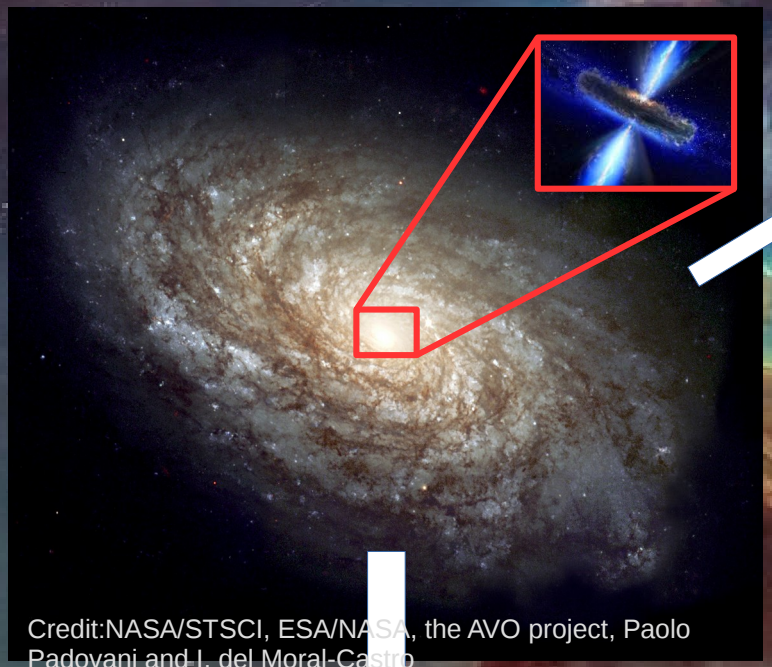
Do active galaxies “dance” different than their twins?

Student: I. del Moral-Castro (IAC, ULL, Spain)
Supervisors: C. Ramos Almeida and Begoña García-Lorenzo (IAC, ULL, Spain)



Credit:NASA/STSCI, ESA/NASA, the AVO project, Paolo Padovani and I. del Moral-Castro

Observational evidences indicate that the majority of galaxies contain a **supermassive black hole.**

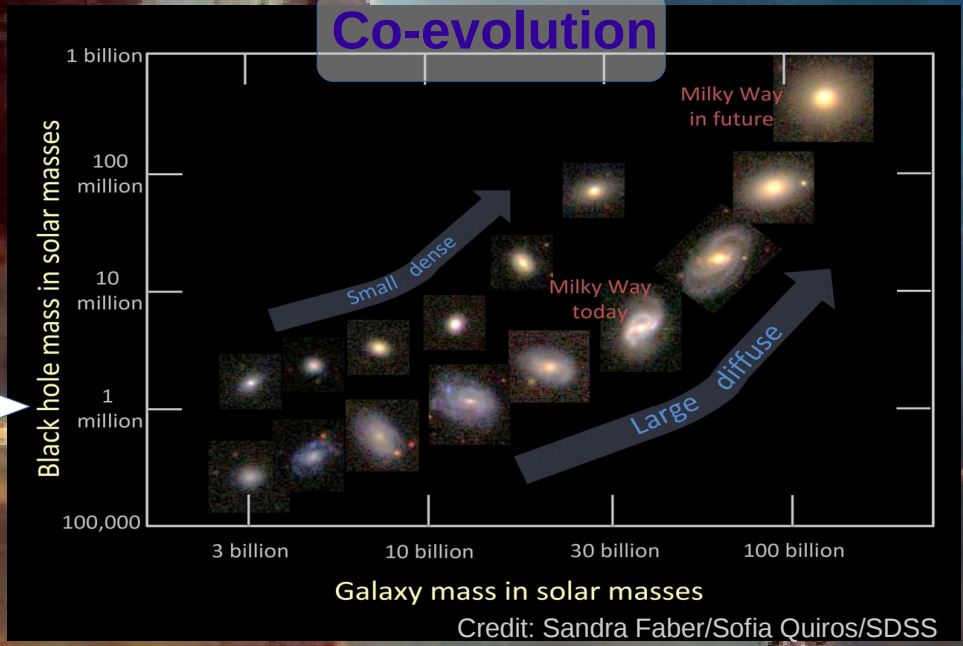
In some galaxies, the SMBH is accreting material at a very high rate, emitting a large quantity of energy.

Active galactic nuclei (AGN)

SMBHs have a basic **influence** on the evolution of galaxies.

Unveiling the mechanism(s) controlling this co-evolution is crucial to improve our understanding of the formation and evolution of galaxies.

