What Drives the Stellar Mass Growth of Early-Type Galaxies? Born or made: the saga continues...

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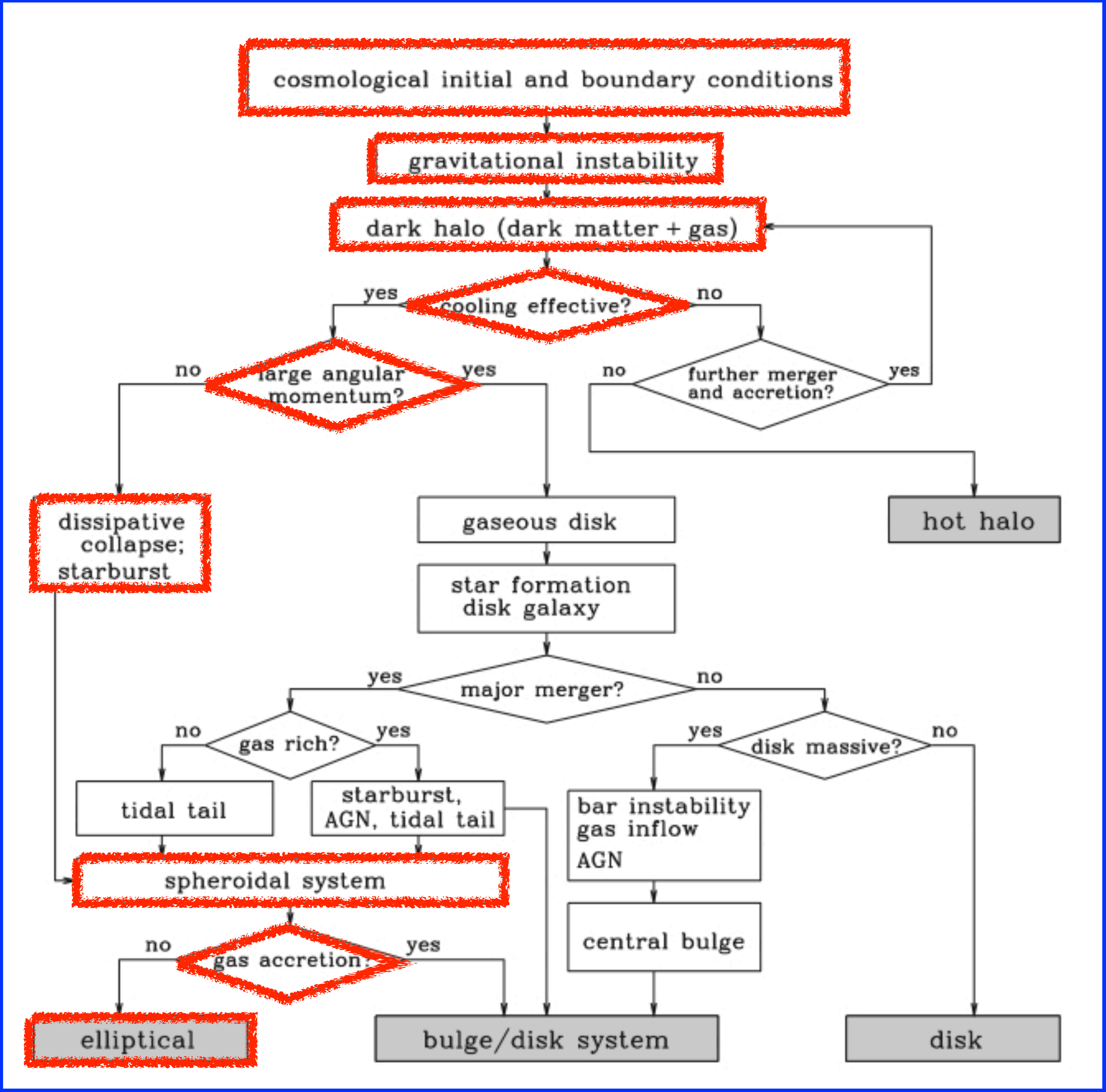
The activities in this project follow from the general context of the main subject that is the evolution of ETGs in different environments up to z ~ 0.5, which corresponds to an epoch of 5 billion years ago. The data used in each specific sub-project come essentially from the GAMA (Galaxy And Mass Assembly) project, and from observing time obtained with FORS2 at VLT/ESO.

