Fornax-like clusters in cosmological simulations

María E. De Rossi [1], L. Zenocratti [2,3], A. Smith Castelli [2,3], F. Faifer [2,3], A. Cortesi [4], L. Sesto [2,3], C. Barbosa [5]

ABSTRACT

The project #59 of the S-PLUS collaboration is aimed at studying the Fornax galaxy cluster. We plan to analyse state-of-the-art numerical simulations to understand relevant observational properties of galaxies in Fornax. We will identify Fornax-like galaxies in the simulations by searching for galaxy clusters with the main characteristics of the Fornax cluster. We will compare the photometric and dynamical properties of such simulated systems with those derived from S-PLUS data. By following the formation histories of simulated objects, we will try to propose possible formation scenarios for similar observed systems. In this poster, we present a preliminary analysis of Fornax-like cluster candidates selected from state-of-the-art cosmological simulations.

1 - Insituto de Astronomía y Física del Espacio, UBA-CONICET, Argentina
2 - Facultad de Ciencias Astronómicas y Geofísicas, UNLP, Argentina
3 - Instituto de Astrofísica de La Plata, CONICET–UNLP, Argentina
4 - Observatorio do Valongo, UFRJ, Brazil
5 - Instituto de Astronomia, Geofísica e Ciências Atmosféricas, USP, Brazil

Contact:
mariaemilia.dr@gmail.com

14th S-PLUS (Virtual) Meeting, December 15–17, 2020

Fornax-like systems in EAGLE and Illustris-TNG simulations

EAGLE simulations

http://eagle.strw.leidenuniv.nl, http://www.eaglesim.org/

The **EAGLE simulations** suite is a set of **cosmological hydrodynamical simulations** in cubic, periodic volumes (Crain et al. 2015; Schaye et al. 2015). These simulations were run with a modified version of the **GADGET-3** code adopting a Planck Collaboration (2015) cosmology. We present results from the simulation **Ref-L100N1504**, which was carried out for a box size **L=100 cMpc**, with an initial baryonic particle mass of **1.2 x 10^6 $M_\odot$**.

Illustris-TNG simulations

http://www.tng-project.org

The **Illustris-TNG simulations** suite is a set of **cosmological magneto-hydrodynamical simulations** in cubic, periodic volumes (Springel et al. 2017; Pillepich et al. 2017a; Nelson et al. 2017; Naiman et al. 2017; Marinacci et al. 2017). These simulations were run with the **AREPO** code adopting a Planck Collaboration (2015) cosmology. We present results from the simulation **TNG100-1**, which was carried out for a box size **L=110.7 cMpc**, with an initial baryonic particle mass of **1.4 x 10^6 $M_\odot$**.

SELECTION OF FORNAX-LIKE CLUSTER CANDIDATES

(Observational data: $M_{vir,Fornax} \approx 5.8 \times 10^{13}\ M_\odot$, $M_{*,NGC1316} \approx 2.6\text{-}3.5 \times 10^{11}\ M_\odot$, $M_{*,NGC1399} \approx 2.75 \times 10^{11}\ M_\odot$)

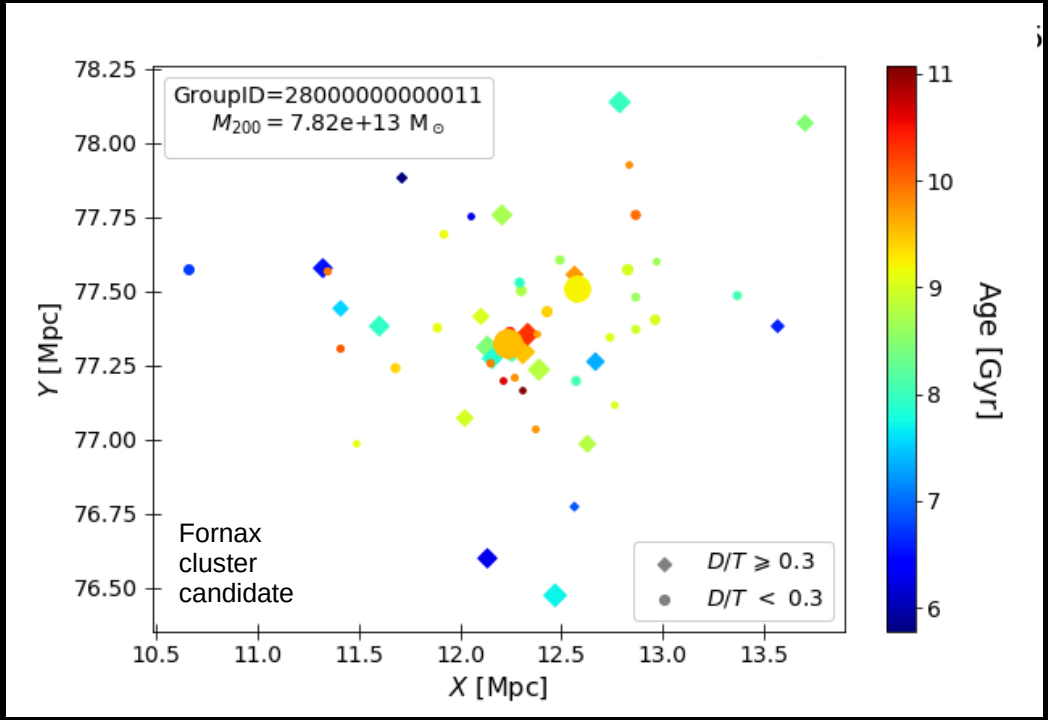
Simulated clusters:

- ***M_{vir} = 4 x 10^{13} $M_\odot$ - 8 x 10^{13} $M_\odot$***
- *Most massive galaxy with **M_* > 2 x 10^{11} $M_\odot$***
- *Second most massive galaxy with **M_* > 1.4 x 10^{11} $M_\odot$***
- *Other galaxy members with **M_* < 1.0 x 10^{11} $M_\odot$***

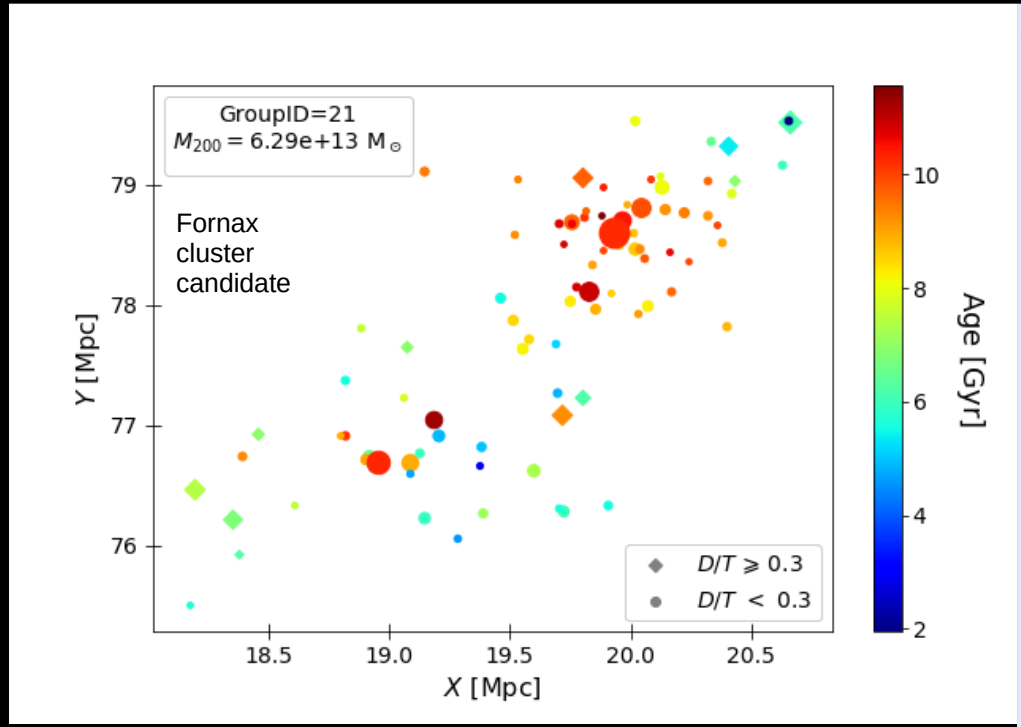
*In order to avoid **resolution issues**, additional constraints were imposed to galaxies selected for analysis within each Fornax cluster candidate.*

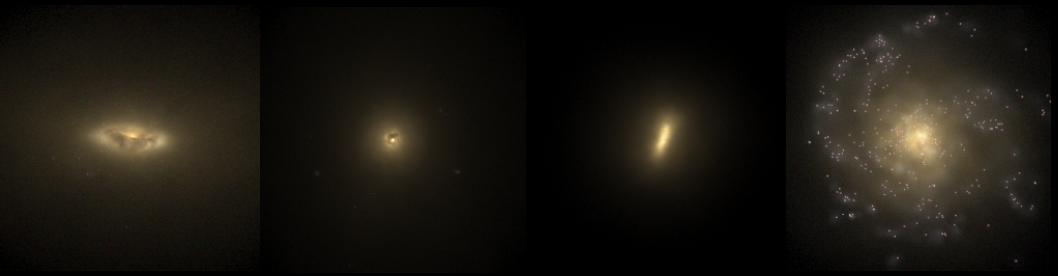
*In the case of **EAGLE simulations**, we selected galaxies with **M_* > 3.2 x 10^8 $M_\odot$** and a number of stellar particles **N_*(R<30 kpc) > 300.** For **Illustris-TNG simulations**, we selected galaxies with **M_* > 3.4 x 10^8 $M_\odot$***