Co-evolution



Credit: Sandra Faber/Sofia Quiros/SDSS

ignaciodelmoralcastro@gmail.com

Background image: NASA, ESA y Hubble Heritage Team (STScI/AURA)

del Moral-Castro, I., et al. 2019, MNRAS, 485, 3794
del Moral-Castro, I., et al. 2020, A&A,639, L9

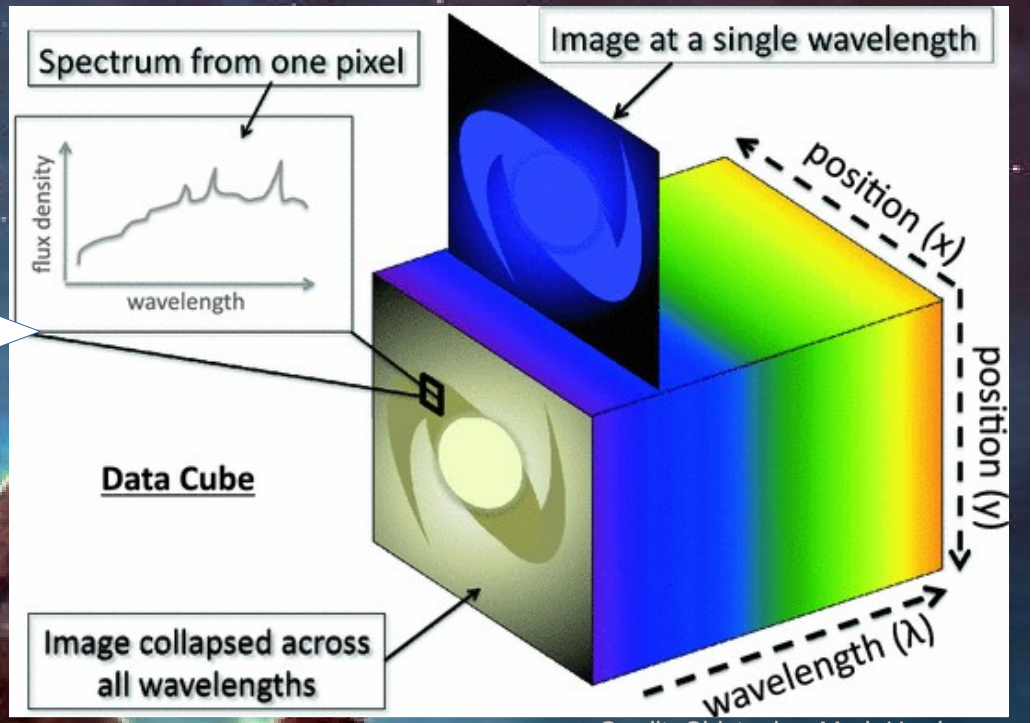
Data → Integral field spectroscopy

IFS is an observational technique that **combines image and spectroscopy**

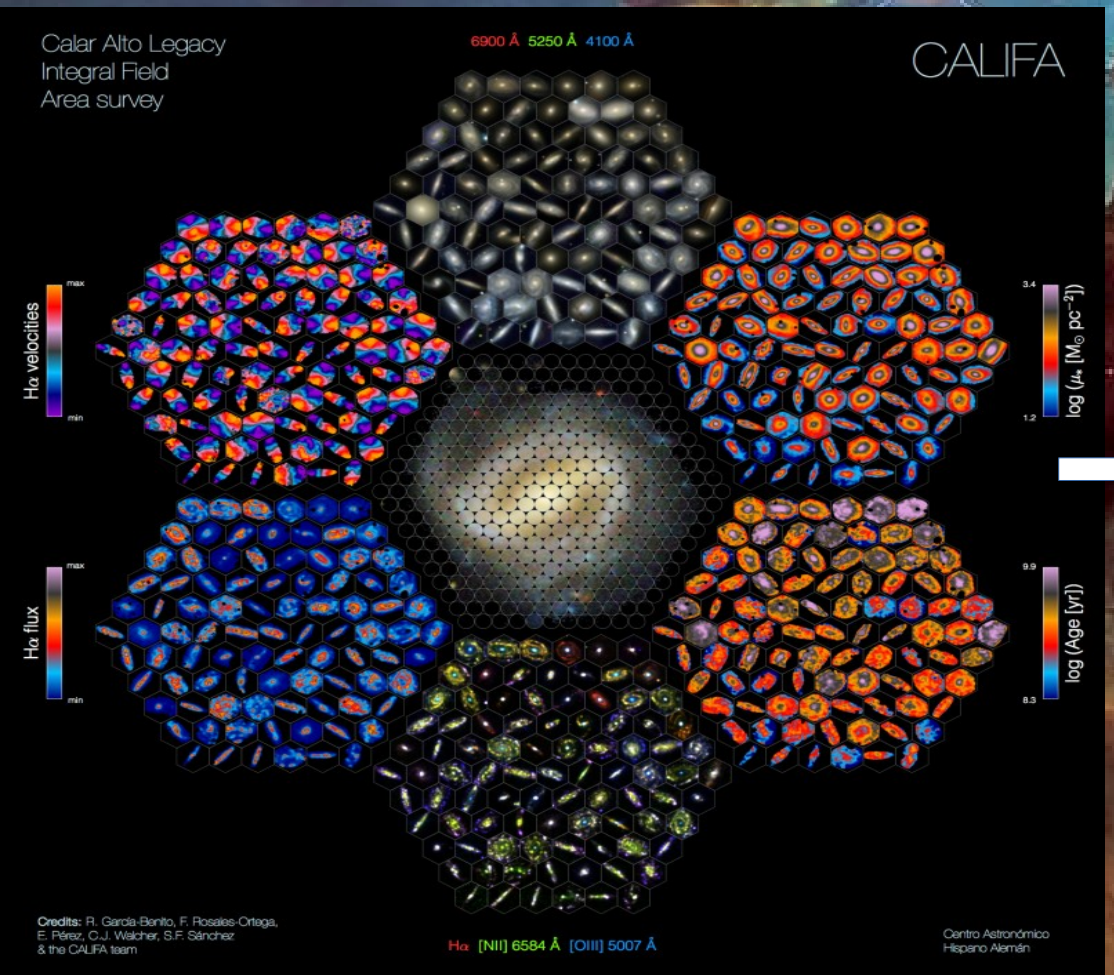
Provides **data cubes with three dimension:**