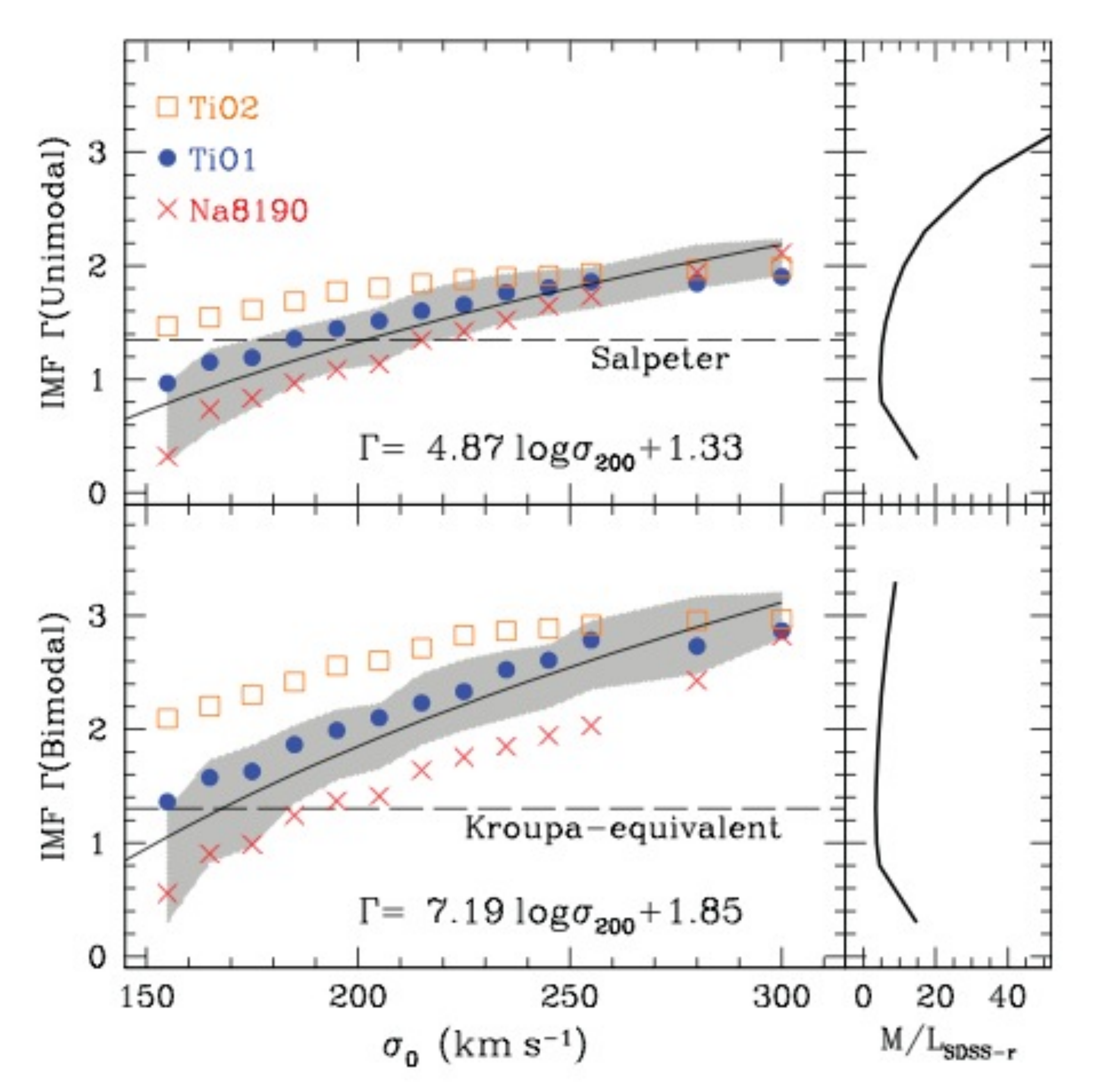
Conceptual Context & Scientific Background



The Initial Mass Function in ETGs

IMF - describes the distribution of stellar masses in a single population at the time of birth.

