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Optical identification of emission line sources in the southern photometric local Universe survey (S-PLUS)

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ABSTRACT

The emission line objects are very important objects in astronomy because reflects different class of objects that evolved physical mechanics that given counts of stellar formation process, presences the gas, shocks, star-burst in galaxies, the finals stage of stars among others process. For this reason we have created a list of Hα emitters selected from the S-PLUS data, which is mapping the southern hemisphere at relatively high latitudes. We implemented the (r - $J0660$) versus (r - i) color-color diagram for that task. We found 9,200 objects that exhibit um excess in emission in the J066o which we have traduced as the presence of the Hα emission line. In addition we have found that by combining the colors: (r - i) and (g - z) with unsupervised (clustering) machine learning it is possible separate the blue sources from red ones, then we ave divided our list of emitters in two sub-groups: one with intense blue continuum and another with intense red one. We compare hierarchical-clustering algorithm with the HDBSCAN. By adopting a "soft" clustering approach, we can assign each emission object a probability of belonging to a given cluster (blue or red group), allowing for more flexibility in the classification of objects according to these colours those objects with a low probability of belonging to any cluster.

Key words: surveys – stars: emission-line, Be – novae, cataclysmic variables – galaxies: dwarf – quasars: emission lines

1 INTRODUCTION

The existence of an ionizing radiation field can lead to Balmer hydrogen emission lines. From the presence of the H Balmer lines in the optical spectra of some sources it is well known the possible presence of ionized gas. Many important astronomical objects involve the physics of photo-ionized gases and the interpretation of the emission-line spectra. Emission line objects as the H II regions allow us to study the star formation history of the far reaches of our Galaxy and of distant galaxies. Planetary nebulae let us to see the remaining envelope of dying stars. Star-burst galaxies and QSOs are one the most luminous objects and hence the most distant that can be observed. Their spectra can reveal details about of the first generation of star and the formation of heavy elements in the young universe. On the other hand, emission lines can also infer the presence or lack the accretion discs (Schwope et al. 2000; Ratti et al. 2012), the properties of single or double picked line can allow us to infer geometrical characteristics (Horne & Marsh 1986), the nature of donor stars in binary system (Steeghs & Casares 2002; van Spaandonk et al. 2010; Casares 2015) and the compact objects as black holes (Casares 2016).

Emission lines are also associated with stars in very early-type and/or very late evolutionary stage which are short phase. As already mentioned are also associated with binaries that experiencing mass transfer. These group of emission line stars includes young stellar (YSOs) and Herbig-Haro (HH) objects, post-asymptotic and some asymptotic giant branch (AGB), some red giant stars (RGB), Wolf-Rayet (WR) stars, supernova remnants, classical Be stars, active late-type dwarfs, interacting binary system like symbiotic stars (SySt) and cataclysmic variables (CV). Most of these class of object are in-homogeneous and some contains many few identified members, for instance at the moment around 323 symbiotic system have been identified from which 257 belong to the Galaxy and ~66 are extra-galactic objects (Akras et al. 019a). The same occurs with PNe from witch around 3500 of them are been cataloged (Parker et al. 2016), this current number of PNe represents only about 15-30% of the estimated total of Galactic PNe (Frew, 2008; Jacoby et al., 2010) showing that a small fraction of the PNe have been cataloged. Many galaxies, in addition to harbor Planetary nebulae and H II regions, show characteristic nebular in their spectra. In most of these objects, the gas is photoionized by hot stars in the nucleus, which is thus much like giant H II region, or perhaps many H II regions. The galactic nucleus with very strongest emission lines of this type are often called blue compact galaxies, extragaltic H II regions, star forming or starburst galaxies (Osterbrock & Ferland 2006). There are also spiral galaxies that present emission lines.

In the past H surveys with modest spatial resolutions have been used to identified extended nebular emission to study supernova remnants, galaxy groups and star forming regions (Davies, Elliott Meaburn 1976). More recently, higher resolution surveys such as the INT Photometric Hα survey (IPHAS; Drew et al. 2005; Barentsen et al. 2014) have focused in the study of compact emission line sources on the Galactic plane, typically with objects in different stage of stellar evolution. The Anglo-Australian Observatory UKS

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chmidt Telescope Supercosmos Hα Survey (Parker et al. 2005) is another Hα survey of the Southern Galactic Plane and Magellanic Cloud which has covered to b ∼ 10-13° (verificar esto). Currently ongoing is the VST Photometric Hα Survey of the Southern Galactic Plane and Bulge (VPHAS+; Drew et al. 2014) that will cover the Galactic bulge and plane in five filters.

Like VPHAS+, others ongoing surveys that are used to study the population of emission line objects are the The Javalambre Photometric Local Universe Survey (J-PLUS[1], Cenarro et al. 2018) and the Southern-Photometric Local Universe Survey (S-PLUS[2], Mendes de Oliveira et al. 2019) are providing observations of the Galactic halo covering both northern and southern celestial hemispheres in a systematic way with twin telescopes using the same set of multi-band filters. In addition to the Hα filter, which is already vastly applied to systematically searching for Hα emitters the telescopes offer 11 more filters. And more ambitious yet the JPAS survey that will the same area of J-PLUS in 56 narrow-band filters.

Traditionally, color-color diagrams based in Hα filter are been used to identify Hα emitters. The analysis the color-color diagram (r - Hα) versus (r - i) has resulted on the discoveried of new emission line objects, for instance Witham et al. (2006, 2007) used the (r - Hα) versus (r - i) colour-colour diagram to find for new CV. On the other hand, Vink et al. (2008) reported the discovery of YSOs by using this same colour criteria. In this sense using this methology a variety of classes of objects are been identified, which include symbiotic stars (Corradi et al. 2008; Corradi & Giammanco 2010; Corradi et al. 2011), early type emission line stars (Drew et al. 2008) and planetary nebulae (Viironen et al. 2009; Sabin et al. 2010). Recently, by using this same color diagram were also identified compact PN candidates in VPHAS+ catalog (Akras et al. 2019). And the same diagram in conjunction with new ones shows to be very efficient to find for PN candidates (Gutiérrez-Soto et al. 2020). In general terms, Witham et al. (2006) presented a methodology and first results in looking for emission line sources in narrow-band surveys.

In this era of big data on astronomy, machine learning techniques are becoming in important statistical tools for the analysis and find meaning from massive data sets. Particularly, unsupervised machine approaches have showed a promised in various applications, especially in automatic classification task. Including object classification and selection, using galaxies with active galactic nuclei as example (Geach 2012), morphological analysis of galaxies (Martin et al. 2020), classification of variable stars, relying only on the similarity among light curves. (Valenzuela & Pichara 2018). Using unsupervised machine learning can be very advantageous because they do not require a labeled data training sets. Unlike of supervised methods like Random Forest algorithm. Instead, unsupervised techniques are generally based in the data itself to identify patrons, e. g. cluster of similar objects, in some pre-defined feature space where the data are defined.

In this work, we used S-PLUS observations of the southern hemisphere to search for objects with an excess of Hα using automatic methods based on the (r - Hα) versus (r - i) color-color diagram we also used color criteria based in (g - r) and (z - g) in conjunction to unsupervised machine learning techniques to split the final list in those with blue and red continuum. The paper is organized as follows...

