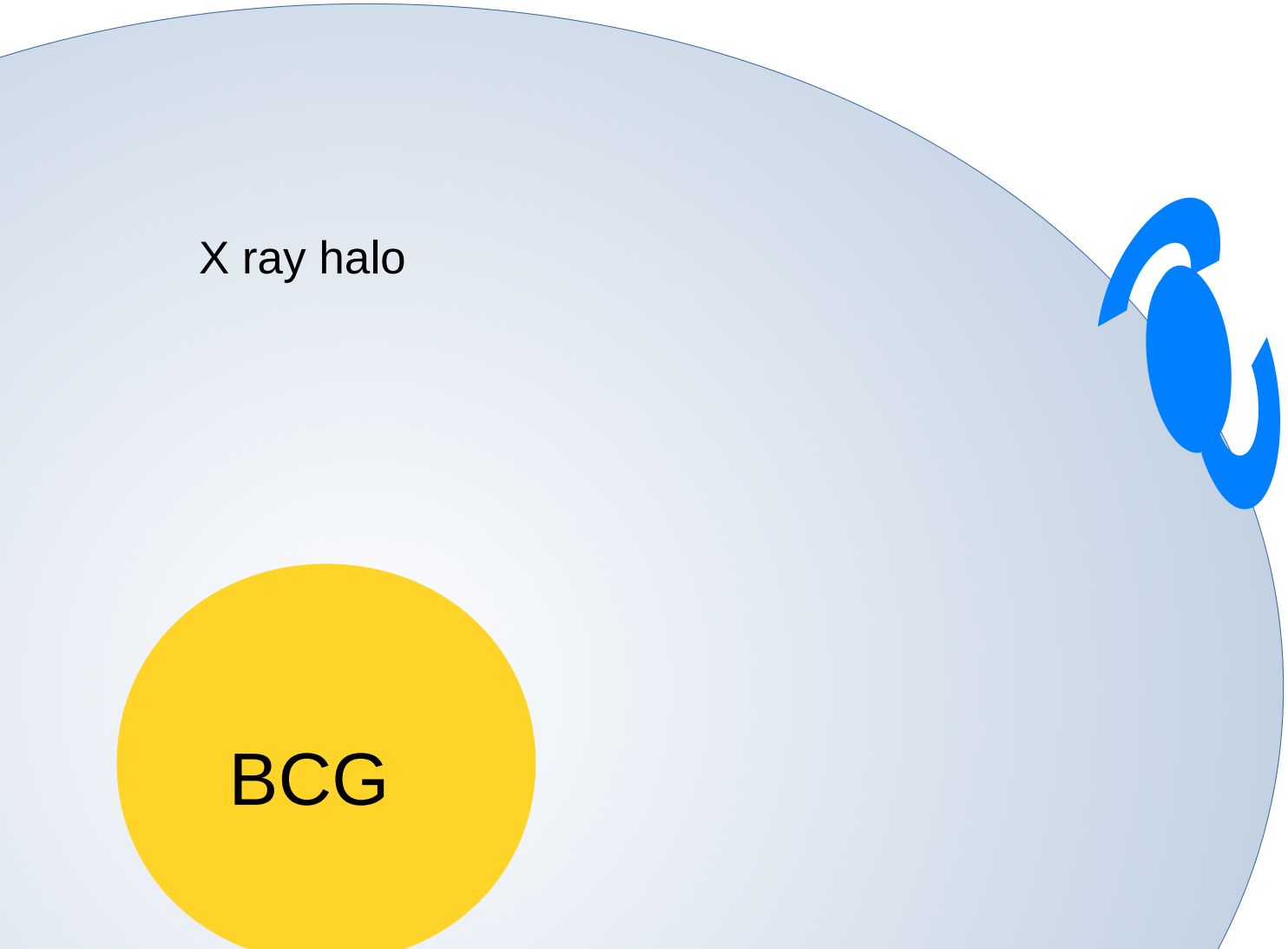


First encounter: JF vs cluster

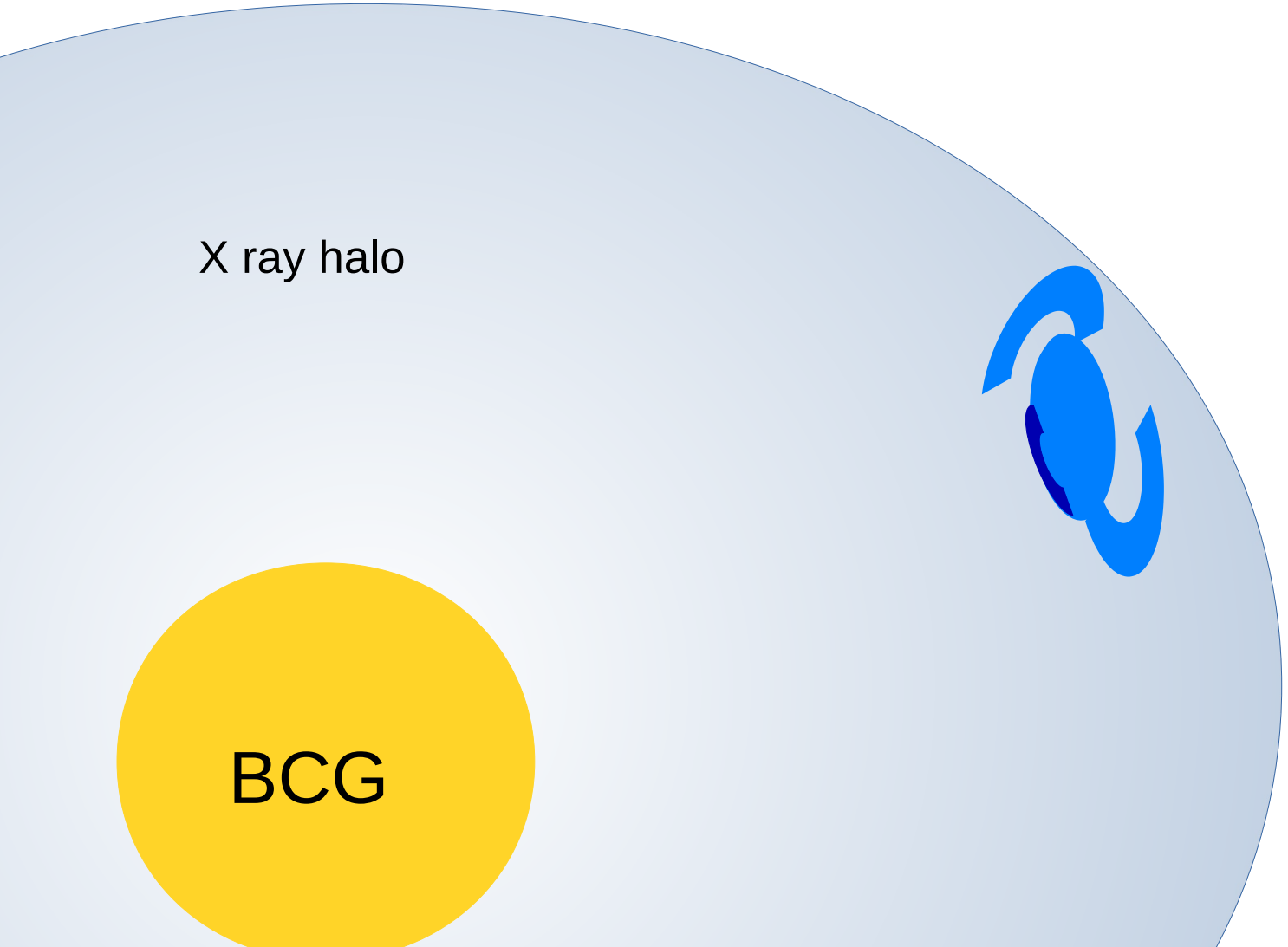




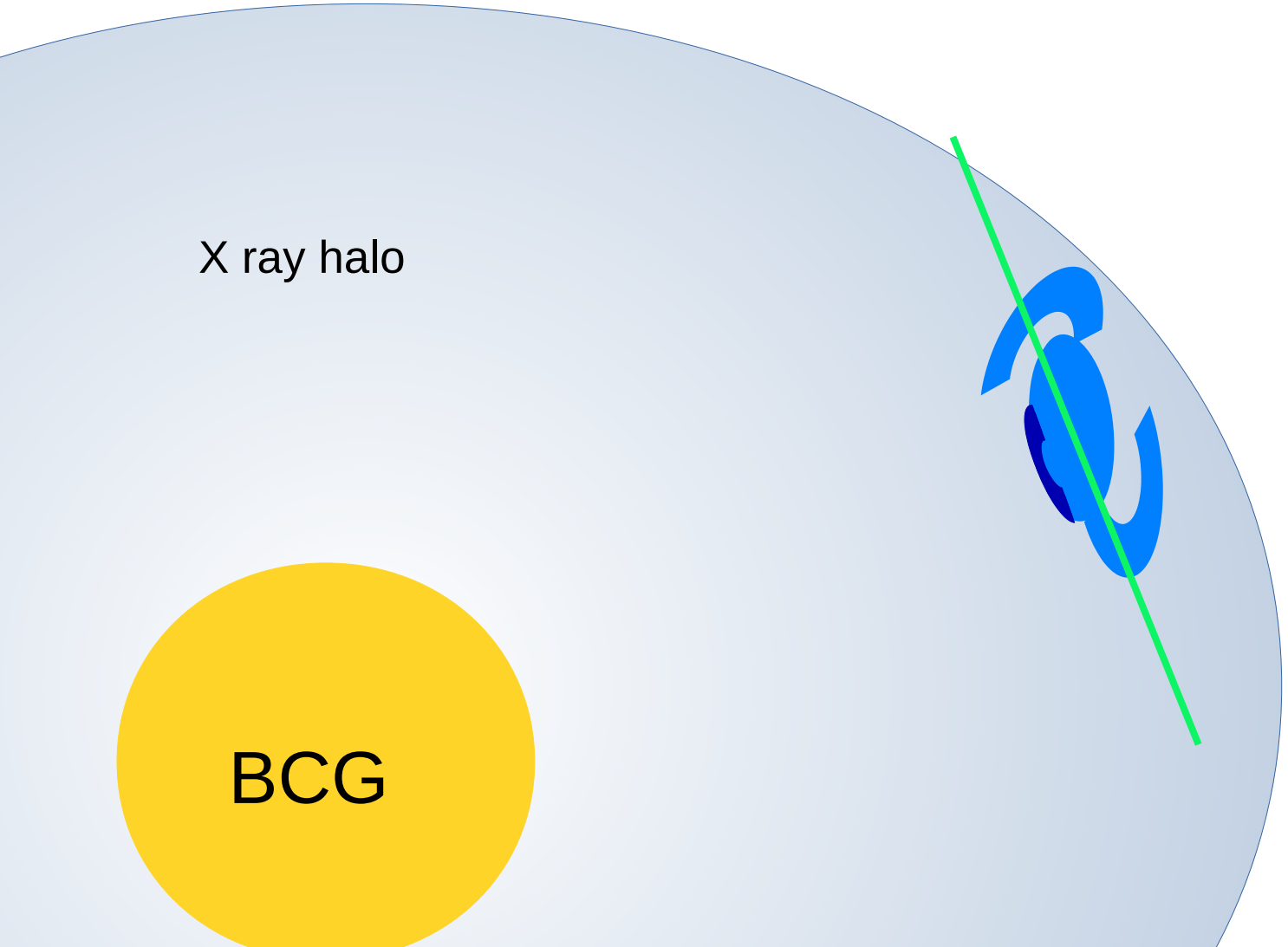
First encounter: JF vs cluster