Studying a sample of ~40,000 ETGs of the SPIDER project, we have found a strong correlation between central velocity dispersion and the slope of the IMF, indicating an excess of low mass stars in massive ETGs.

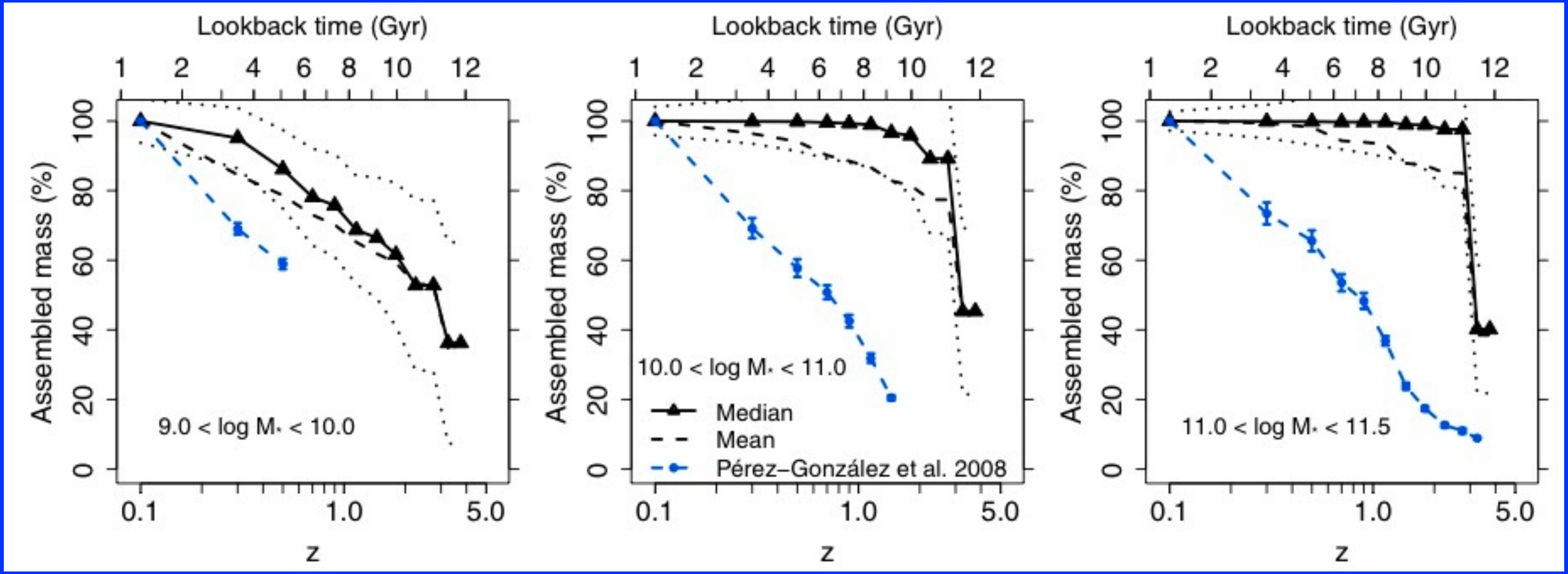


Ferreras et al. (2013)

These recent results expressing the non-universality of the IMF have strong implications for theories of galaxy formation and evolution. However, there is still great debate on the degeneracy between a true IMF variation and abundance ratio variations.

The Star Formation History vs. Distance to Cluster Center

Several physical processes occurring only in groups and clusters may alter the evolution of a galaxy, like ram-pressure, harassment, and starvation. The environment also plays an important role in the star formation history of the system.

