TFM

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Understanding the merging process: the unusual case of the isolated galaxy triplet SIT45

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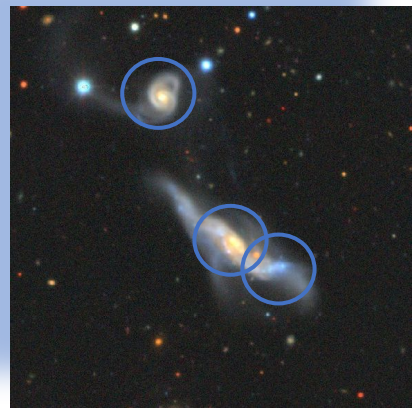


A brief abstract

Mergers of galaxies in isolated triplets give us the opportunity to study the already complex merging process, with **minimal contamination of external environmental effects** that potentially allow and accelerate galaxy transitions from active star forming to passive galaxies.

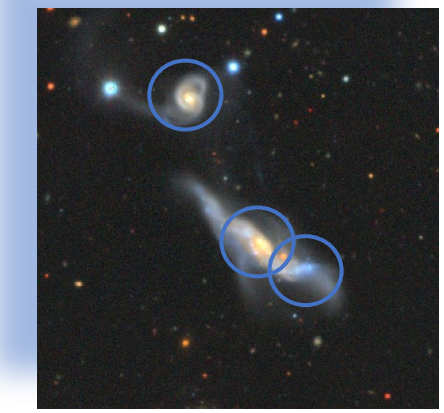
The main aims of this work are to study the evolution of the complex system **SIT 45 (an isolated merger of three late-type galaxies)** through its dynamic properties and configuration, as well as its dependence on its local and large-scale environments; along with the connection to its star formation history (SFH).

We conclude that SIT 45 is a system of three interacting galaxies that are **evolving within the same dark matter halo**, where its compact configuration is a consequence of the ongoing interaction, rather than due to a long-term evolution. The isolated triplet SIT 45 is therefore an ideal system to study short timescale mechanisms (~10^8 years), such as **starbursts triggered by interactions** which are more frequent at higher redshift.

A bit of context

- Understanding galaxy merging is critical to understand galaxy evolution. However we don't know yet everything about mergers, moreover in galaxy triplets!
- Galaxy triplets are the simplest systems to understand galaxy mergers and group evolution (only three galaxies, should be easy, isn't it?)
- Merging is messy! Isolated galaxy triplets are unusual (only 3% of galaxies in the local universe) and mergers in galaxy triplets are even more unusual (9 out of 315 systems).

SIT 45 (UGC 12589)



SDSS-based catalogue of **I**solated **T**riplets
(Argudo-Fernández et al. 2015)

Our tools to explore Into the Unknown:

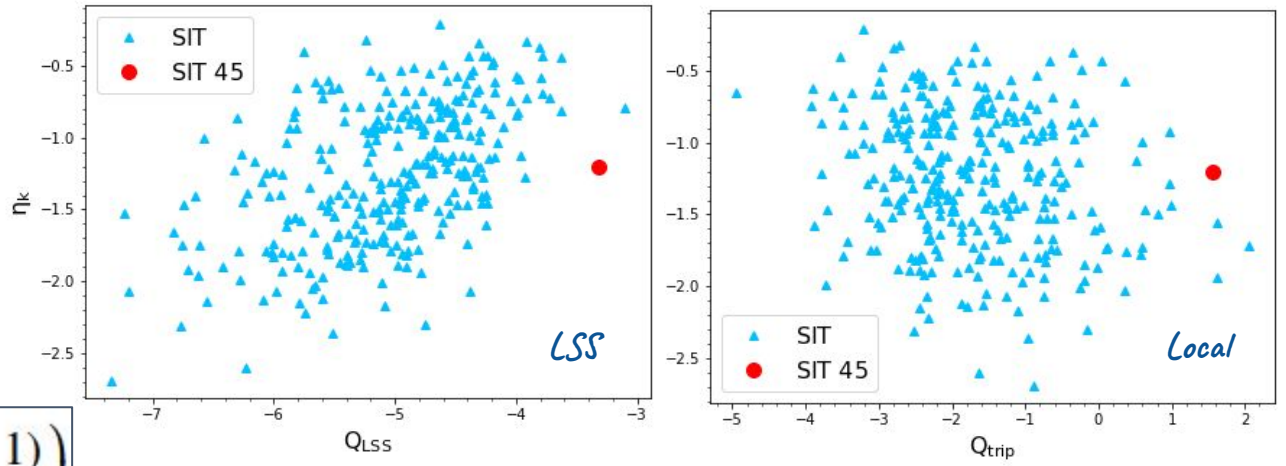
1.- Separating local from large-large scale environment

Tidal Strength

$$Q \propto \log\left[\sum_i \frac{M_{\star i}}{M_{\star A}}\left(\frac{D_A}{d_i}\right)^3\right]$$