First encounter: JF vs cluster

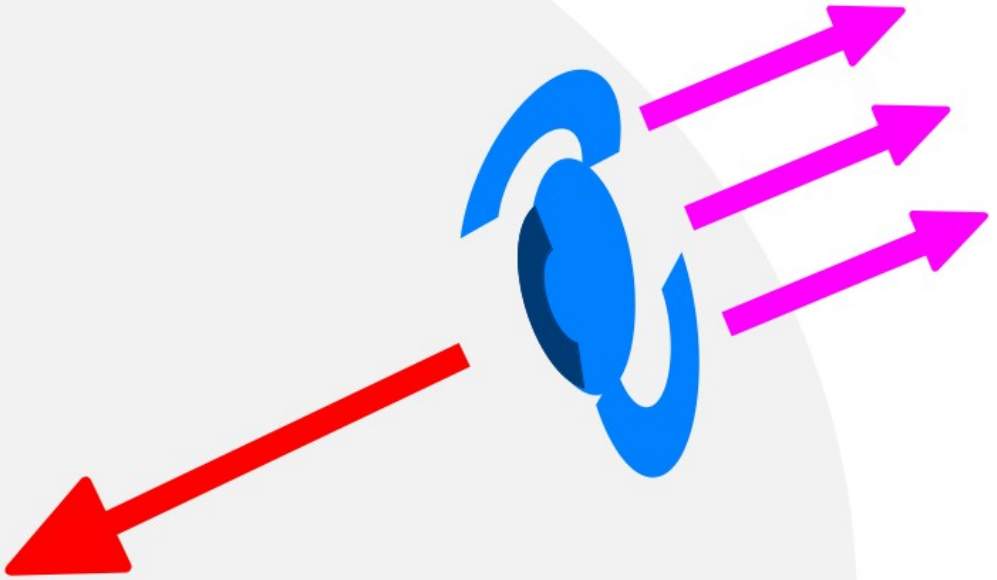


First encounter: JF vs cluster



First encounter: JF vs cluster

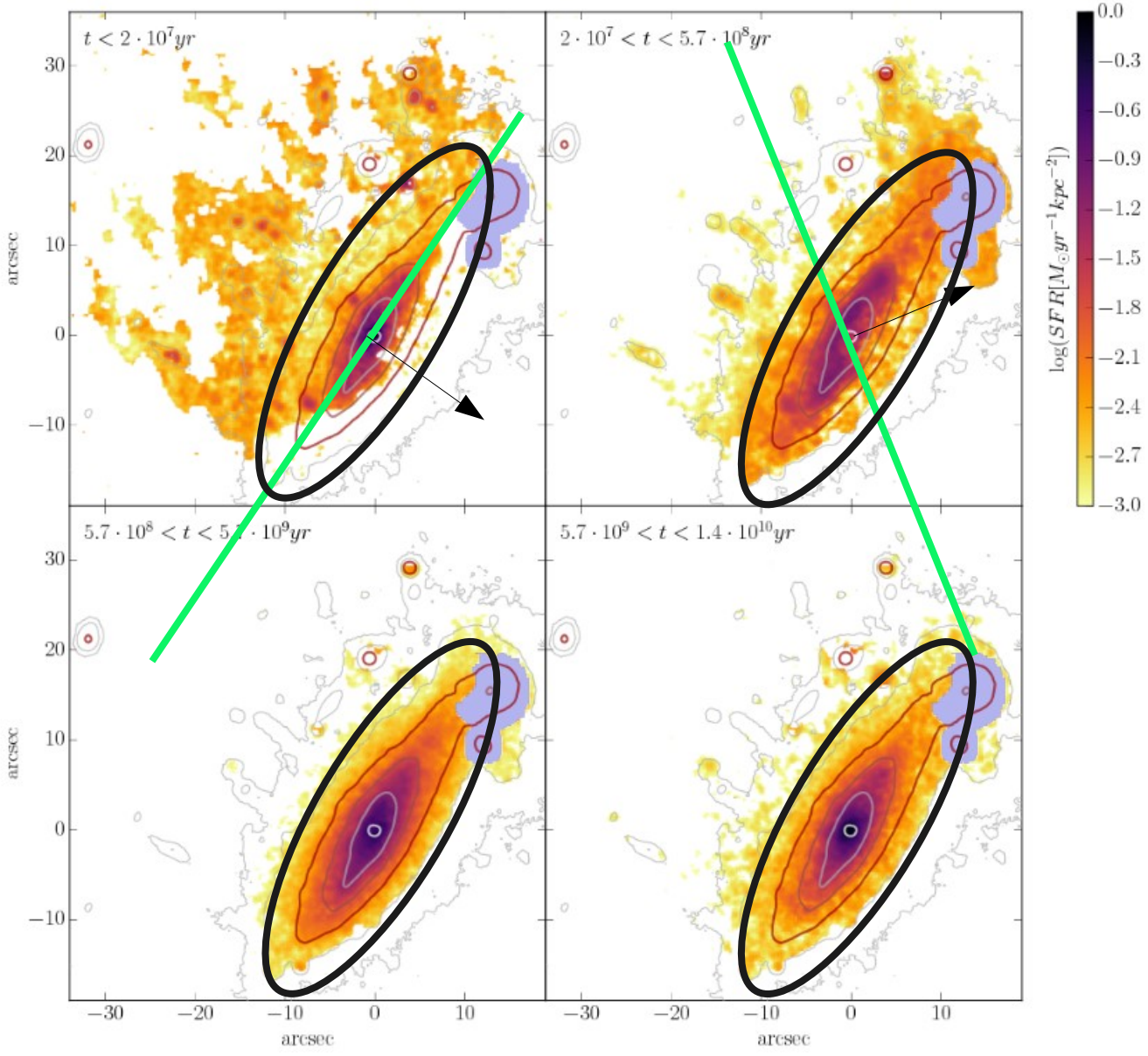
X ray halo



BCG

JO204 (J5)