[1] https://www.j-plus.es
[2] http://www.splus.iag.usp.br

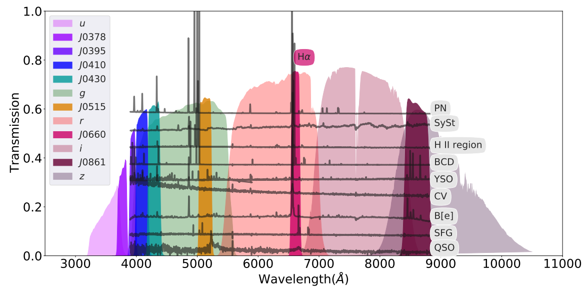

Figure 1. Transmission curves of the S-PLUS filters set. The narrow-band filter $J0660$ detects the Hα emission line. Over-plotted are different classes of emission line objects, from upper to down PN, SySt ...

2 OBSERVATIONS: THE S-PLUS PROJECT

We are implemented data from S-PLUS DR3 (ref) to carried out our study. S-PLUS is 12-band optical photometric survey, which are formed by seven narrow-band ($J0378$, $J0395$, $J0410$, $J0430$, $J0515$, $J0660$ and $J0861$) and five brow-band like SDSS filters (u, g, r, i and z, Fukugita et al. 1996). The narrow-band set include the filter $J0660$ which detect the Hα emission line. For more detailed about the configuration of S-PLUS filter set see Figure 1 shows the Javalambre filter system (Marín-Franch et al. 2012) overlapping are the optical spectra of several class emission line objects on which it is possible to see that the Hα line falls into the $J0660$ filter, except for the QSOs.

The actual data release contains about 60 millions of objects covering a total area of ∼8000 deg^2, at high Galactic latitudes (> 30 deg) using a dedicated 0.83m robotic telescope,the T80-South (T80S), located at Cerro Tololo, Chile. S-PLUS will cover an additional 1300 deg^2 of the Galactic plane and bulge toenable Galactic studies. In this work, we focus on the aspects thatare of particular interest to the second data release of the S-PLUS main survey. Additional information about S-PLUS can be found in Mendes de Oliveira et al. (2019).

3 METHODOLOGY

We first constructed a sub-sample from all S-PLUS DR3 from which we applied an iterative and automatic technique to select objects with an excess of Hα emission line. Once the objects were selected we also make a separation of them into two groups those with red and blue continuum by using optical colors in conjunction with unsupervised machine learning statistical tools. These procedures are described below:

3.1 Initial selection sample

The firts step in our selection procedure consist in the following criteria to guarantee the quality of the observations of the objects:

(i) The sources must have detection in the filters: r, i and $J0660$. To assure that we select object must have error minor or equal to 0.2 in each of three filters.
(ii) Must have an r magnitude until $r = 21$.

3.2 Finding the main stellar locus and selecting the Hα emitters

Once the initial cut were made, we proceed to select the objects with an excess of Hα wich is represent with a relatively high value of the filter $J0660$ in comparison with r-band filter. For that we first divided our sub-sample in for magnitude bins using the r-band magnitudes. The bins have the follow distribution:

- 1 bin- objects with magnitude in the r-band $r < 16$
- 2 bin- objects with magnitude in the r-band $16 \leq r < 18$
- 3 bin- objects with magnitude in the r-band $18 \leq r < 20$
- 4 bin- objects with magnitude in the r-band $20 \leq r < 21$

To select the emission lines we used the same method created and implemented by Witham et al. (2008) its possible to do that because the S-PLUS has similar filters that the IPHAS project, which are r, $J0660$ and i. This technique was used by Scaringi et al. (2013) to identify blue objects with excess of Hα and after that Wevers et al. (2017) also applied this methodology to create catalogue of candidate Hα emission showing an high effectiveness. In this order of ideas we attempted this methodology in S-PLUS.

We first generated the (r - $J0660$) versus (r - i) color- color diagram for each magnitude bins. We then carried a out an initial straight line fit to all objects in each magnitude bin. This initial fit is an attempt to find the loci of main-sequence and giant stars. We implemented a iterative σ-clipping tecnique to find the best-fitting of the main stellar locus. In this order of ideas, we made four interactive σ-clipped. Once we have found the apropiate fitting for each maginitude bin, we identified those objects significantly above of this final fit as likely sources with a excesses of Hα. Objects with a contribution significative of Hα meet the condition:

$$(r - J0660)_{\mathrm{obs}} - (r - J0660)_{\mathrm{fit}} \geq C \times \sqrt{\sigma_{\mathrm{s}}^2 - \sigma_{\mathrm{phot}}^2} \quad (1)$$

where σ_{s} is the root mean squared value of the residuals around the fit and σ_{phot} is the error on the observed $(r - J0660)$ colour idex. C is a constant which has the value 4 following Wevers et al. (2017). The fits are carried out with the aid of the python library `astropy.modeling` [3].

Figure 2 ilustrates the procedured used to slected the Hα emitters in S-PLUS DR3 for each magnitude bin. The continuos black lines represent the initial fit and the dashed lines indicate the 4-σ clipping fit lines. The dotted lines are the cut selection criteria for the Hα emitters – the 4- above of the final fit–. Note that theses cut lines are only an approximations because to trace these lines it is only considered the residual around the fit. The actual selection criteria used here also include the phothometric uncertainties in r - $J0660$ for each individual data source as shows on the Equation 1.

After the algorithm was applied to all data, we visually inspectioned the resulting list by seeing the S-spectra and corresponding colored image. The figure 3 shows an example of how looks like a S-spectra[4] of sources in magnitude unities selected with methods explained above. This object clearly exhibits strong H$alpha$ emitter.

Once, we felt confident of our sample of Hα emission lines sources, we proceeded to classify the objects into two big groups; one group containing those objects with a strong blue continuum and another with an intense emission of the continuum on the blue part of the spectrum.

[3] https://docs.astropy.org/en/stable/modeling/index.html
[4] S-spectra signify the S-PLUS emission in flux or magnitude unities of an object in all twelve bands.

3.3 Unsupervised machine learning/clustering techniques

In this work we are using unsupervised machine learning approaches to divided our sample in two groups: one represent the blue sources and the another one are the red sources. The blue are those that have strong emission of the continuum on the part blue of the spectrum and the another with strong emission continuum of the red one. For that task, was performed two clustering techniques; hierarchical clustering and Hierarchical density-based cluster selection

3.3.1 Hierarchical agglomerative clustering

Hierarchical clustering belong to the family of clustering algorithms on which are constructed clusters by merging and splitting them successively. It is an unsupervised algorithm that yields a dendrogram-Dendrogram is a diagram representing tree, which shows hierarchical relationship between objects. represents the nested grouping of patterns and the levels of similarity at which the groupings change (Jain et al. 1999). There is two type of hierarchical clustering: one is the *hierarchical agglomerative clustering* (that we have used in this work) which is “bottom-up” approach. Hierarchical agglomerative clustering (`HAC`) consists of building a binary merge tree, starting from each data element stored at the leaves (interpreted as individual clusters) and proceed by merging two by two the “closest” sub-sets (stored at nodes) until it reaches the root -unique cluster- of the tree that contains all the elements of the data set. Agglomerative term is used to define it since the individual data point are successively agglomerated into higher-level. In each iteration, two cluster are selected that are considered as close as possible. These cluster are merged and replaced with a newly created merged cluster. Thus, each merging step reduces the number of cluster by “1”. Therefore, the method needs to be designated for measuring proximity between cluster containing multiple data points, so that they may be merged (Mann & Kaur 2013; Aggarwal 2015). We could describe how to work the algorithm in three simple steps:

(i) Initially, each data point represents the clusters i.e. leaves.
(ii) It looping merges the nodes (clusters) that have the maximum similarity between them.
(iii) At the end of the process all the nodes belong to an unique cluster. This is known as the root of the tree structure.