-2 spatial dimensions

- 1 spectral dimension



Credit: Chistopher Mark Harrison



CALIFA Survey

Already observed and reduced **public data**

More than 600 galaxies in the local universe ($0.005 < z < 0.03$)

Spatially resolved spectroscopic **properties** of galaxies

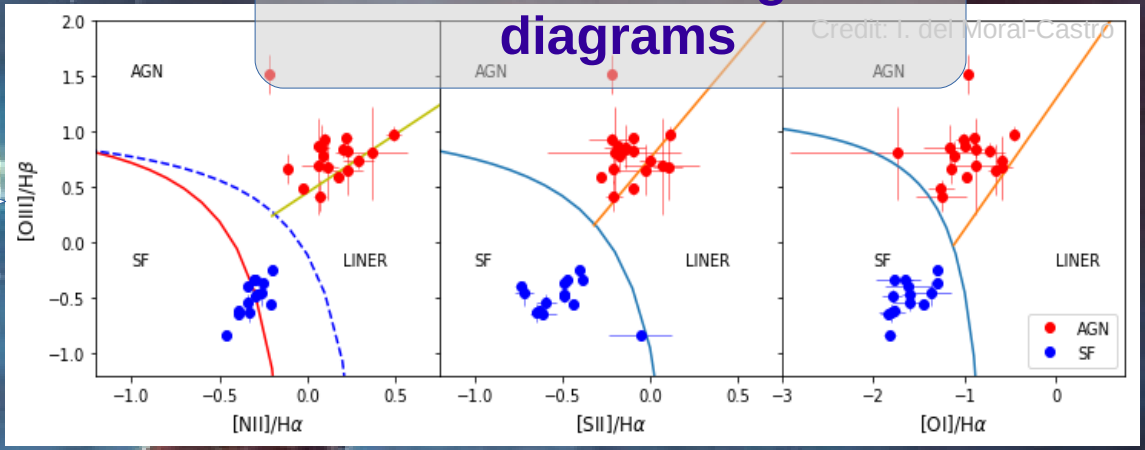
Background image: NASA, ESA y Hubble Heritage Team (STScI/AURA)

Methods → One-to-one comparisons

1

Identify the spiral active galaxies analysing the spectra of the central spaxel

Emission lines diagnostic diagrams



2

Look for large-scale almost identical **pairs of isolated spiral galaxies** differing in nuclear activity

Twin galaxies

Match in:

- Mass
- Magnitude
- Inclination
- Redshift
- Bar length
- Morphology

Background image: NASA, ESA y Hubble Heritage Team (STScI/AURA)

Results → Rotational support

We assess the **rotational support of the galaxies** using the dimensionless λ_R spin parameter.