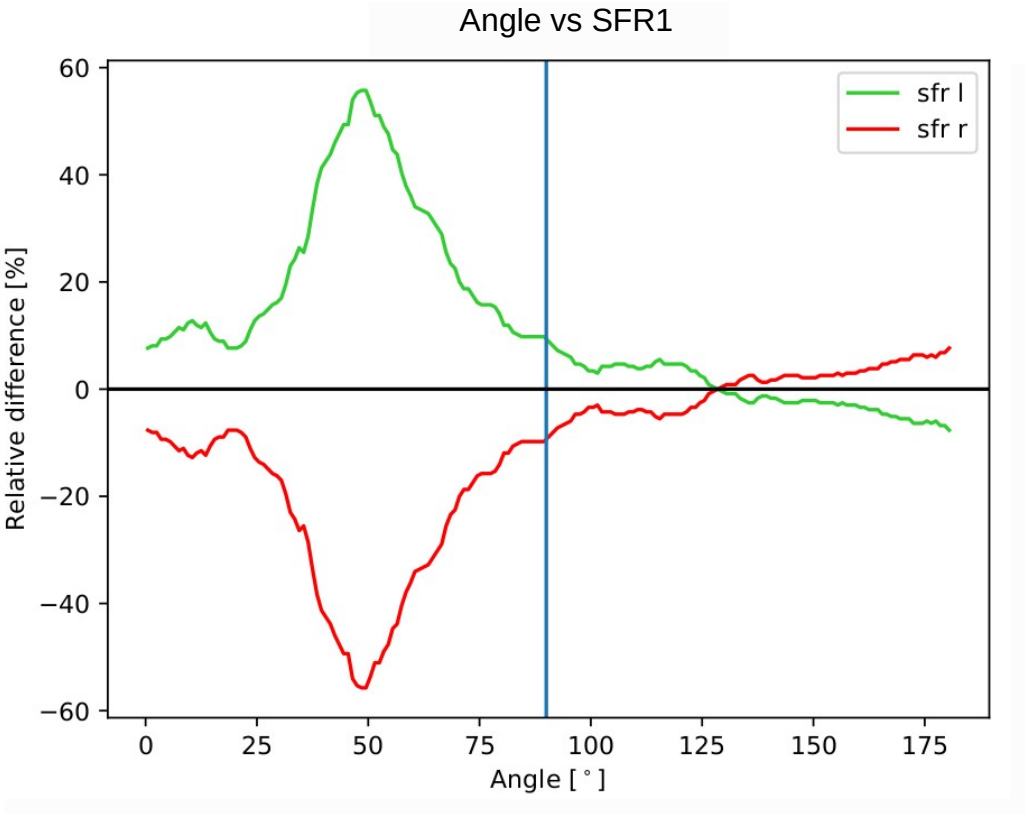
50°



112°

Gullieuszik+2017

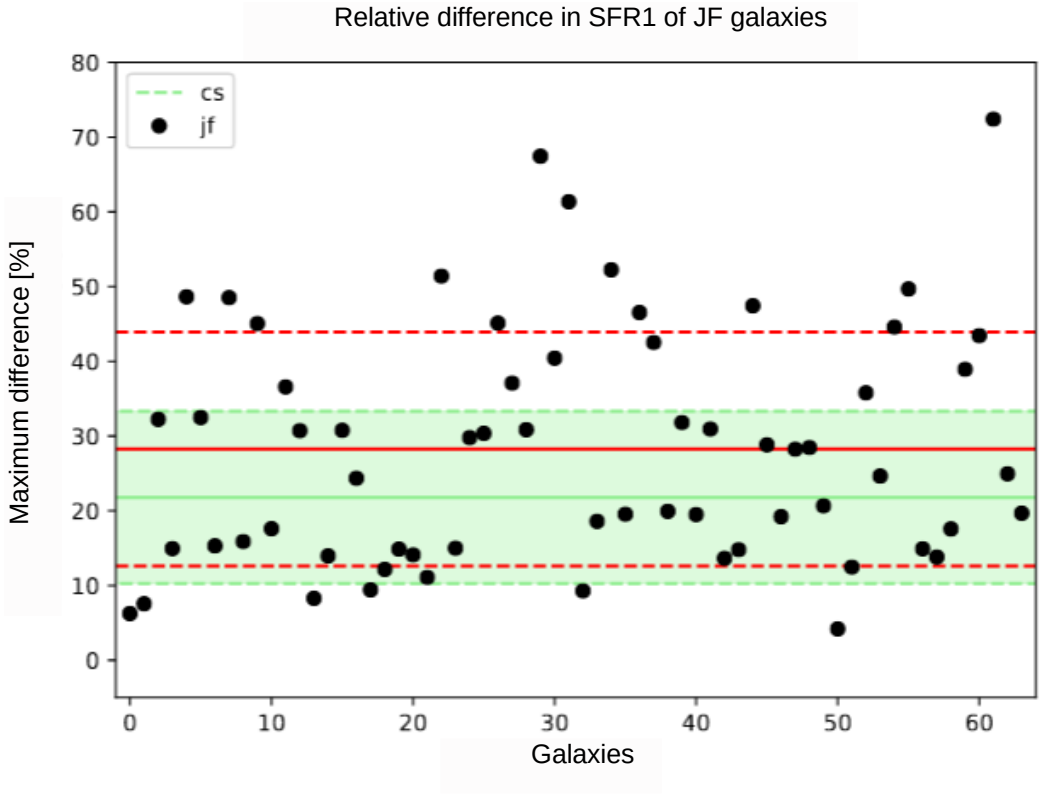
Looking for differences



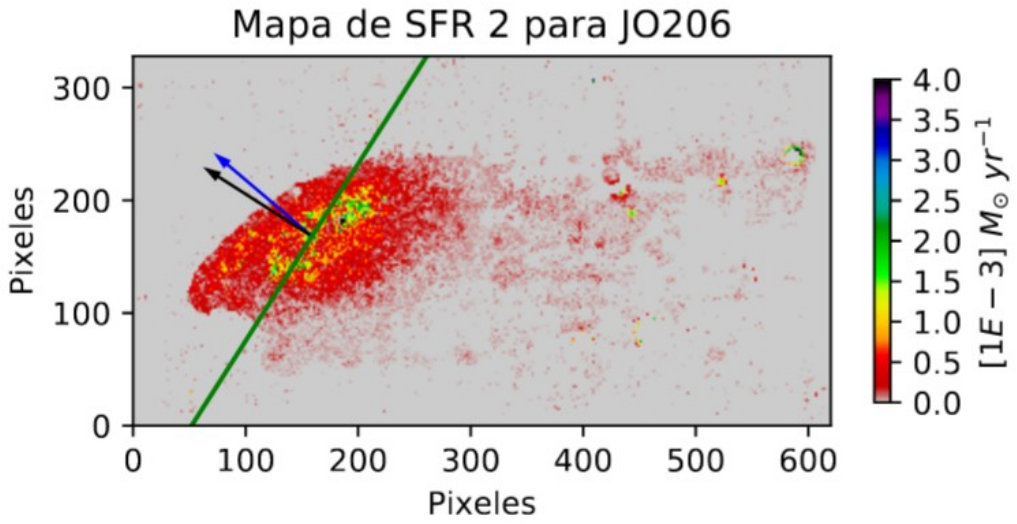
$$\Delta P(\theta) = \frac{0.5 \times \mathrm{val}_T - \mathrm{val}_H(\theta)}{0.5 \times \mathrm{val}_T} \times 100$$

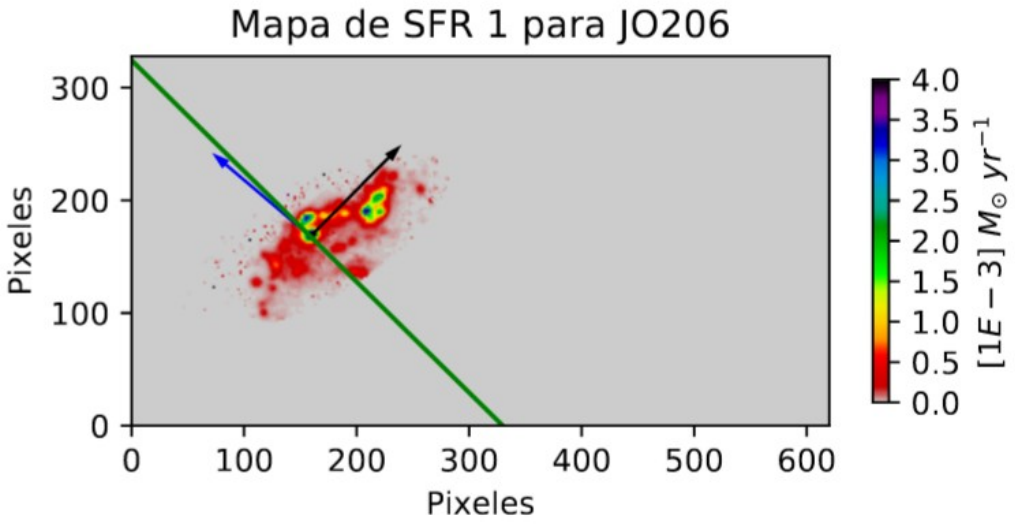
$$A_{idx} = \mathrm{Max}[\Delta P(\theta)] = \Delta P(\theta_{max})$$