The other type is the *hierarchical divisive clustering*. This is a “top-down” approach. The data start in one cluster (the root of the tree), and splits step by step are performed recursively as one moves down the hierarchy. It is the inverse procedure of `HAC`.

In simple words, hierarchical clustering approaches can be interpreted as an algorithm that groups similar objects into groups called clusters or nodes. The endpoint is a set of clusters, where each cluster is distinct from each other cluster, and the objects within each cluster are broadly similar to each other.

Choosing the number of cluster. Firstly, the Hierarchical cluster output dendrogram (tree) can be implemented to obtain the desired clustering. Secondly, the dendrogram schema allows a convenient way to establish the entity relationship between at all levels of granularity. In conclusion, a dendrogram is a visualization in form of a tree showing the order and distances of merges during the hierarchical clustering.

- On the x axis you see labels. If you do not specify anything else they are the indices of your samples in X.
- On the y axis you see the distances (of the “ward” method in our case).

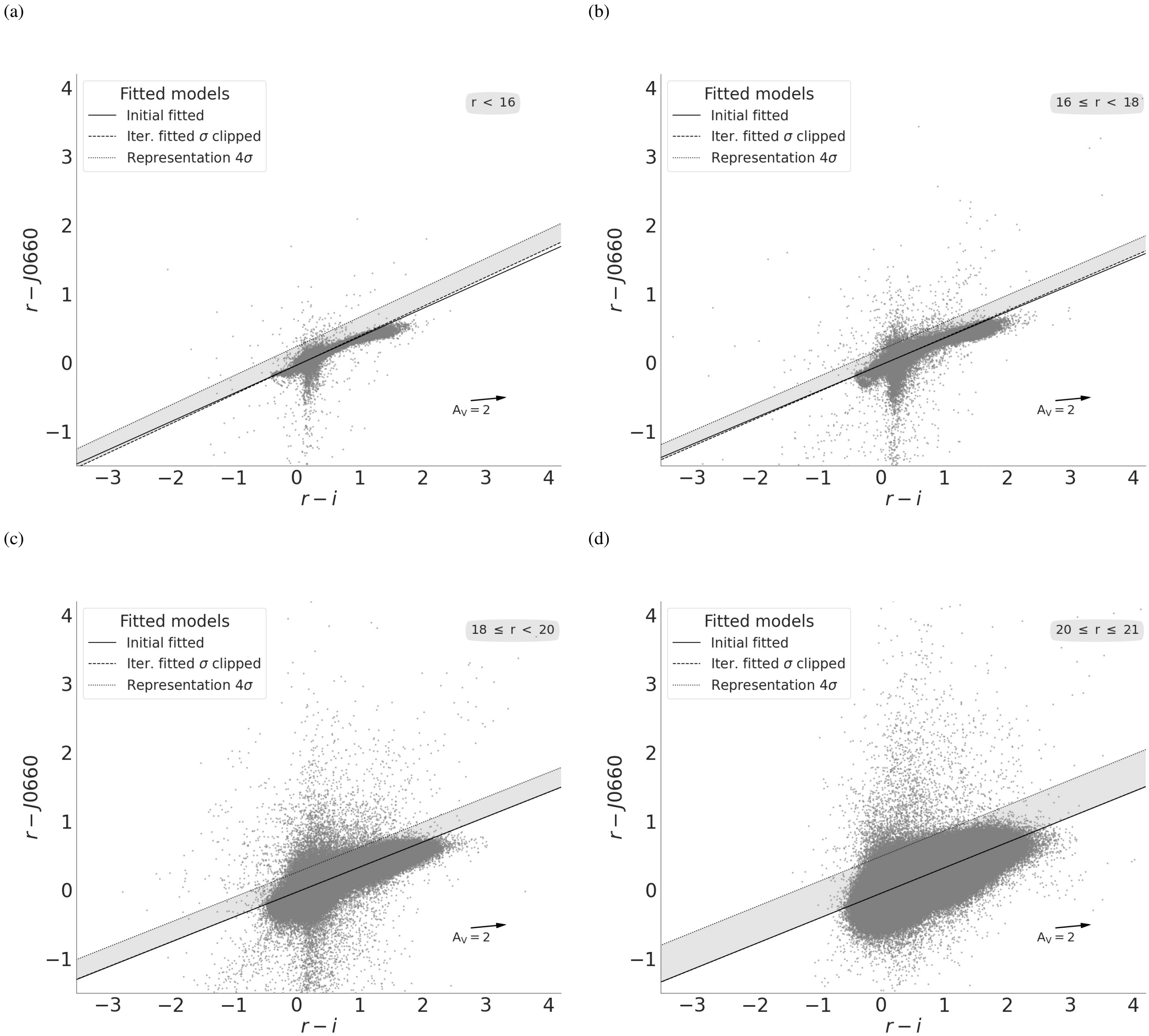

Figure 2. An illustration of the selection criteria used to identify strong emission-line objects via colour-colour plots. The data shown here are all from the S-PLUS DR3. The data are split up into four magnitude bins, as shown in the four panels. Objects with Hα excess should be located near the top of the colour-colour diagrams. The thin red lines illustrate the original linear fit to all the data (grey points). The dashed lines represent the final fits to the stellar locus of points which were obtained by applying an iterative σ-clipping technique to the initial fit. The actual cuts used to select Hα emitters are shown by the dotted lines. Objects selected as Hα emitters must be located above. Note that the cut lines (selection criteria) shown here are only approximate, as the actual selection criterion also considers the errors on each source. This means that an object could be in the bottom right-hand panel is not selected despite clearly lying above the cut line (EXPLICAR ESTA ÚLTIMA FRASE MEJOR).

Dendrogram Truncation

As you might have noticed, the above is pretty big for many samples already and you probably have way more in real scenarios, so let me spend a few seconds on highlighting some other features of the dendrogram() function:

Starting from each label at the bottom, you can see a vertical line up to a horizontal line. The height of that horizontal line tells you about the distance at which this label was merged into another label or cluster. You can find that other cluster by following the other vertical line down again. If you don't encounter another horizontal line, it was just merged with the other label you reach, otherwise it was merged into another cluster that was formed earlier.

Hierarchical clustering can be performed with either a distance matrix or raw data. When raw data is provided, the software will automatically compute a distance matrix in the background. The distance matrix below shows the distance between six objects.

