SPLUS and the Study of the Large Scale Structure in the Nearby Universe

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ABSTRACT

Context: The Southern Photometric/Low Resolution Survey (SPLUS) is a survey which will reach BIMU coverage of the southern sky in 17 bands (4 clear bands and 13 narrow bands over the main stellar features). This system will allow more precise estimations of photometric redshifts of galaxy clusters than ever achieved, because it will have good cluster membership determination and a more accurate derivation of luminosity function at z ≤ 1.

Aim: The main goal of this project is to apply different methods of finding clusters of galaxies in a mock catalog of SPLUS. Then, we will determine photo-z for a galaxy in a certain area of SPLUS and the cluster selection will be used on real data.

Methods: There are some new methods to find galaxy clusters in the sky. We use Voronoi Tessellation, Bayesian Cluster Finder and the Voronoi Filters technique. We will apply some of these methods and compare with each other. We are using the Bayesian Cluster Finder technique in SPLUS mock catalog and then we will apply to real data. The goal is to apply this method in a general way. It should then be possible to change the limits (the priors the cutting radii and weighting functions) according to the object of study to apply to different scenarios. The rest of general priors will be done, such as the use of the presence of redshifts and of a brighter cluster galaxy in the system.

INTRODUCTION

In an era of great technological advancements and Big Data, it has been necessary to deal with large amounts of data, in particular, in astronomy. In this context, cosmetic redshift surveys have provided us with a wealth of multi-color information for millions of galaxies, through SDSS, 2dFGRS, 6dFGS, SDSS-III, etc. Since these modern redshift surveys cannot be obtained in an inexpensive and quick way compared to spectroscopic methods, there is a crucial tool for studies in modern astronomy.

The S-PLUS survey uses 3800 square degrees of the Southern sky with twelve optical bands using a new dedicated 1.33 meter telescope and an optical imager with 3 square degrees of field of view. The S-PLUS three-color system consists of Broad R and narrow R and narrow I filters and the transmission curves can be seen in Figure 1. It has been designed to find low-redshifted and high-blue luminosity stars, high-redshifts determine the physical properties of nearby galaxies and to map the large-scale structures of this medium. A more detailed section of this medium has been shown (Millesi et al., 2017) that the S-PLUS photometric cones reach a precision of δz/1+z = 0.005 for cluster galaxies with magnitudes brighter than R = 17 and a precision of δz/1+z = 0.003 for galaxies with R > 18. This result can be seen in Figure 2.

These redshifts estimated by our group using SPLUS data are (up to a factor of) three times more precise that photometric redshifts surveys in the Southern hemisphere such as ERO, 2dF, SDSS. These precise photometric redshifts for the local Universe provide us with the opportunity to review knowledge about the large-scale structures, better identify members of galaxy clusters, and to comprehend in a better way how clusters form and evolve. Furthermore, Millesi et al., 2017 identified 10 luminous red galaxies (LRGs) for galaxies z =0.69 in the nearby cluster (561zV = 6220), and they found that S-PLUS/PLUS photo-zs are able to recognize as members the entire spectroscopic sample and in addition they are much hundreds of galaxies on several new redshifts located at 2 < z < 3. This means a new survey of the S-PLUS data to reveal membership in nearby clusters of galaxies, leading to a more accurate derivation of luminosity or stellar-mass function and a better overview in understanding the formation and evolution of clusters of galaxies.

METHODOLGY

There are several methods to find galaxy clusters in the literature using optical data. There are three principal groups of methods to identify clusters of galaxies with optical data considering this parameterization of galaxy, the red sequence, or when characteristics such as luminosity or density are taken into account to mark galaxy clusters. In the first group are the Voronoi Tessellation Method (Cruz et al. 2004; Kim et al., 2007; Lee et al. 2004), Quarta a Cella Method (Galametz et al., 2004; Liddle 2004; Moresco et al. 2003). Population Aggregation Algorithms (Galmetz et al., 2004; Galametz et al., 2003; Brown et al. 2008). The second group consists of the Cardellino Effect Algorithms (David et al., 2005; the Cluster Red Sequence Method (Hensler et al. 2006; López-Corredoira et al. 2006, 2008; Goto et al. 2009, 2010). The third group consists of the Loomis Effect Algorithms (Stephane et al., 2005) the Adaptive Masking Filter (Agarap et al., 2006; Hybrid Masking Filter (Koester et al., 2007; van Dokkum et al., 2007). Figure 1 shows the performance of the SPLUS filter system. The figure shows an example of the SED fitting for an early-type galaxy in the SPLUS filter system, and the SED fitting for a late-type galaxy in the SPLUS filter system.

REFERENCES

Cruz et al. (2004), Lee et al. (2004), Kim et al. (2007), Lee et al. (2004), Quarta a Cella Method (Galametz et al., 2004; Liddle 2004; Moresco et al. 2003). Population Aggregation Algorithms (Galmetz et al., 2004; Galametz et al., 2003; Brown et al. 2008). The second group consists of the Cardellino Effect Algorithms (David et al., 2005; the Cluster Red Sequence Method (Hensler et al. 2006; López-Corredoira et al. 2006, 2008; Goto et al. 2009, 2010). The third group consists of the Loomis Effect Algorithms (Stephane et al., 2005) the Adaptive Masking Filter (Agarap et al., 2006; Hybrid Masking Filter (Koester et al., 2007; van Dokkum et al., 2007). Figure 1 shows the performance of the SPLUS filter system. The figure shows an example of the SED fitting for an early-type galaxy in the SPLUS filter system, and the SED fitting for a late-type galaxy in the SPLUS filter system.

IN PROGRESS AND FUTURE PERSPEKTIVES

We used a mock catalog developed by Mercon et al. (2013) to calculate the densities around each galaxy. We calculated the densities using photometric redshifts and spectroscopic redshifts. In the first we are we calculated the number of galaxies inside a cylinder centered in the galaxy with a MPR of 0.5 and we used as a threshold for the cluster a 0.005 and we found that the cluster has a 0.005 and we found that the cluster has a 0.005 for galaxy at (X,Y) with a redshift magnitude and spectral type, if there is a cluster at (X,Y) with a redshift magnitude and spectral type, if there is a cluster at (X,Y) with a redshift magnitude and spectral type, if there is a cluster at (X,Y) with a redshift magnitude and spectral type, if there is a cluster at (X,Y) with a redshift magnitude and spectral type, if there is a cluster at (X,Y) with a redshift magnitude and spectral type. The labels on the right show the colors and metallicity in the SPLUS filter system. Left: The figure shows an example of the SED fitting for an early-type galaxy in the SPLUS filter system, and the SED fitting for a late-type galaxy in the SPLUS filter system.