Relative differences in the maps of JF galaxies

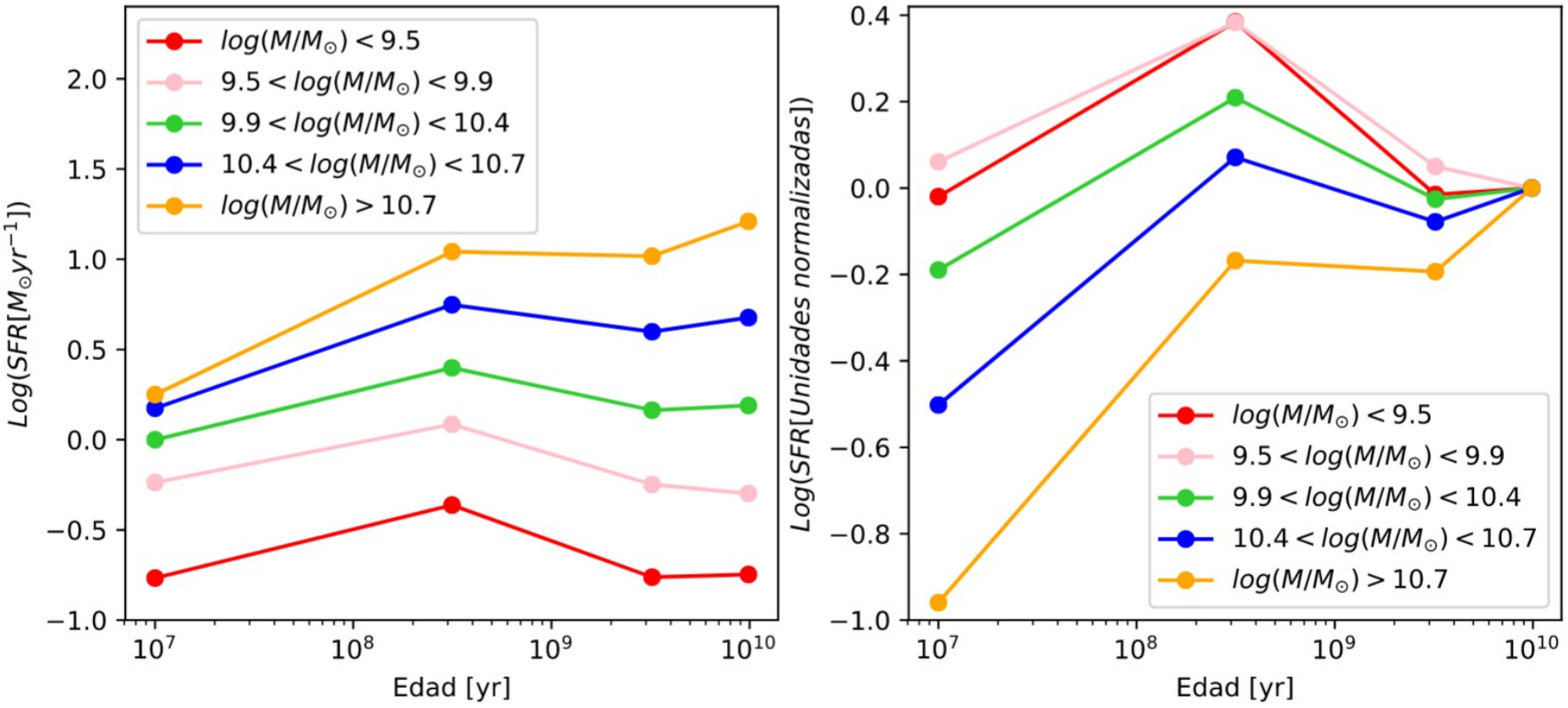


SFR maps for JO206

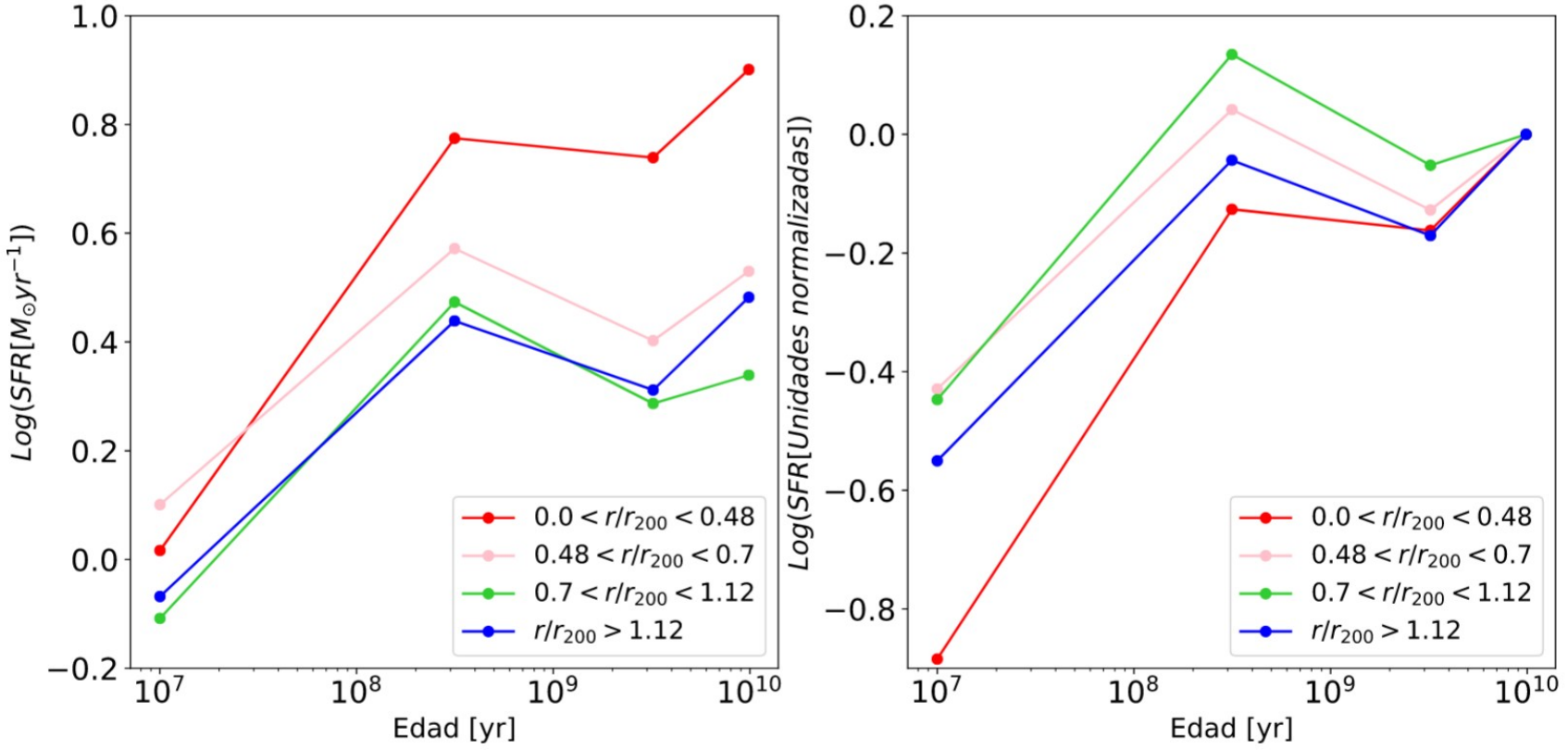




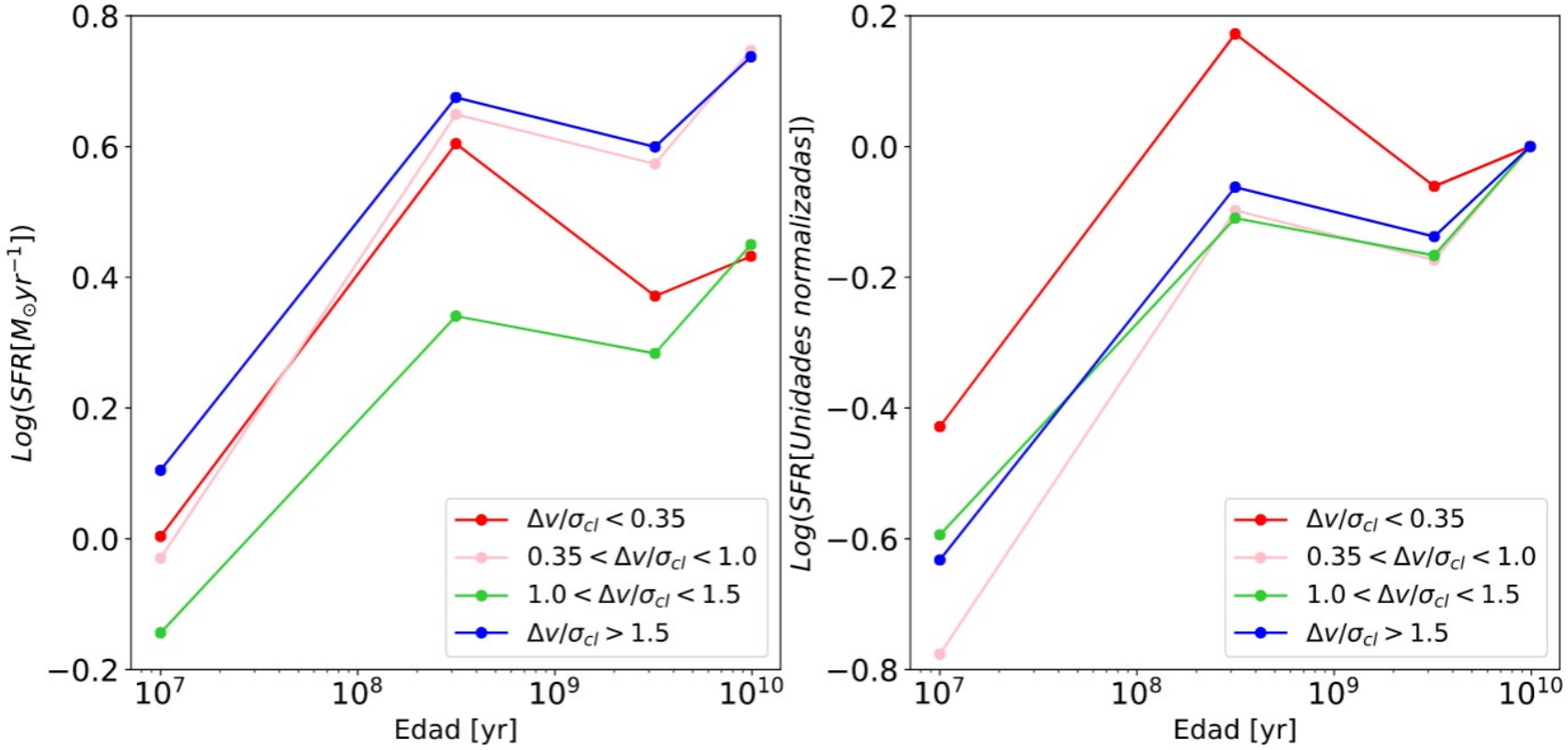
SFH according to the stellar mass



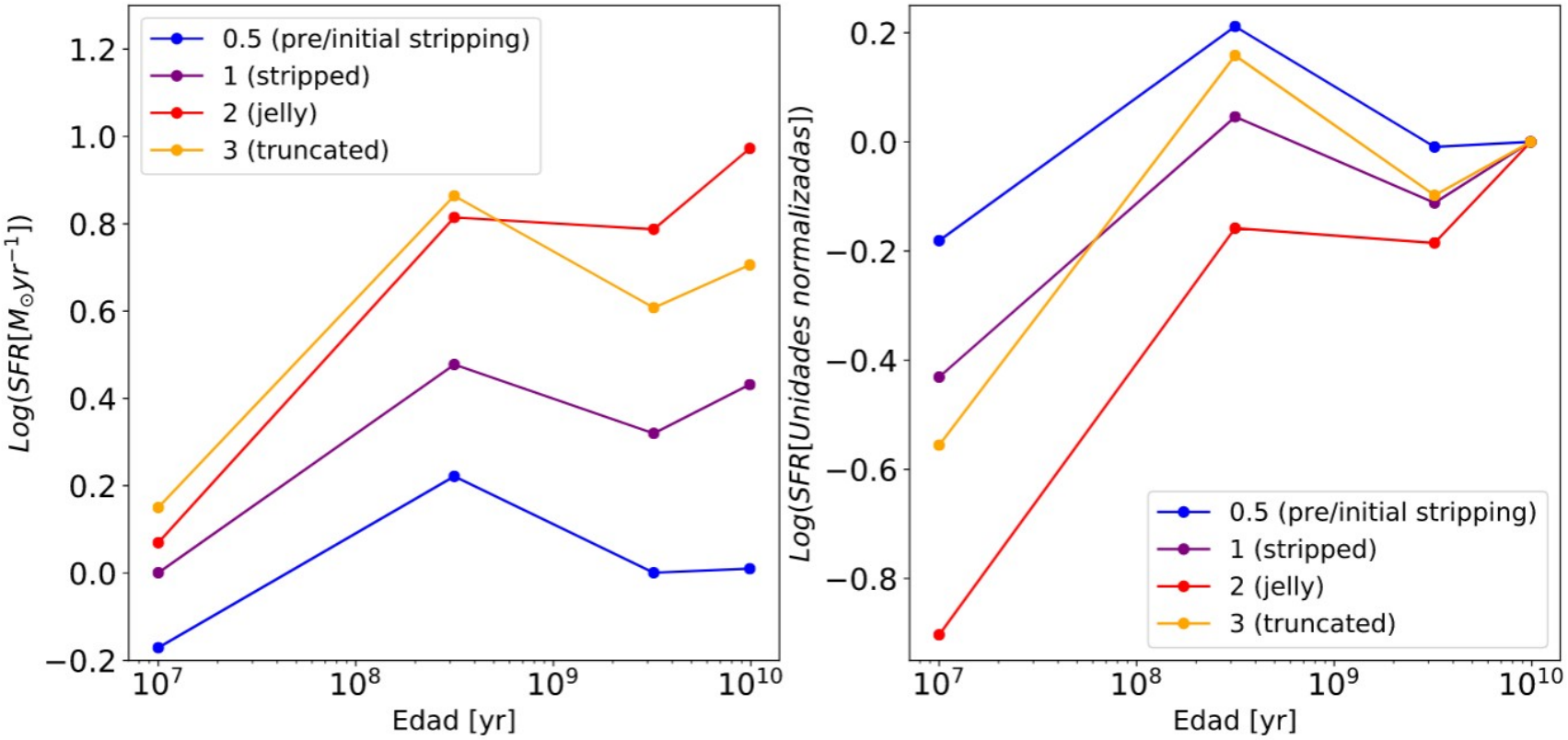
SFH according to the distance



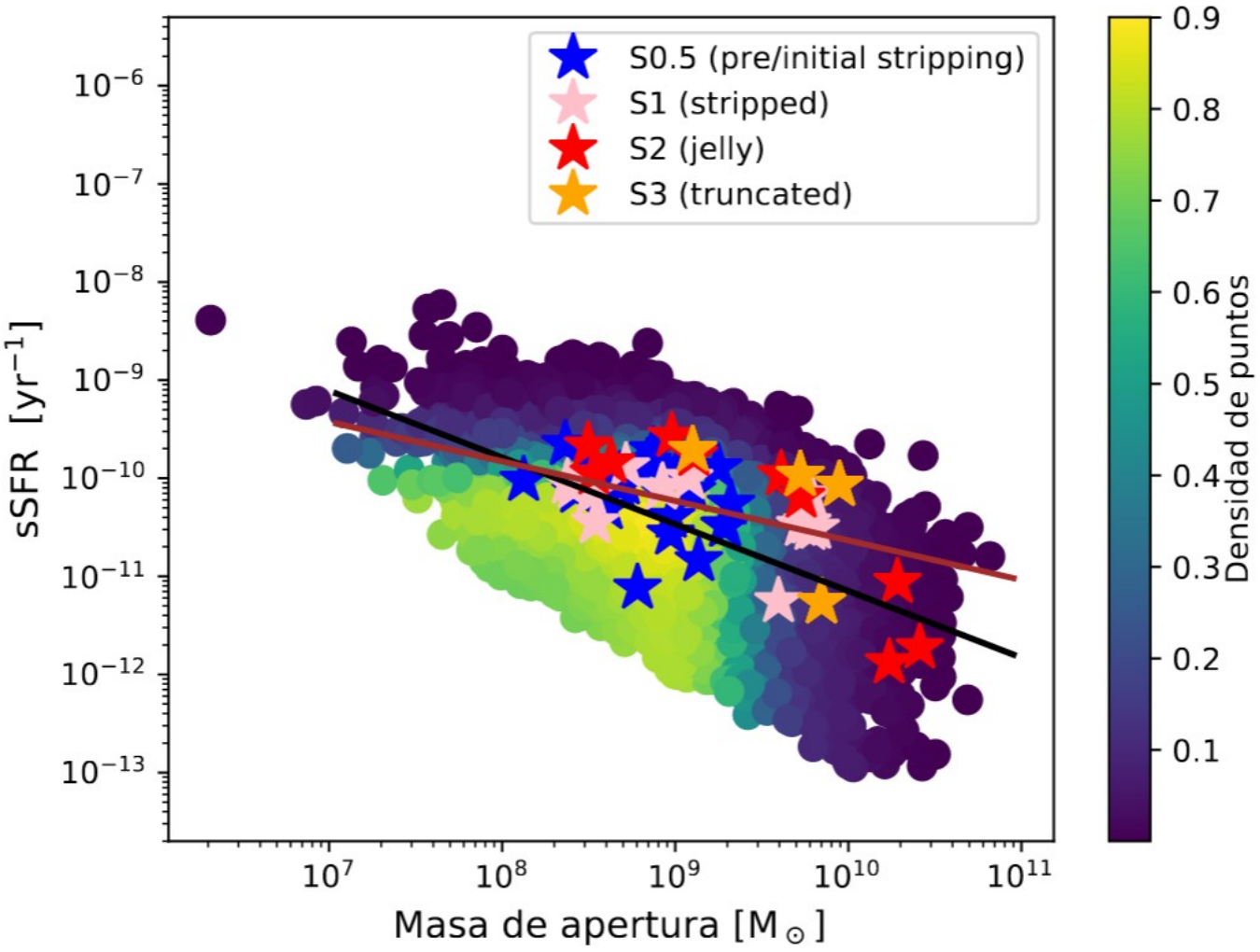
SFH according to the velocity