Hierarchical clustering starts by treating each observation as a separate cluster. Then, it repeatedly executes the following two steps: (1) identify the two clusters that are closest together, and (2) merge the two most similar clusters. This iterative process continues

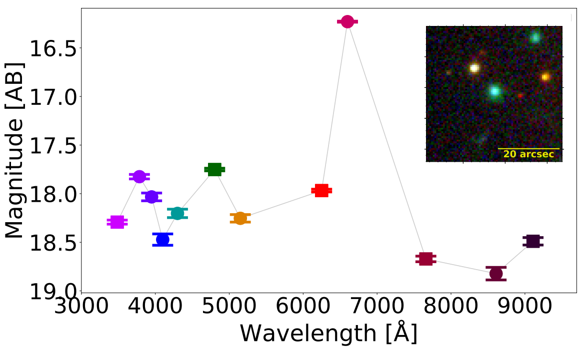

Figure 3. S-spectra of a random object observed by S-PLUS. Squares represent the SDSS-like broad-band filters. From left to right they are u, g, r, i and z. Circle symbols are the narrow-band filters, which from left to right represent $J0378$, $J0395$, $J0410$, $J0515$, $J0660$ and $J0861$.

until all the clusters are merged together. This is illustrated in the diagrams below.

Hierarchical clustering 2

3.3.2 *Hierarchical density-based cluster selection*

Hierarchical density-based cluster selection (`HDBSCAN`, Campello et al. 2013) is another unsupervised machine learning algorithm that hinges on clustering. It is based on a slightly modified version of Density-based Spatial Clustering of Applications with Noise (`DBSCAN`; Ester et al. 1996) which declare points as noise. It is a algorithm that assumes clusters are characterized by "islands" of high density in the sea of the parameter space, such that clusters are regarded as data partitions that have a higher density than their surroundings (Ntwaetsile & Geach 2021). HDBSCAN takes forward the DBSCAN concept by introducing a hierarchy to the clustering, with "persistent" clusters finally extracted from the hierarchical tree. The main advantage of HDBSCAN in comparison with the predecessor consists in the possibility in finding clusters of variables densities and different shape. Following Malzer & Baum (2021) and Ntwaetsile & Geach (2021) works as follows:

(i) In `HDBSCAN` is consider the "core" distance for a point x, $\mathrm{core}_k(x)$ which defines the distance of an object to the kth nearest neighbor that is an efficient way of measurement of density. Low values of $\mathrm{core}_k(x)$ represents high density and vice-versa.

(ii) The "mutual readability distance" between two points a and b is defined as $d_\mathrm{m}(a, b) = \min\{core_k(a), \mathrm{core}_k(b), d(a, b)\}$, where $d(a, b)$ is the distance between a and b according, for instance, Euclidean metric. The mutual readability distance allows points in dense regions stay close together and those that are in lees dense regions pushed away.

(iii) The mutual readability graph is used to construct the minimum spanning tree, and sorting its edges by the mutual readability distance results in a hierarchical tree structure. The hierarchy of connected components is defined by sorting the edges of the tree by distance in reverse order, describing a dendrogram. This is the structure from which cluster will be identified.

(iv) `HDBSCAN` allows to extract clusters of variable density, effectively by cutting the dendrogram at different points.

(v) The cluster tree is condensed into a simpler structure. Considering the single main trunk which contains all of the data points, the tree splits into branches. A condensed cluster hierarchy can be described by considering the number points kept in each branch as it splits. If a given branch splits into two, with a branch containing fewer points than the minimum cluster size means, the large branch "persists" and the smaller split branch "falls out" of the cluster. If a branch splits into two with both branches exceeding the minimum cluster size, both new branches persist.

(vi) The clusters are extracted on the notion of persistence in the hierarchy. The parameter $\lambda = d_\mathrm{m}^{-1}$ is defined, and each cluster has a λ_birth (the point at which the cluster split off) and λ_death (the point when the cluster split into other clusters). In each cluster, we have λ_p describing when each point fell out of the cluster (or was split off into new cluster), $\lambda_\mathrm{birth} \leq \lambda_p \leq \lambda_\mathrm{death}$. Cluster stability S is defined as the sum of $\lambda_p - \lambda_\mathrm{birth}$ for all points in the cluster. To extract cluster the following procedure is implemented: First, select all leaves as cluster. Then, working through the hierarchy, consider the stability of a parent cluster S_p and its n descendants $S_d^{0,1,2,...,n}$. If $S_p > \sum_{i=0}^{n} S_d^i$ we unselect all the descendants. If $S_p < \sum_{i=0}^{n} S_d^i$ then the cluster stability is set such that $S_p = \sum_{i=0}^{n} S_d^i$. At the root node we have our set of selected cluster. Any point in the sample that does not fall into one of the selected clusters is defined as noise.

(vii) The selected cluster are used the label points. Furthermore, the definition of λ_p within a cluster, when normalized between O and 1 provides a means of characterization a probability that a given point belongs to the cluster or alternative a measure of the strength of membership.

The algorithm starts off much the same as DBSCAN: we transform the space according to density, exactly as DBSCAN does, and perform single linkage clustering on the transformed space. Instead of taking an epsilon value as a cut level for the dendrogram however, a different approach is taken: the dendrogram is condensed by viewing splits that result in a small number of points splitting off as points "falling out of a cluster". This results in a smaller tree with fewer clusters that "lose points". That tree can then be used to select the most stable or persistent clusters. This process allows the tree to be cut at varying height, picking our varying density clusters based on cluster stability. The immediate advantage of this is that we can ave varying density clusters; the second benefit is that we have eliminated the epsilon parameter as we no longer need it to choose a cut of the dendrogram. Instead we have a new parameter `min_cluster_size` which is used to determine whether points are "falling out of a cluster" or splitting to form two new clusters. This trades an unintuitive parameter for one that is not so hard to choose for EDA (what is the minimum size cluster I am willing to care about?).

Hierarchical Density-Based Spatial Clustering of Applications with Noise (Campello, Moulavi, and Sander 2013), (Campello et al. 2015). Performs `DBSCAN` overvarying epsilon values and integrates the result to find a clustering that gives the best stability over epsilon. This allows `HDBSCAN` to find clusters of varying densities (unlike `DBSCAN`), and be more robust to parameter selection. The library also includes support for Robust Single Linkage clustering (Chaudhuri et al. 2014), (Chaudhuri and Dasgupta2010), GLOSH outlier detection (Campello et al. 2015), and tools for visualizing and exploring cluster structures. Finally support for prediction and soft clustering is also available.

In the last years, `HDBSCAN` have been in astronomy for classifying tasks. Jayasinghe et al. (2019) presented the second data release Milky Way Project (MWP), a citizen science initiative on the Zooniverse platform, presents internet users with infrared (IR) images from Spitzer We aggregate 3 million classifications made by MWP volunteers during the years 2012-2017 to produce the DR2 catalogue, which contains 2600 IR bubbles and 599 candidate bow shock driving stars. The reliability of bubble identifications was made by using HDBSCAN. Webb et al. (2020) used HDBSCAN for transient discovery. Recently, Ntwaetsile & Geach (2021) used it to group radio sources into a sequence of morphological classes, illustrating a simple methodology to classify and label new, unseen galaxies in large samples.

