Pixel Colour-Magnitude Diagram Analysis of the Fornax Cluster using S-PLUS images (Part I)

Carlos Escudero[1,2]; Favio Faifer[1,2]; Analía Smith Castelli[1,2]; Leandro Sesto[1,2]

1. Facultad de Ciencias Astronómicas y Geofísicas, UNLP
2. Instituto de Astrofísica de La Plata

INTRODUCTION

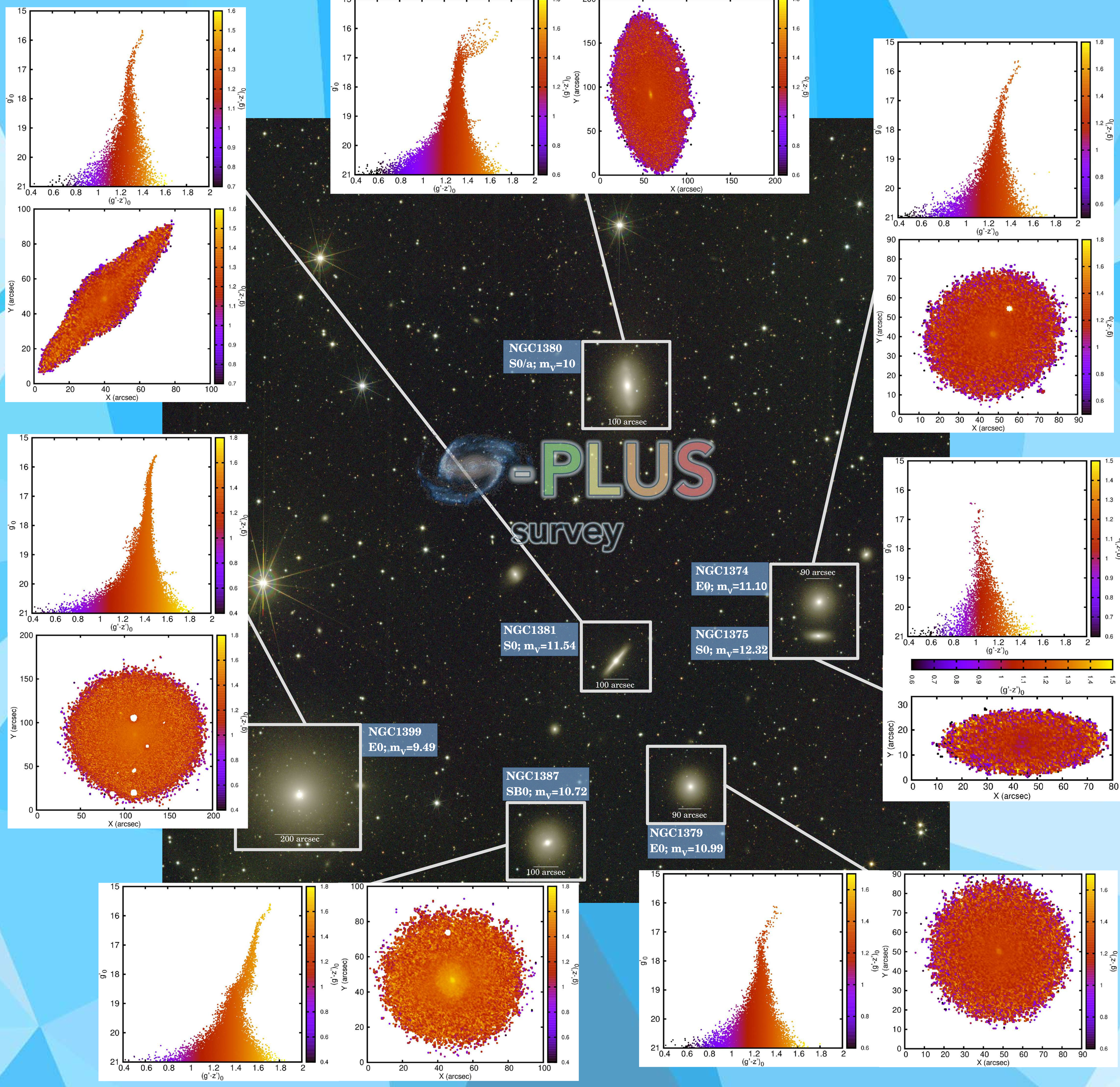
Galaxy clusters are the largest gravitationally bound systems in the universe and therefore play an important role in cosmological studies. They contain a wide variety of stellar systems, ranging from galaxies of different morphological types and masses, up to ultra-compact dwarf galaxies and globular clusters. According to the hierarchical clustering scenario, galaxy clusters continuously grow by accreting individual galaxies, as well as entire galaxy groups. Therefore, they have been regarded as powerful laboratories for studying the evolution of galaxies in dense environments where the physical properties of these galaxies might have been influenced by many different mechanisms, such as strong galaxy-galaxy interaction, harassment, ram pressure stripping, and starvation. All these cluster environmental processes result in different properties for cluster and field galaxies. An important resource for studying galaxy evolution is the availability of homogeneous and complete samples of galaxy observations that can be used statistically to investigate the properties of the galaxies in these environments. In this sense, the images (1.4 deg^2) obtained by the Southern Photometric Local Universe Survey (S-PLUS; Mendes de Oliveira et al. 2019) in 12 optical bands are a valuable tool for this type of study.

FORNAX CLUSTER

The Fornax cluster (α = 03h 38m 29.024s, δ = −35d 27' 03.18") is the second most massive galaxy concentration within 20 Mpc (Blakeslee et al. 2009), after the Virgo cluster, and is one of the best sites to study the properties of galaxies in an environment dominated by the gravitational potential of the cluster. Different works suggest that the centre of the cluster is dynamically evolved (e.g., Jordán et al. 2007), since most of the brightest (M_B < -16.5 mag) cluster members have transformed into early-type galaxies. In this work, we focus on the inner ~1 square degrees around the core of the Fornax Cluster (r ∼ 0.2 Mpc), in order to study some features of the brightest members through the analysis of the pixel colour-magnitude diagram (pCMD) and pixel colour-colour diagram (pCCD) (see, Lanyon-Foster et al. 2007). The proximity of the cluster will allow us to study possible correlations between different morphological properties (disks, bars, bulges, nuclei, etc) and known stellar populations, with substructures that can be detected in the analysis of pixelated diagrams.

pixel Colour Magnitude Diagram (pCMD)

We use the S-PLUS photometric data in the 5 *u'g'r'i'z'* broad-band filters to construct individual colour–magnitude diagrams of the galaxies such that each point corresponds to one pixel of a galaxy image. A pixel-by-pixel analysis provides a novel way of looking at the stellar populations and structures of galaxies and reveals information that an analysis of integrated light does not. Prior to the construction of these diagrams, fluxes were converted from counts per pixel to apparent magnitude per square arcsecond by considering the pixel scale, and subsequently, calibrated to the standard system. Finally, we applied the Galactic extinction coefficient values from the NASA/IPAC Extragalactic Database (NED).



Continue in Part II