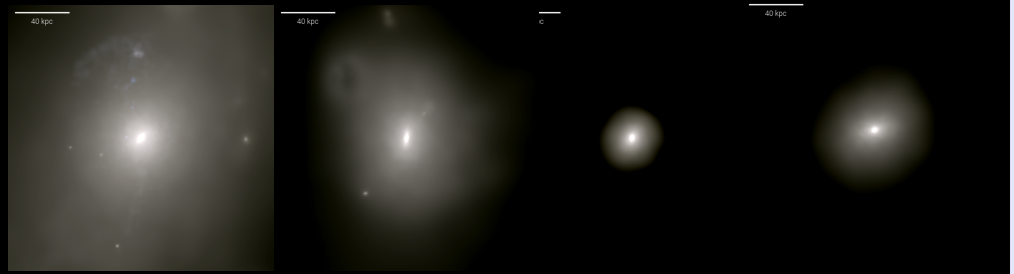
EAGLE SIMULATIONS

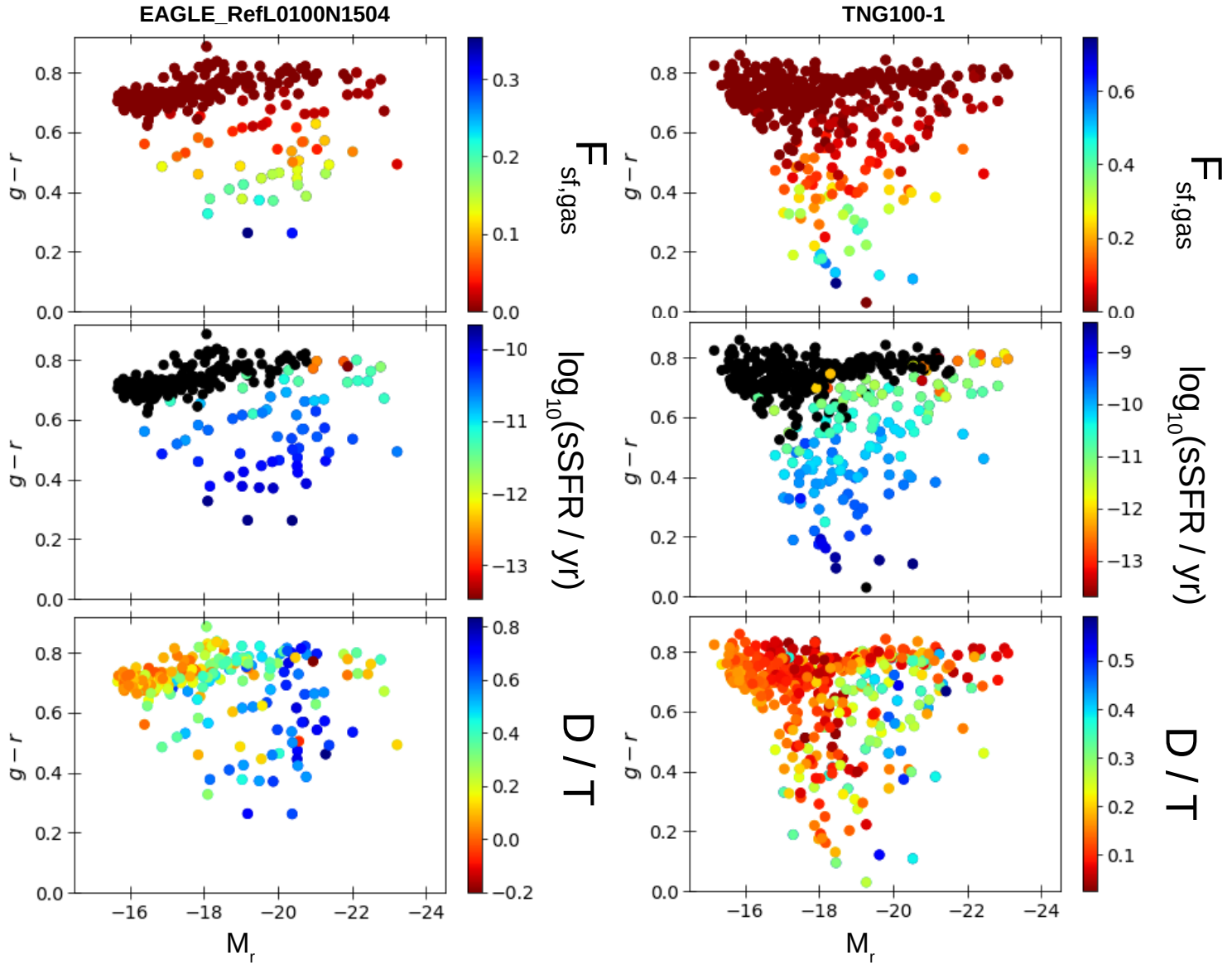


ILLUSTRIS-TNG SIMULATIONS