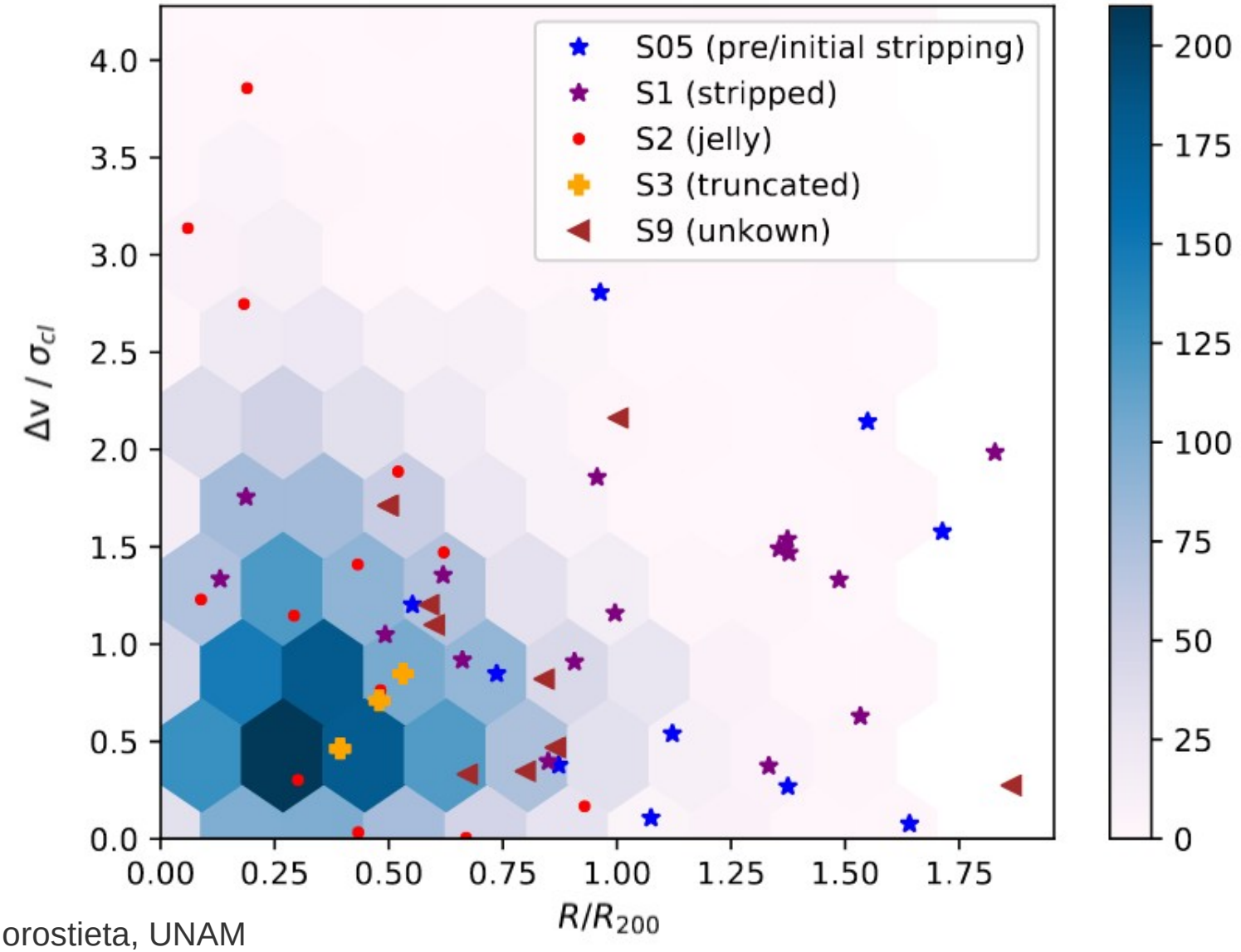
SFH according to the stripping phase



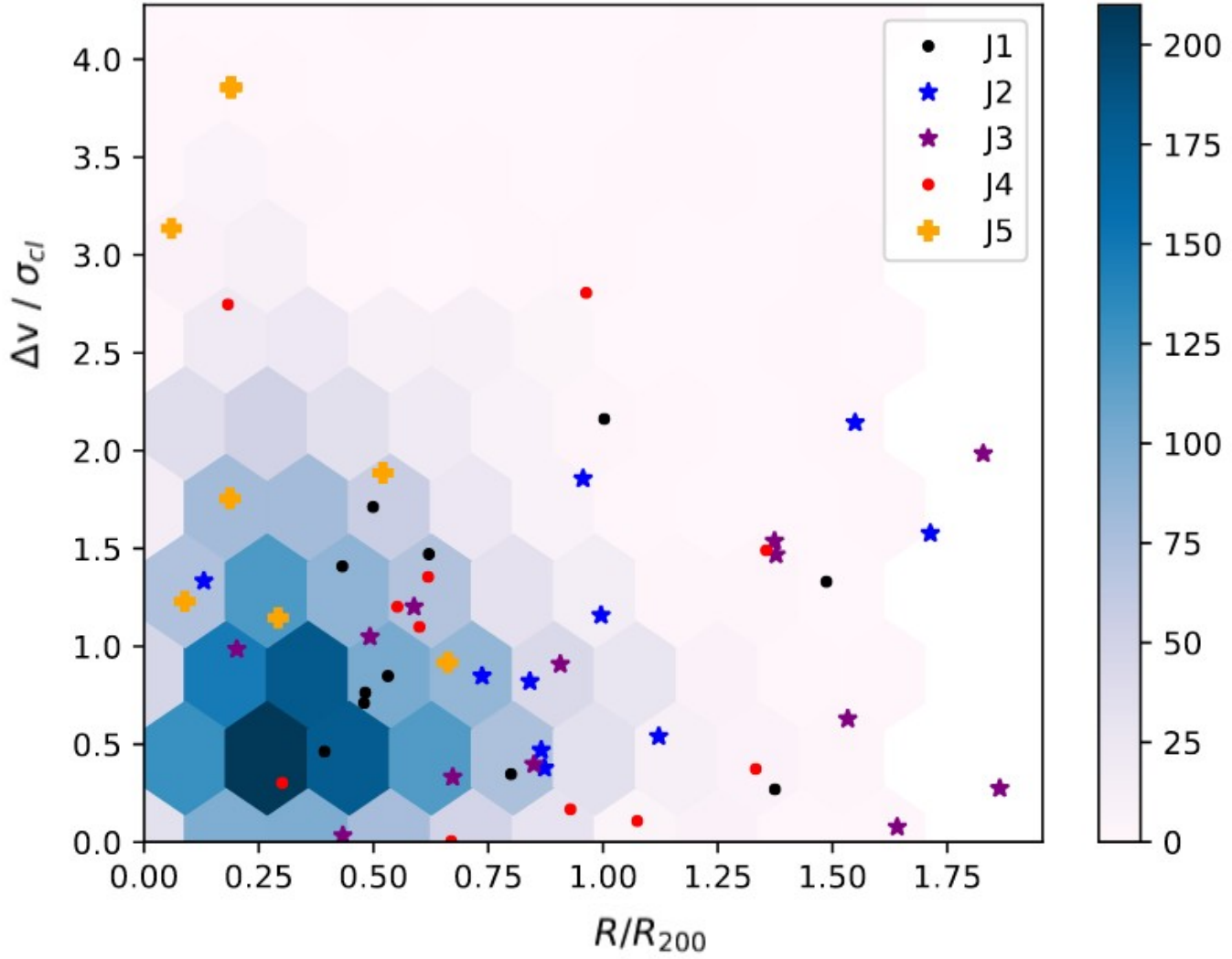
sSFR as a function of the mass depending on the stripping phase



Space-phase of jellyfish galaxies depending on the stripping phase



Space-phase of jellyfish galaxies depending on the JClass



CONCLUSIONS

- We worked with a sample of 114 galaxies that conform the GASP sample.
- There is an enhancement of the SFR when gas stripping phenomenon is occurring or has occurred.
- We see a clearly enhancement in the SFR at older ages.
- There is a trend on the SFH of the JF galaxies depending on the mass: the less massive the galaxy is, the higher the enhancement between the 3rd and 2nd bin is.
- We use asymmetries in the SFR maps for the study of the velocity direction of the galaxies and the possible presence of RP phenomena.
- It is more difficult than one can think to get a direction from the asymmetries due to different factors.
- SFHs of JF galaxies at intermediate projecting distances have the largest SFR values because at long distances they are not affected by RAM-pressure and at short distances they could be found at advancing stages of their lives.