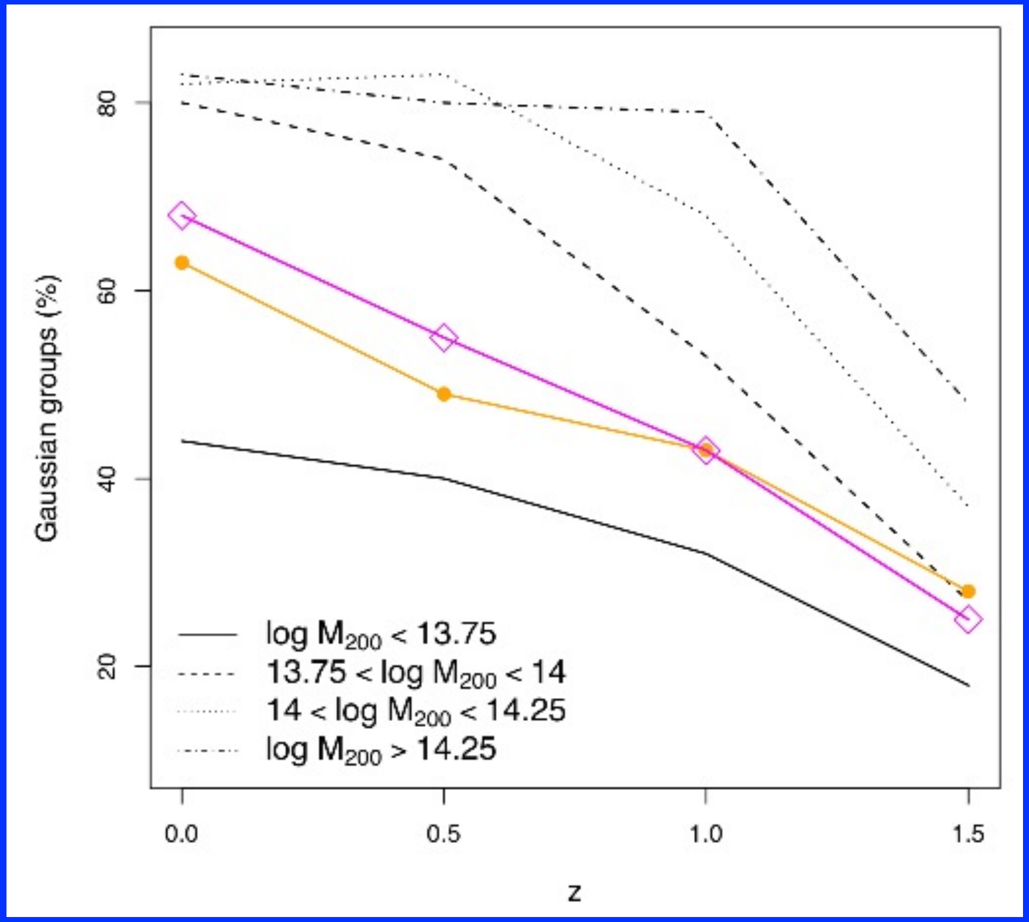


Trevisan et al. (2012)

In this project we will examine the process of accumulating baryons as a function of the distance from the center of the cluster, its mass, and its redshift, incorporating in the analysis the three specific physical mechanisms described above, with different efficiencies.

The velocity distribution of cluster galaxies and its influence on galaxy properties

We recently presented a new methodology to quantify the gaussianity of a velocity distribution as a way of characterizing the environment.