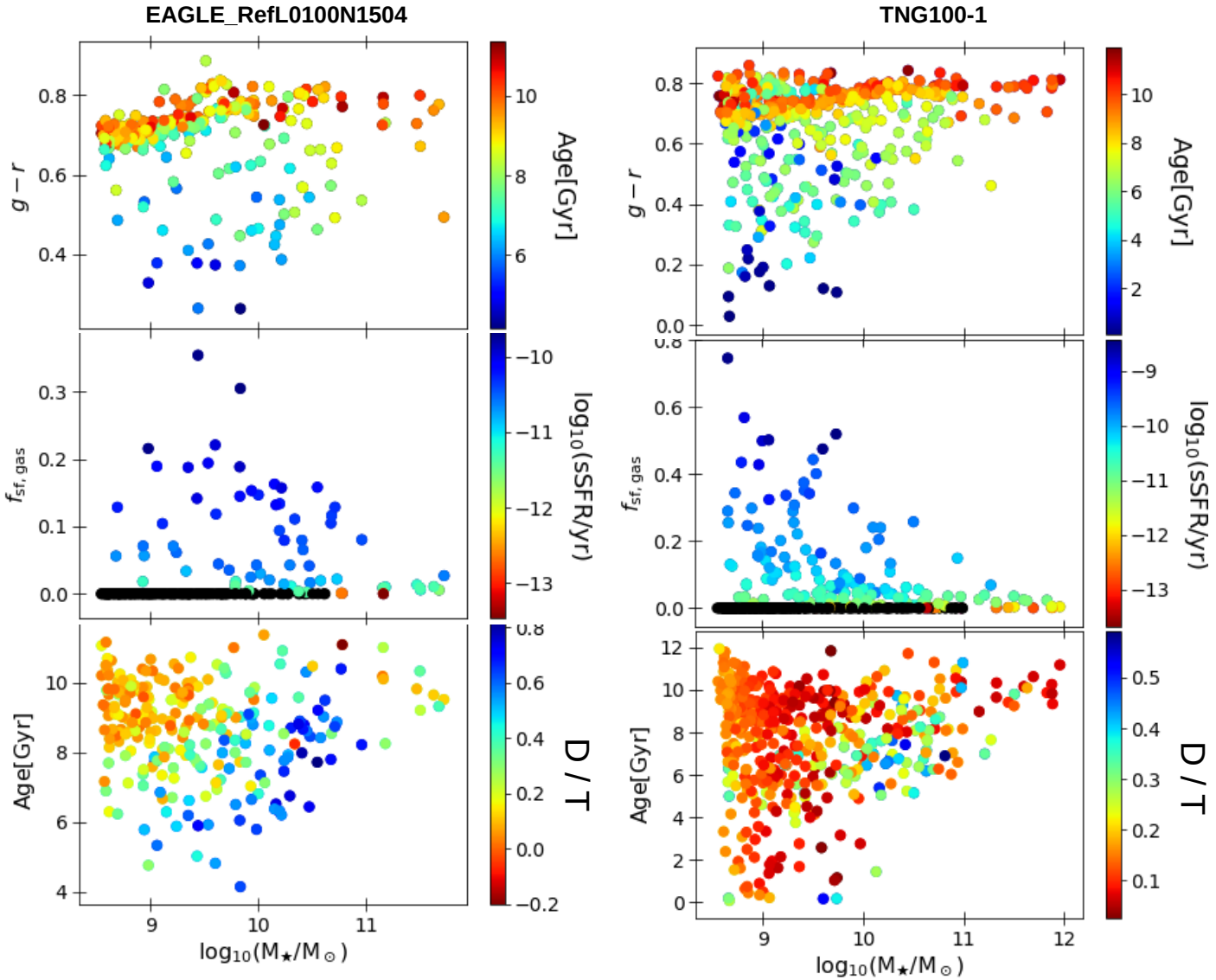




We studied a sample of galaxies composed by systems belonging to all of the selected Fornax-like cluster candidates.