Projected number density

$$\eta_{k,LSS} \equiv log\left(\frac{k-1}{Vol(d_k)}\right) = log\left(\frac{3(k-1)}{4\pi d_k^3}\right)$$



Details in Verley et al. 2007; Sabater et al. 2013;
Argudo-Fernández et al. 2013, 2014, 2015

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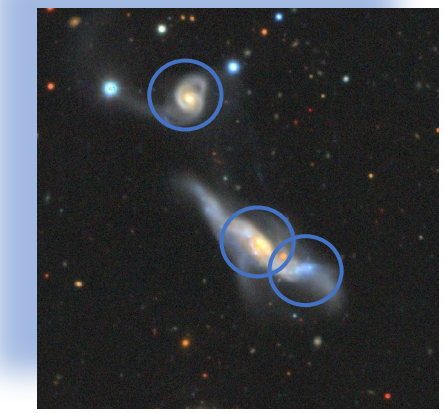

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Our tools to explore Into the Unknown:

2.- Quantifying its dynamics and configuration

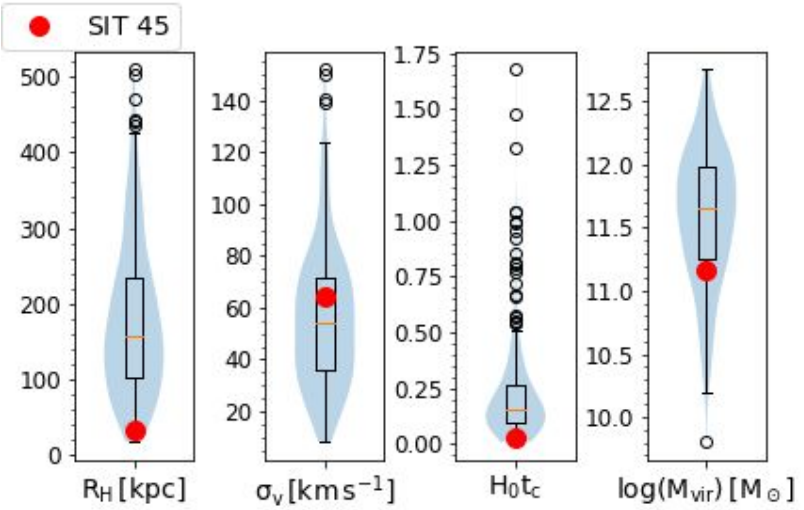
Details in Hickson et al. 1992; Araya-Melo et al.2009; Duplancic et al. 2013, 2015; White et al. 2015

Viral mass $M_{\rm vir} = \frac{3\pi R_H \sigma_v^2}{2G}$

$R_{\rm H} = \left(\frac{1}{N}\sum R_{ij}^{-1}\right)^{-1}$ **Harmonic radius**

Dimensionless crossing time $H_0 t_c = H_0 \frac{4R_H}{\sqrt{3}\pi\sigma_v}$

$\sigma^2_{v_{los}} = \frac{1}{N-1}\sum (v_r - \langle v_r \rangle)^2$ **Velocity dispersion**



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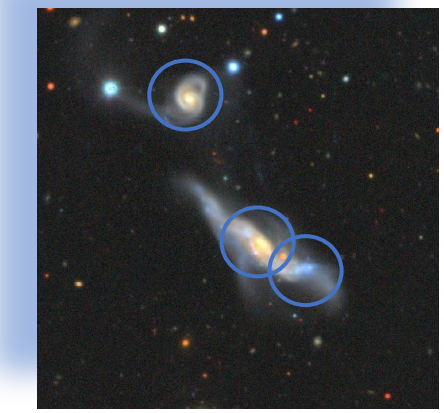