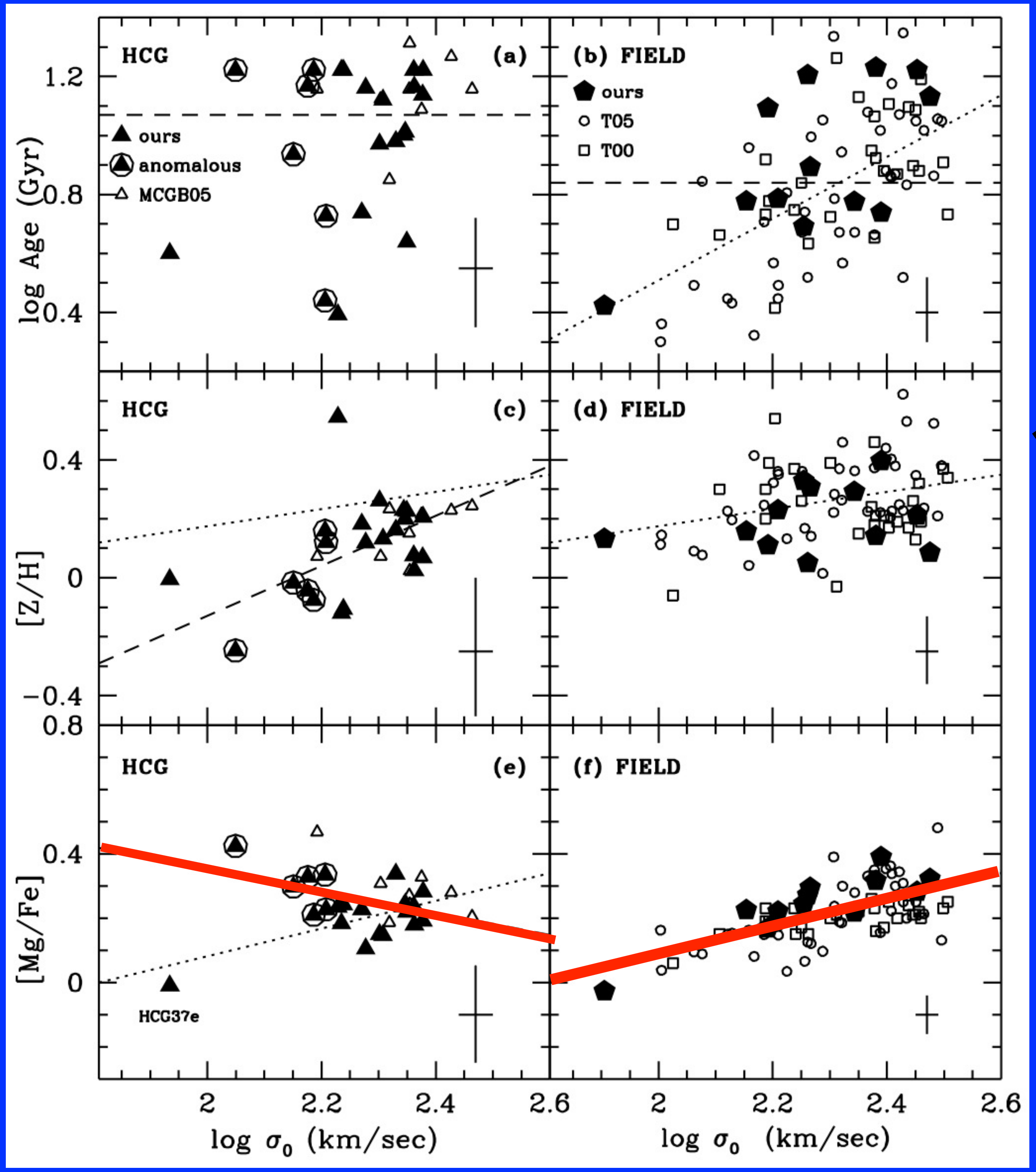
Ribeiro et al. (2013)

Bright galaxies located in the external and internal regions of the groups show no significant differences in the galaxian properties, regardless of whether the groups are G or NG. For fainter galaxies we find a significant difference in the properties depending on their host groups (G vs. NG), suggesting strong environmental effects.

Motivated by these findings we embarked on a collaboration with the GAMA team to investigate how these effects extend to z = 0.5, tracing the evolutionary history of star formation in group/cluster galaxies and the relation to the dynamical evolution of those group/clusters.

The Stellar Populations in Compact Group ETGs

Due to their high densities and low velocity dispersions, these systems were considered ideal laboratories for studying tidal interactions and merging process.