3.4 Grouping the Hα emitters into blue and red sources

3.4.1 HAC

In this work, we implemented HAC by using the python machine learning library Scikit-learn[5] (Pedregosa et al. 2011). There are some parameters to have in count when the algorithm is applied: n_clusters which is the number cluster to find. Given that our goal is to divide our sample in two groups we set this value in 2. Affinity, Metric used to compute the linkage. We found that a simple "Euclidean" distance metric was effective. Linkage which determines which distance to use between sets of observation. The algorithm merge the pairs of cluster that minimize this criterion. Here was implemented "ward" which minimizes the variance of the clusters being merged. As was mentioned, the input variables are the colors; $(g-r)$ and $(z-g)$.

Fig. 9 shows the dendrogram truncated diagram visualization that shows the branching of the sample from the main root. And Fig. 10 shows the position of the two groups that resulted after to applying HAC in the color-color diagram. The two cluters represent the blue sources (blue simbols) and red sources (blue symbols) as already by analyzing the diagram of the Fig. 7. Now, we have divided our list in two groups in agreement with the nature of their continuum. We found that the number of blue Hα emitter is bigger than the red one.

3.4.2 HDBSCAN

We also used HDBSCAN to separate the blue sources from the red ones. This just for comparing the performance of two algorithms and show that the our resulted are consistent. We used the python implementation of HDBSCAN[6] (McInnes et al. 2017). Like HAC, in addition to the colors input parameters, there are key parameters that should be considered when the algorithm is applied. "Euclidean" metric is implemented which results to be very efficient. The two most critical parameters to be implemented are the "minimum cluster size" and "minimum number of samples". The former refers to the smallest size grouping that we wish to consider a cluster. We have adopted the value "80". The latter provides a measure of how conservative we want our clustering to be and expressed as the fraction of data classified as noise. The value implemented was "40". With this configuration of our model we found two cluster. If we use values of minimum number of samples smaller than "40" several small cluster are found that do not make sense.

Left panel of Fig 11 the resulted cluster found with HDBSCAN. Two group are found and these results are consistent with results found with HAC. In fact, by applying the condensed_tree_ to the data colors two clusters are selected (for mare detail about condensed_tree_ attribute see appendix A and related Fig. A1). The two primary clusters are located in the same region in the $(g-r)$ versus $(z-g)$ color-color diagram where lie the group found by the other algorithm. The main difference between the two algorithm is that HDBSCAN is much conservative, then many data points are classified as noise. The two final cluster contain, which we are labeled blue and red sources contain xxx and xxx objects, respectively.

3.5 Soft clustering for HDBSCAN

Perhaps, the main disadvantage of HDBSCAN is that many of the sources are labelled as "noise", on which some sources are not assigned to any cluster. As was mentioned, this comes from the conservative nature of HDBSCAN and that they are located far away of the cluster cores. An alternative to avoid the outlier classification consists in used the concept of "soft clustering". We have carried out here soft clustering for HDBSCAN to assign every object to its most likely cluster. This means that with this approach, points are not assigned cluster labels, instead are assigned a vector of probabilities. The probability value at the ith entry of the vector is the probability that a data point is a member of the ith cluster. We can then simply assign cluster labels for every point by taking the most likely cluster it belongs to, using probability thresholds. Soft clustering for HDBSCAN is based on the Global-Local Outlier Score from Hierarchies (GLOSH) algorithm (Campello et al. 2015) and combines this with a measure of distance from a given cluster to produce an estimate of the probability that any given data point belongs to any of the fixed clusters extracted from the condensed tree.

The right panel of Fig. 11 shows at what most likely cluster belongs the data points classified as the noise by HDBSCAN. We have used blue and red colors for the points that have the highest probability of being in the blue and red groups, respectively. This fills out the clusters nicely. We see that there were many noise points that are most likely to belong to the clusters we would expect, e. g. in agreement we the results obtained with HAC. Indeed, We now have improved our classification of our list into sources with blue and red continuum because we have estimated the probability of each source to belong to every group.

4 RESULTS

4.1 Simbad

We made cross-match between our sample and Simbad. We found 1000 matches that include a big variety of emission line objects:

4.1.1 Nebulae

As was mentioned, objects with nebulousity include several type of objects like H II region and planetary nebulae. The H II regions are objects with gas that being ionized by amounts of UV light come from massive stars (OB type) on which are formed the emission lines. In theses clouds of ionized nebulae new stars are formed. Unlike H II regions, planetary nebulae represent the final stages of low- and intermediate-mass stars where the gas previously ejected in the phase of AGB is ionized by their central star.

In our list of Hα emission line a PN () appears cataloged in SIMBAD. This objects is a very interesting because is one of the twelves PNe that belong to the Galactic halo. These PNe are low metallizite and present large velocities that can give cont of the origin and nucleosintheis of the early universe.

30 HII regions listed on the SIMBAD database are in our sample of Hα emitters

[5] https://scikit-learn.org/stable/
[6] https://hdbscan.readthedocs.io/en/latest/

4.2 SDSS

4.3 Lamost

5 CONCLUSIONS

We have found a important sample of emission line objects.

ACKNOWLEDGEMENTS

DATA AVAILABILITY

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APPENDIX A: CONDENSED TREES

The question now is what does the cluster hierarchy look like - which clusters are near each other, or could perhaps be merged, and which are far apart. We can access the basic hierarchy via the `condensed_tree_` attribute of the clusterer object. It is possible to see that `HDBSCAN` has found two cluster that in agreement with previous results are the blue and red sources.