It is normalized and goes to **unity** when **rotation dominates.**

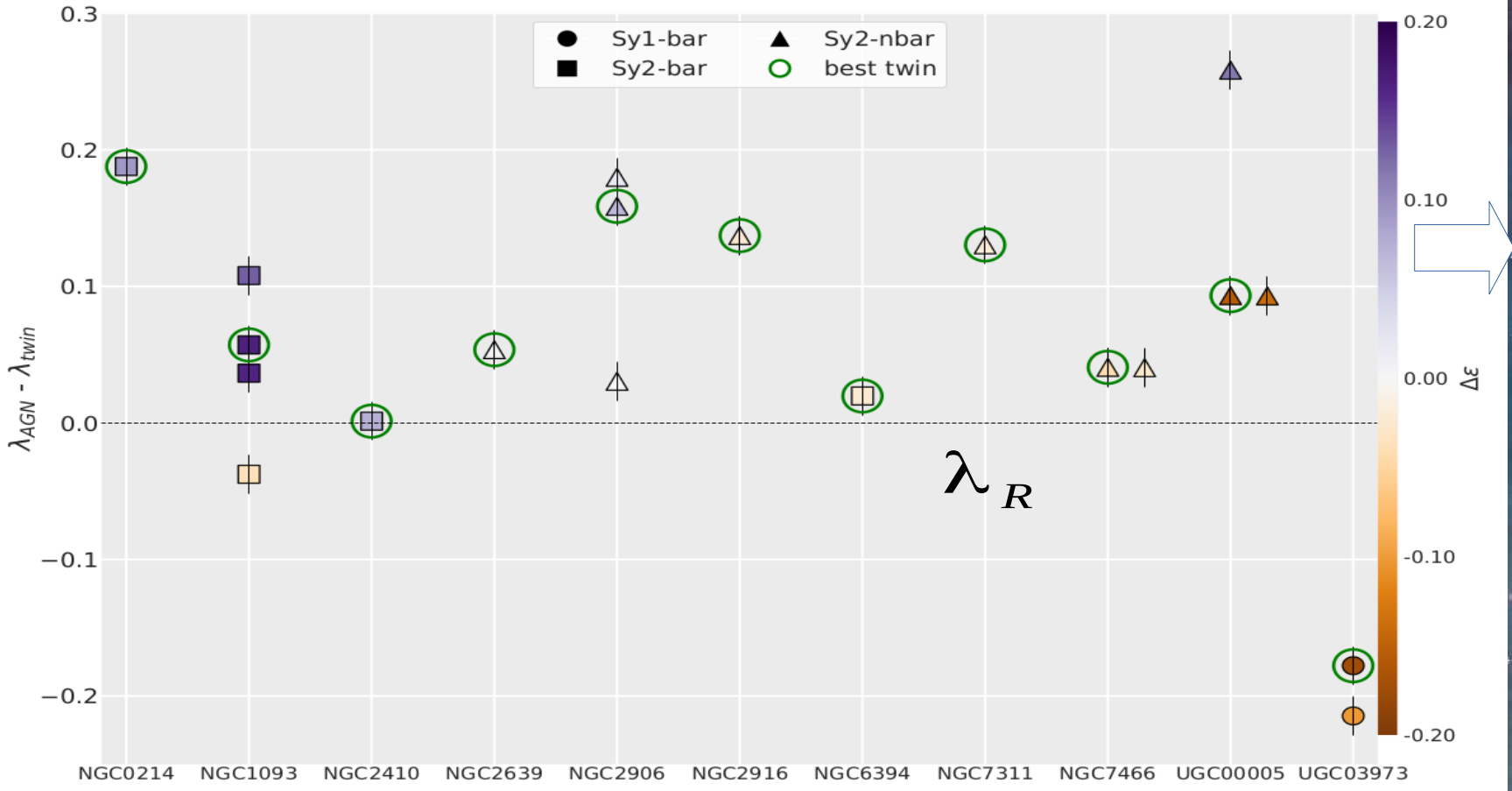


Fig. 2. Differences in stellar λ_R between the pairs of twin galaxies. The best twin of each AGN is marked with a green circle. Each column corresponds to an active galaxy and each symbol to the difference in λ_R with each of its twins. The colour code indicates the difference in ellipticity ($\epsilon_{AGN} - \epsilon_{twin}$, see Table 1). Error bars correspond to propagation of the individual uncertainties (see Sect. 3).

Credit: I. del Moral-Castro

~80% of the **active galaxies** show **higher λ_R values** that their corresponding non-active twins.

Active galaxies have larger rotational support.

First evidence of galaxy-scale differences between the dynamics of active and non-active spiral galaxies in the Local Universe.

This could then imply that not every galaxy goes through an active phase.

Background image: NASA, ESA y Hubble Heritage Team (STScI/AURA)