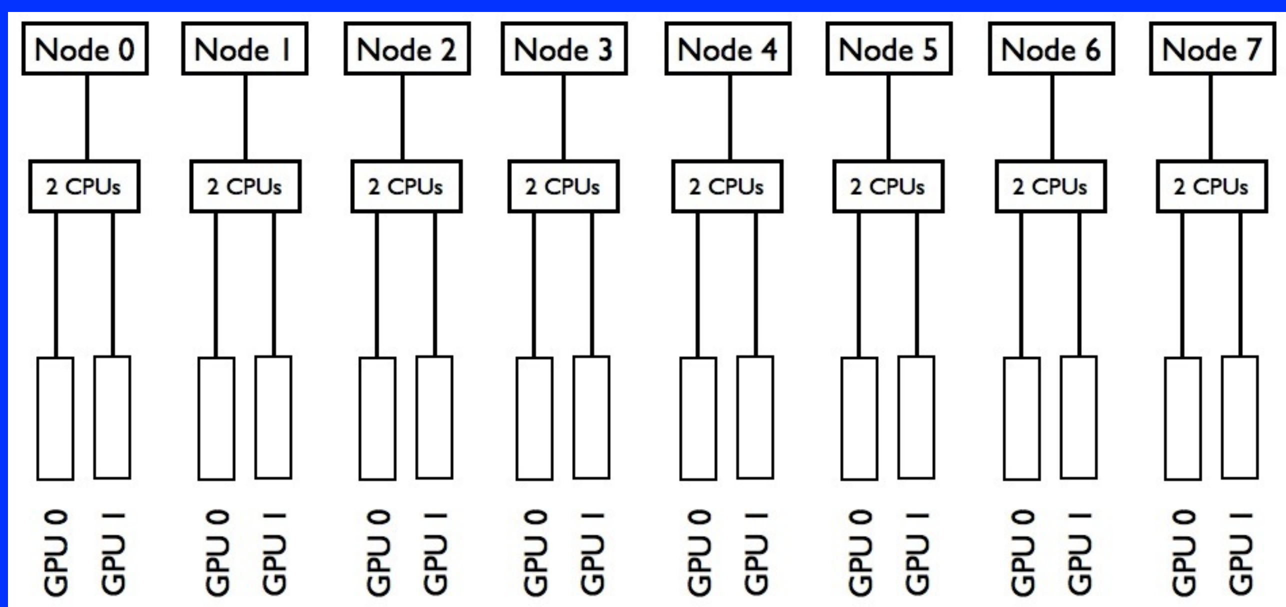
de la Rosa et al. (2007)

Interpreted as evidence for a mechanism for truncation of star formation in ETGs in HCGs. Hydrodynamical simulations confirm this interpretation (Di Matteo et al. 2005)

Crossmatching of the McConnachie et al. (2009) sample with SDSS-DR10 yields a subsample of 70 quartets. We gathered spectroscopic for extra 35 CGs from TNG, confirming 20 as real quartets. In summary, we have a subsample of 105 CGs in the redshift range of $0.05 < z < 0.095$. These data will allow us to investigate in detail the question of how truncated star formation operates in dense systems like CGs.

Implementing GALPHAT in GPUS

In the last five years we have invested considerable time and effort in developing a two-dimensional surface photometry package, 2DPHOT (La Barbera et al. 2008), which was extensively used during the SPIDER project. A new galaxy image decomposition tool, GALPHAT (GALaxy PHotometric ATtributes), is now available, which is a front-end application of the Bayesian Inference Engine (BIE).



CPU configuration	GPU configuration
- Clock Rate: 2,2GHz. - Instruction cache size L1: 256 Kbytes - Cache size L2: 2MBytes. - Cache size L3: 20MBytes	1. - Cores units Up to 2400 2. - Clock rate Up to 700 MHz 3. - Memory: 5GB GDRR5 4. - Memory bandwidth Up to 200Gb/s.

Running GALPHAT on the LNCC cluster it takes 3 hours to process one galaxy, implying that 1,000,000 galaxies would take 100 years to process - completely unfeasible. Initial benchmarks suggest that processing can be accelerated by a factor of ~700 per GPU, so our cluster of 16 GPUs may reduce the processing time for a million objects to a mere 10 days, which is reasonable and competitive, considering that the Bayesian methodology will provide unbiased results on the global properties of galaxies with strong implications for the study of how galaxies form and evolve.