THANK YOU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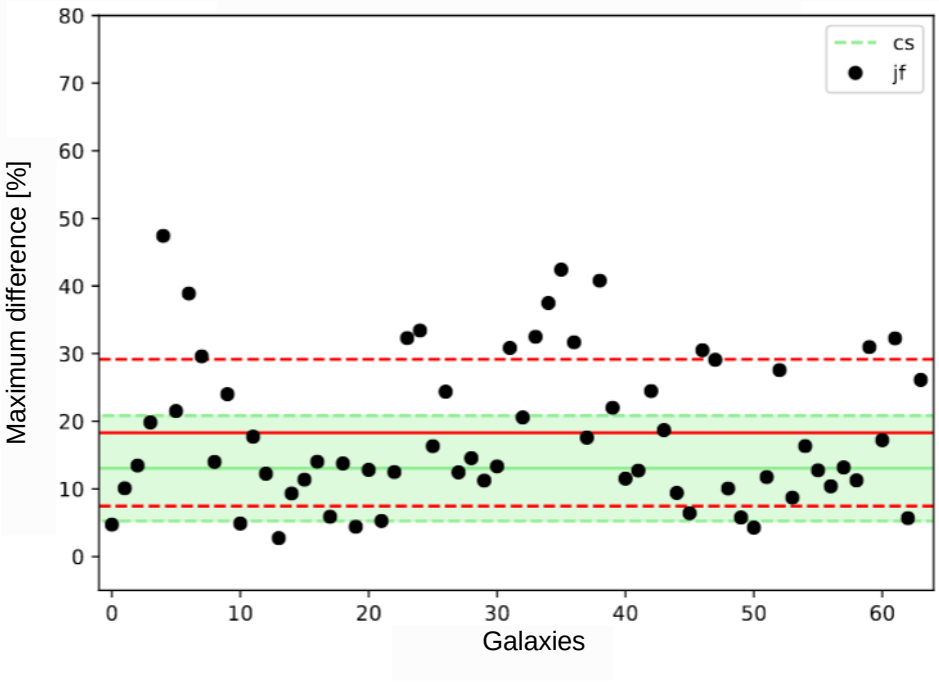
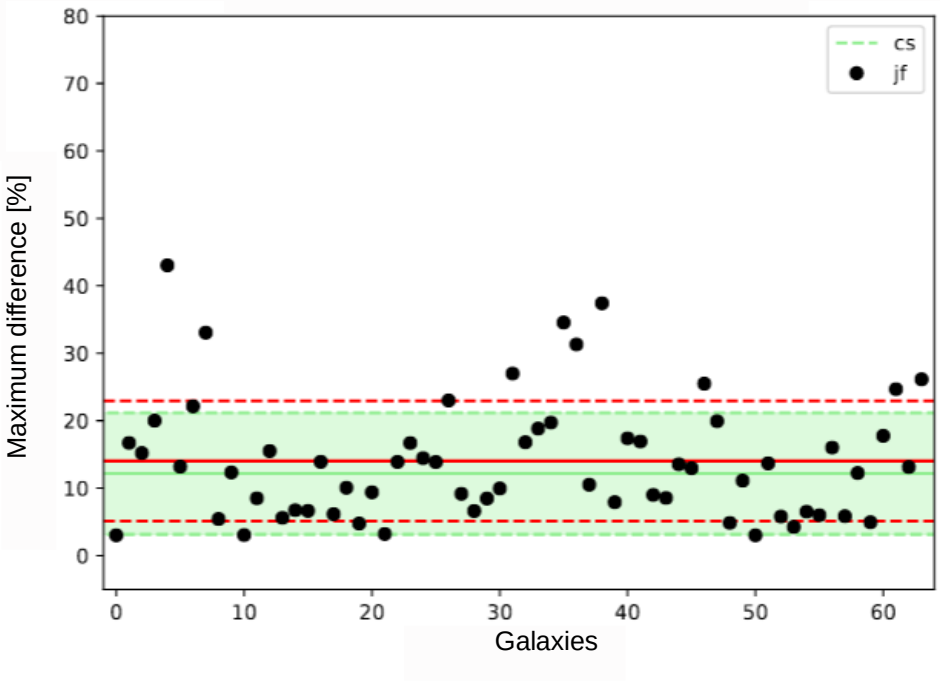
UNAM

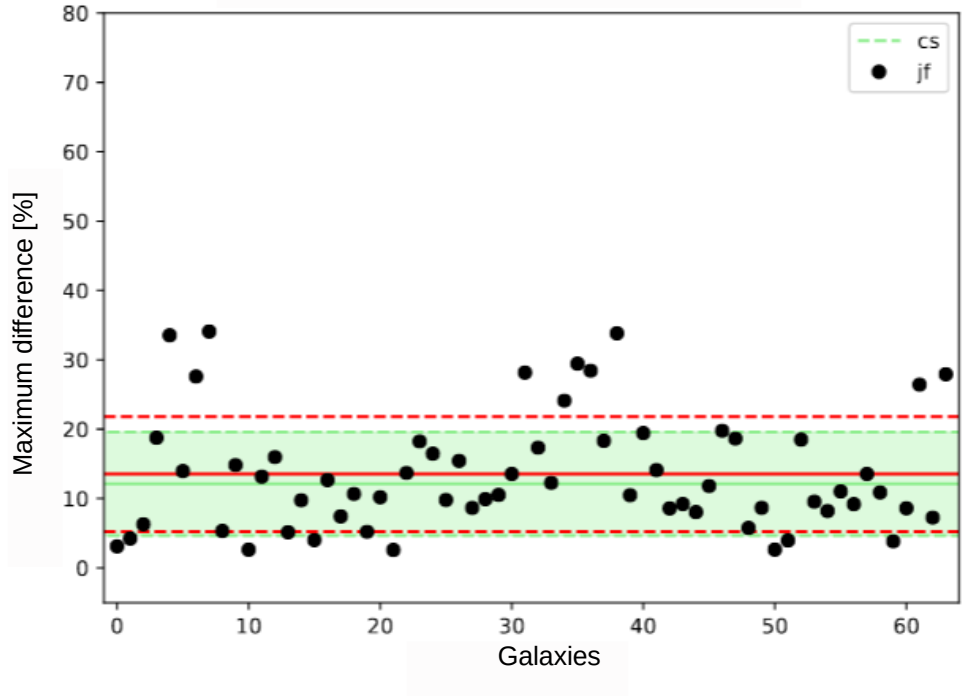
Relative difference in SFR2 of JF galaxies



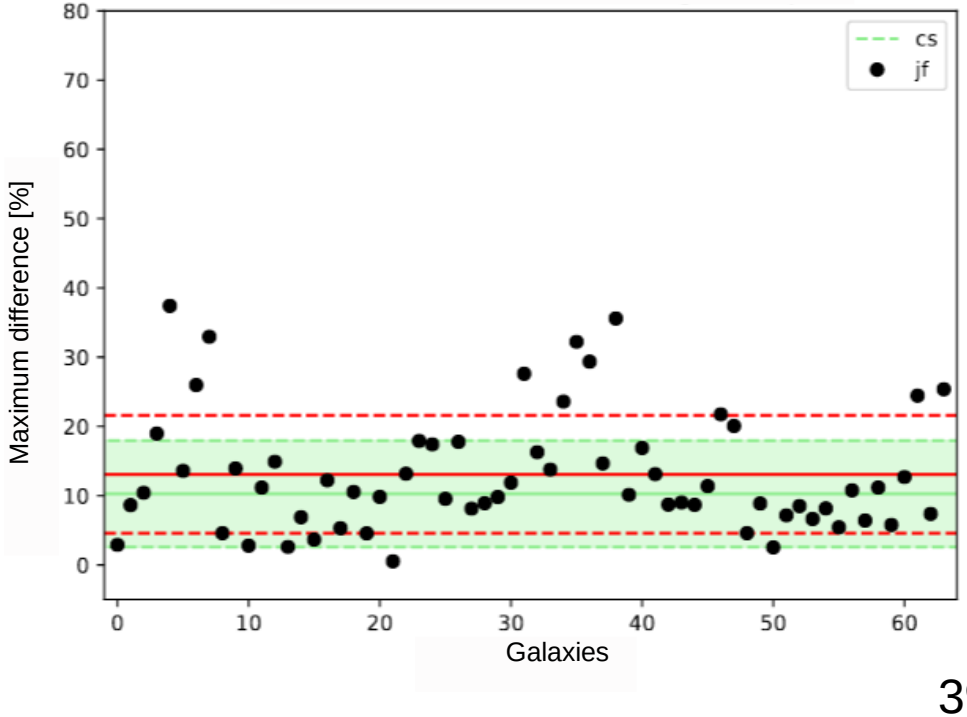
Relative difference in SFR3 of JF galaxies



Relative difference in SFR4 of JF galaxies



Relative difference in mass of JF galaxies



WHAN diagram

Cid Fernandes + 2011