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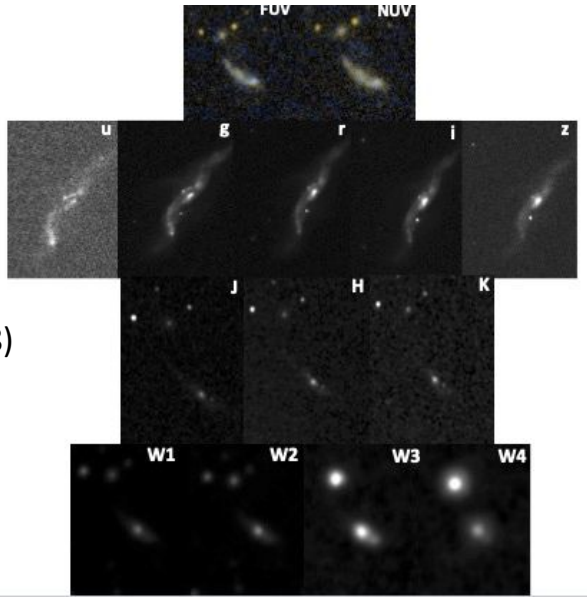
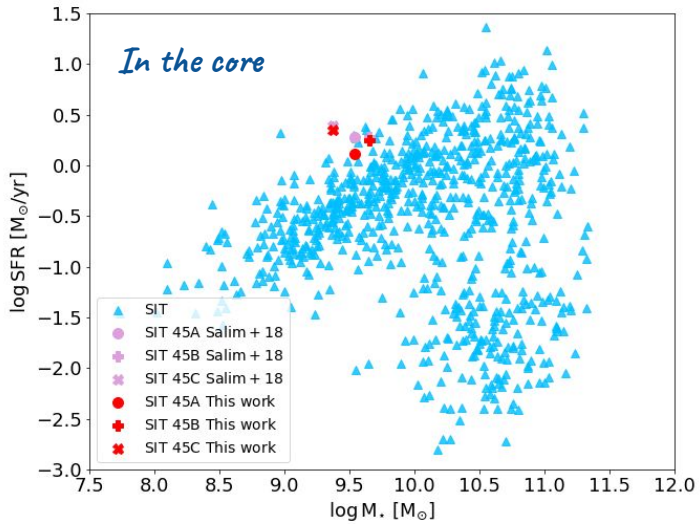
Our tools to explore Into the Unknown:

3.- Constraining its SFH from multi-lambda SED fitting

CIGALE (Boquien et al. 2019)
+
Core regions → GALEX-SDSS-WISE Legacy Catalogue (Salim et al. 2016, 2018)
+
MUSE IFU spectroscopy
+
Tidal tails, bridges, LSB regions → Deep optical photometry (Pan-STARRS, HSC, DECaLS)





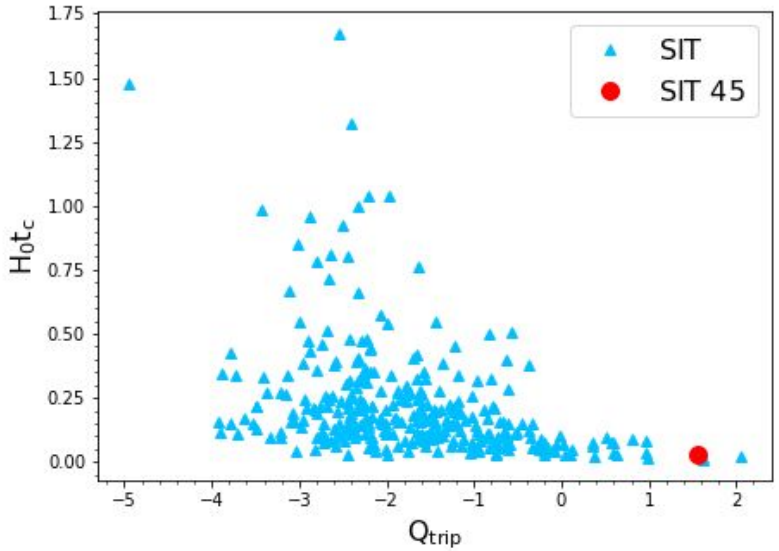
Results and first conclusions

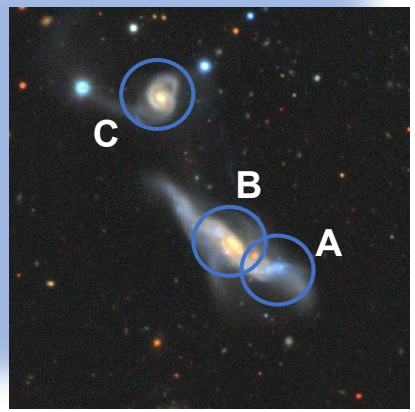
- **SIT45 is a compact system** as shown by its harmonic radius and compactness, which is consistent with the fact that the three galaxies that compose it are interacting.

- According to its SFH, the triplet is **composed of starburst galaxies**. The galaxies also have a high percentage of their stellar mass recently created, indicating that this activity may have been **triggered by the ongoing merging process**.

- The harmonic radius and crossing time values are much smaller than in the rest of the SIT triplets, which would suggest that the system is highly evolved. However, contrary to what would be expected, the triplet is composed of blue spirals with high star formation rate. So **its configuration is a consequence of the ongoing merging,** rather than due to a long-term evolution.

- SIT 45 does not present a high value of its virial mass, where the percentage of dark matter of the triplet is in agreement with that expected according to the standard cosmological model, where the three interacting galaxies that are **evolving within a common dark matter halo**.





DECaLS *gri* image of SIT~45

Proposed scenario:

Is SIT 45A a tidal galaxy formed from a first encounter between galaxies SIT 45B and SIT 45C?

More for the future...looking at the gas contribution (H_I and CO) and explore the SFH at LSB regions