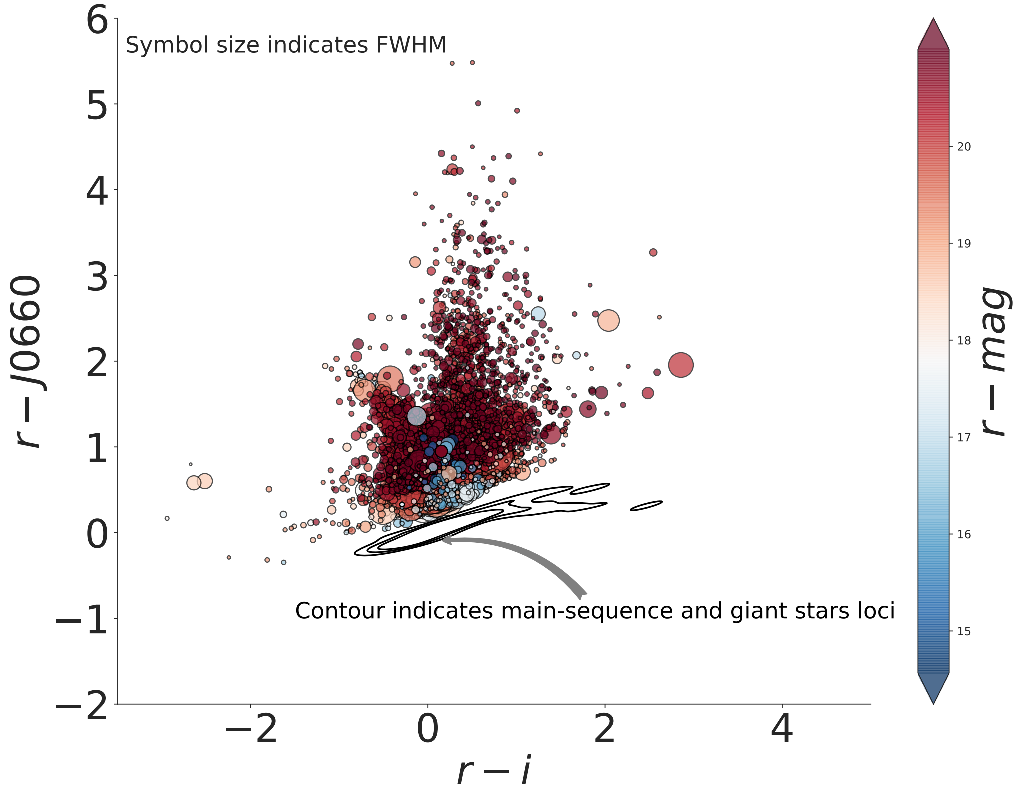

Figure 4. Colour-colour diagram with all the emission line objects selected from S-PLUS DR3. Size of the symbols represent the measured FWHM assuming a Gaussian core (for more detail see Almeida-Fernandes et al. 2021). Colored bar indicates the magnitude values in the r-band. The contours represent the synthetic main-sequence and giant stars loci from the library of stellar spectral energy distributions of Pickles (1998).

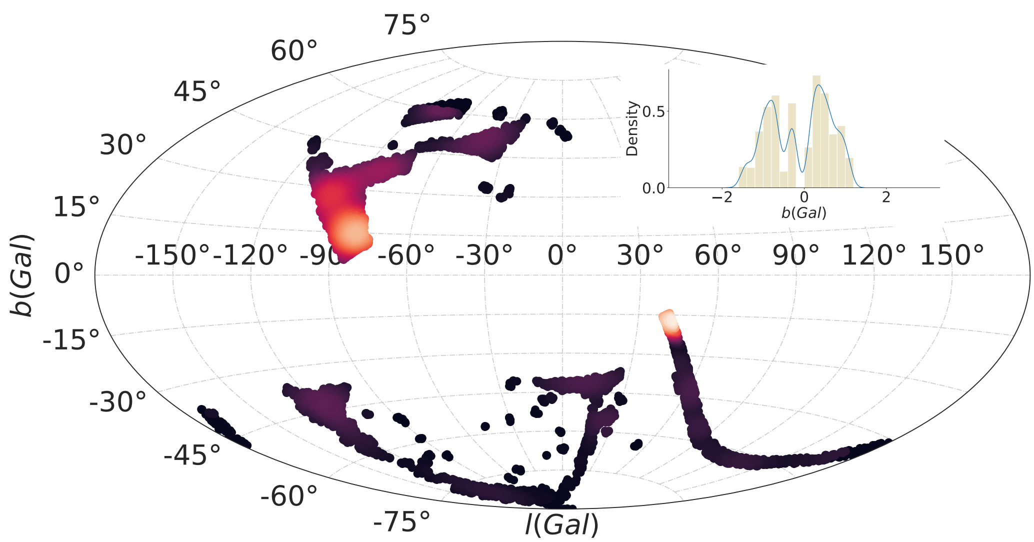

Figure 5. Distribution of Hα emitters in Galactic longitude and latitude. The emitters are shown as red points if brighter than r = 18, and black points if fainter. The S-PLUS direct fields are shown by green squares (offset fields are not shown). All emitters are shown here, including those with flagged with 'c' in Table 1.

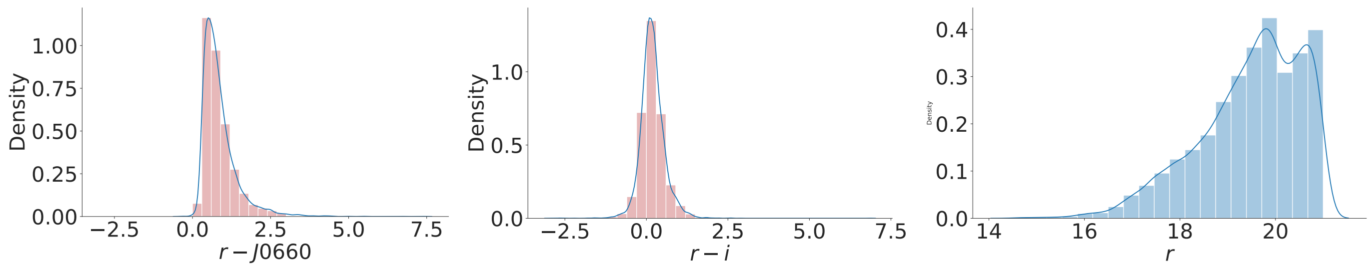

Figure 6. Emission lines selected...

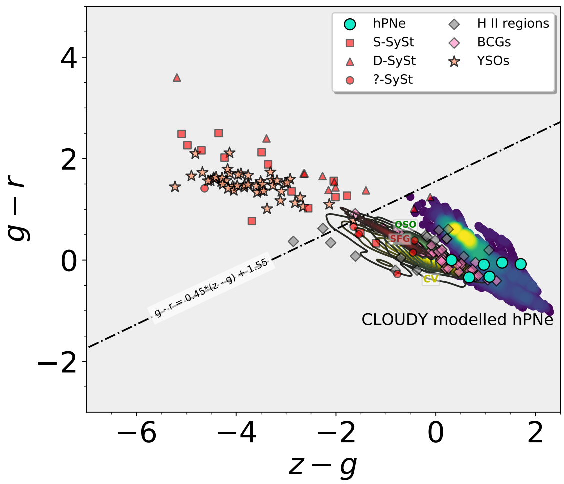

Figure 7. Classifying...

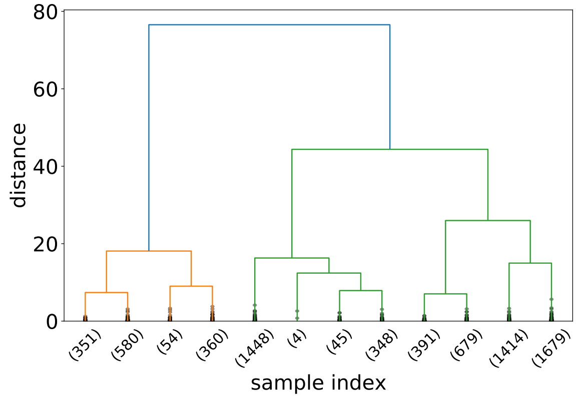

Figure 9. Costomer dendrogram...

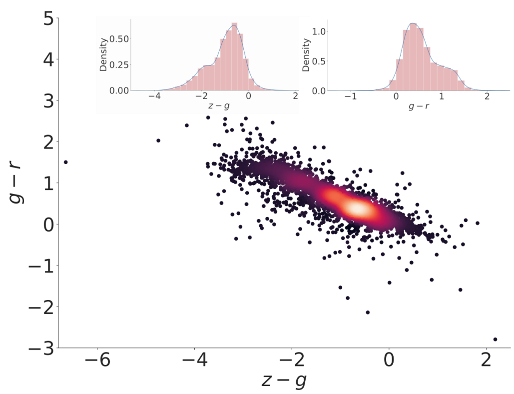

Figure 8. Classifying...