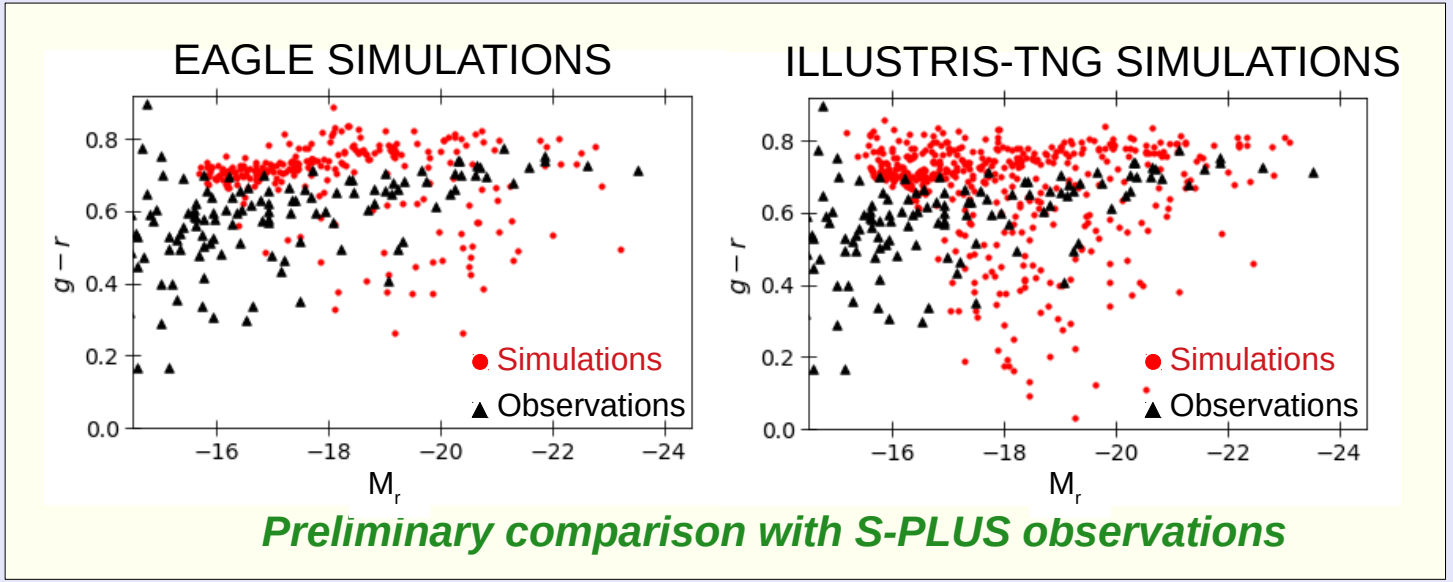
We analyzed **relations between different properties** of galaxies, such as **g-r**, $\mathbf{M_r}$, **stellar age**, $\mathbf{M_*}$, star-forming gas fraction ($\mathbf{f_{sf,gas}}$=$M_{sf,gas}$/(M_*+$M_{sf,gas}$), where $M_{sf,gas}$ is the mass of star-forming gas), specific star formation rate (**sSFR**), disc-to-total ratio (**D/T**), among others.

Left figure compares the **color-magnitude relations** of EAGLE and Illustris-TNG simulations.



We are analysing the existence of correlations between different properties in EAGLE and Illustris-TNG simulations.

Our sample of galaxies is composed by systems belonging to all of the selected Fornax-like cluster candidates.



Preliminary comparison with S-PLUS observations

Summary

- As part of the **project #59** of the **S-PLUS collaboration**, we searched for systems similar to the **Fornax cluster** in state-of-the-art cosmological simulations.
- We presented a preliminary selection of such systems in the **EAGLE** and **Illustris-TNG simulations**.
- We analyzed different **relations between photometric and dynamical properties** of galaxies.
- We carried out a **preliminary comparison between the simulated and observed color-magnitude relations**, obtaining good agreement between simulated and observed trends.

Future work

- We will carry out a **more detailed comparison with observations**, considering other properties of Fornax galaxies.
- We will analyze the **formation histories** of Fornax-like cluster candidates in simulations in order to provide clues about the origin of the Fornax cluster.
- We will evaluate if it is necessary to include **other simulations** for our comparison.