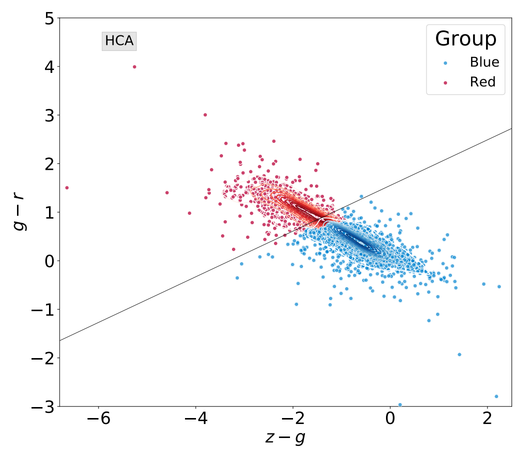

Figure 10. Costomer dendrogram...

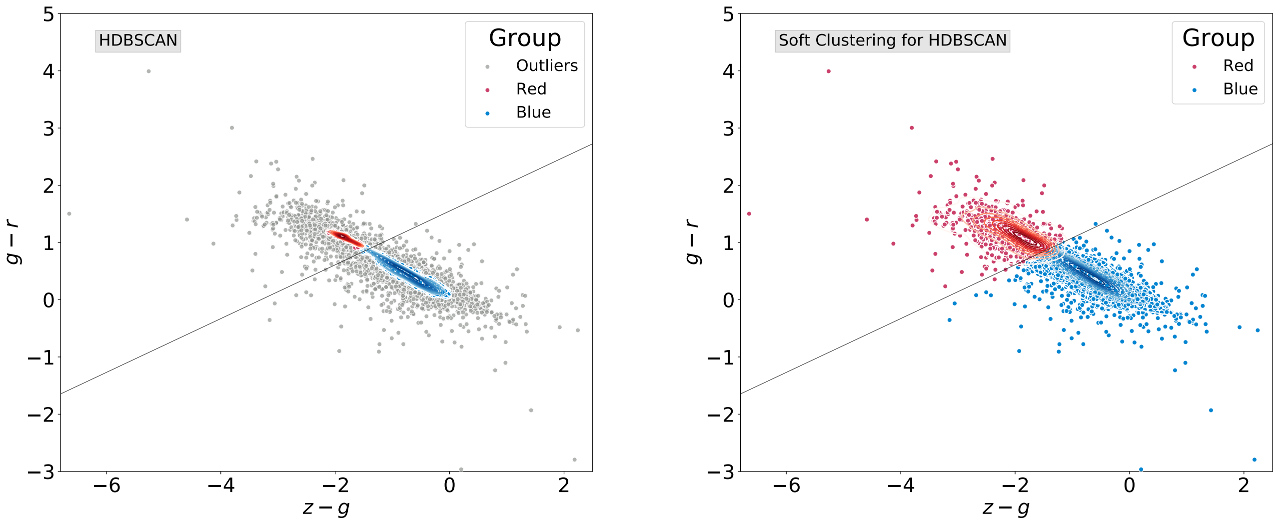

Figure 11. New color-color diagram to separate the blue objects from the red ones.

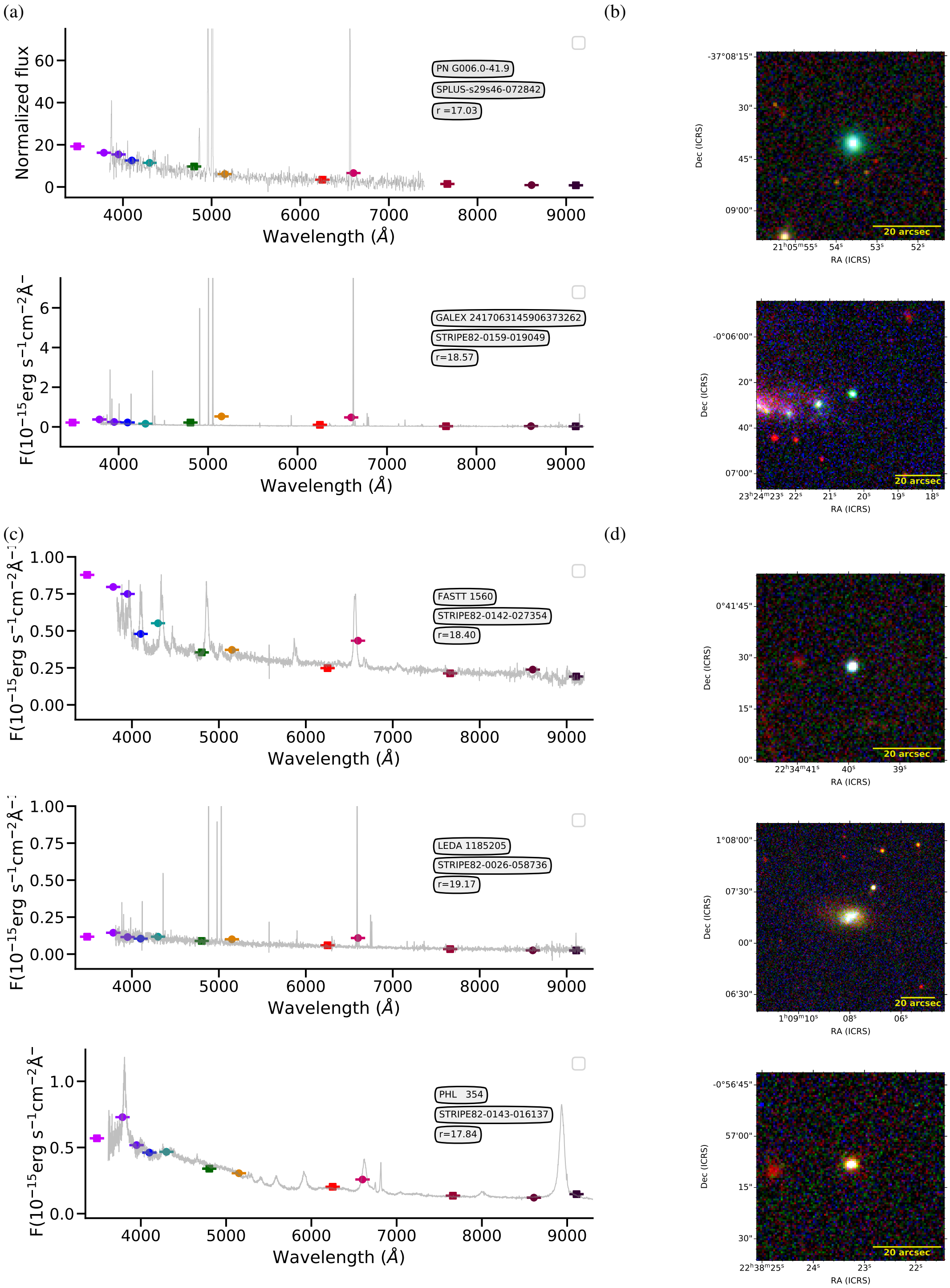

Figure 12. Spectra of the known objects select with our algorithm

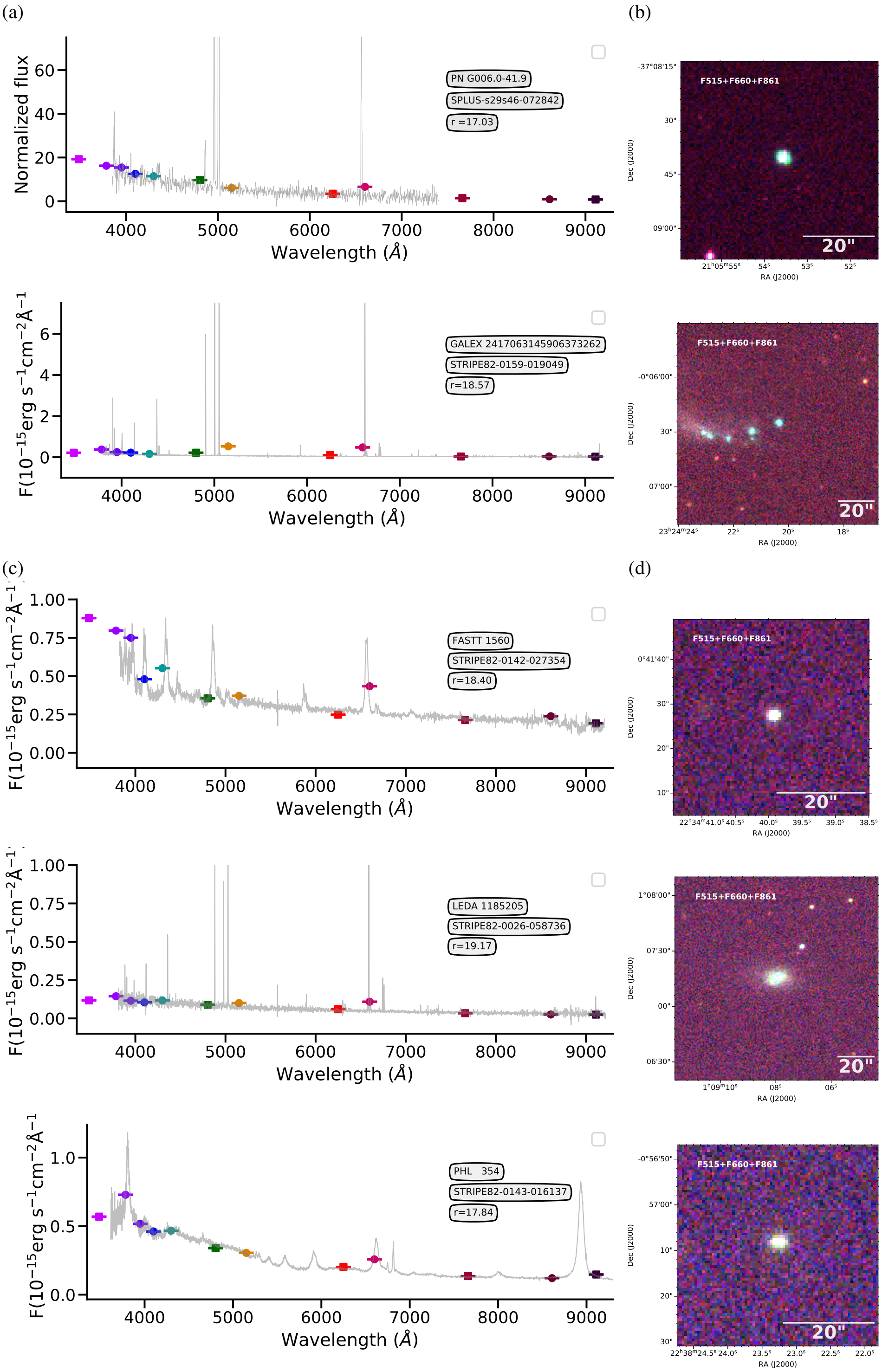

Figure 13. Spectra of the known objects select with our algorithm

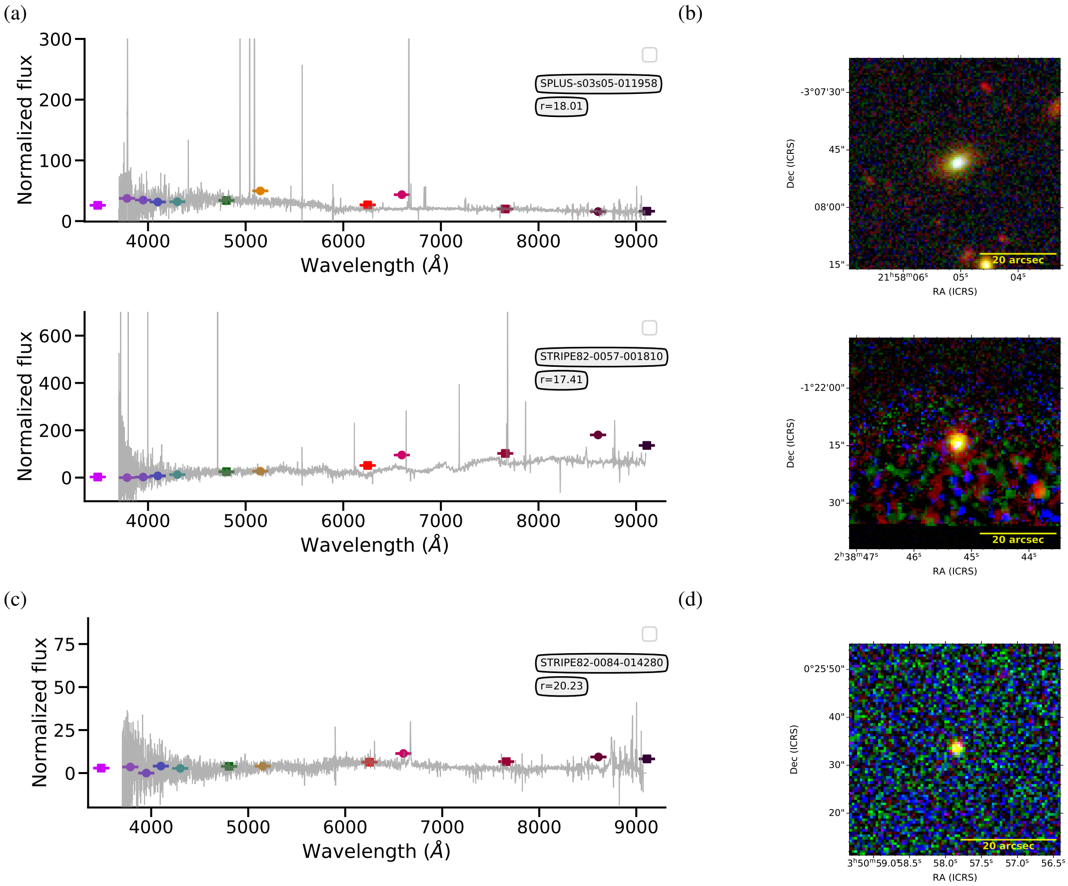

Figure 14. Spectra of the Lamost

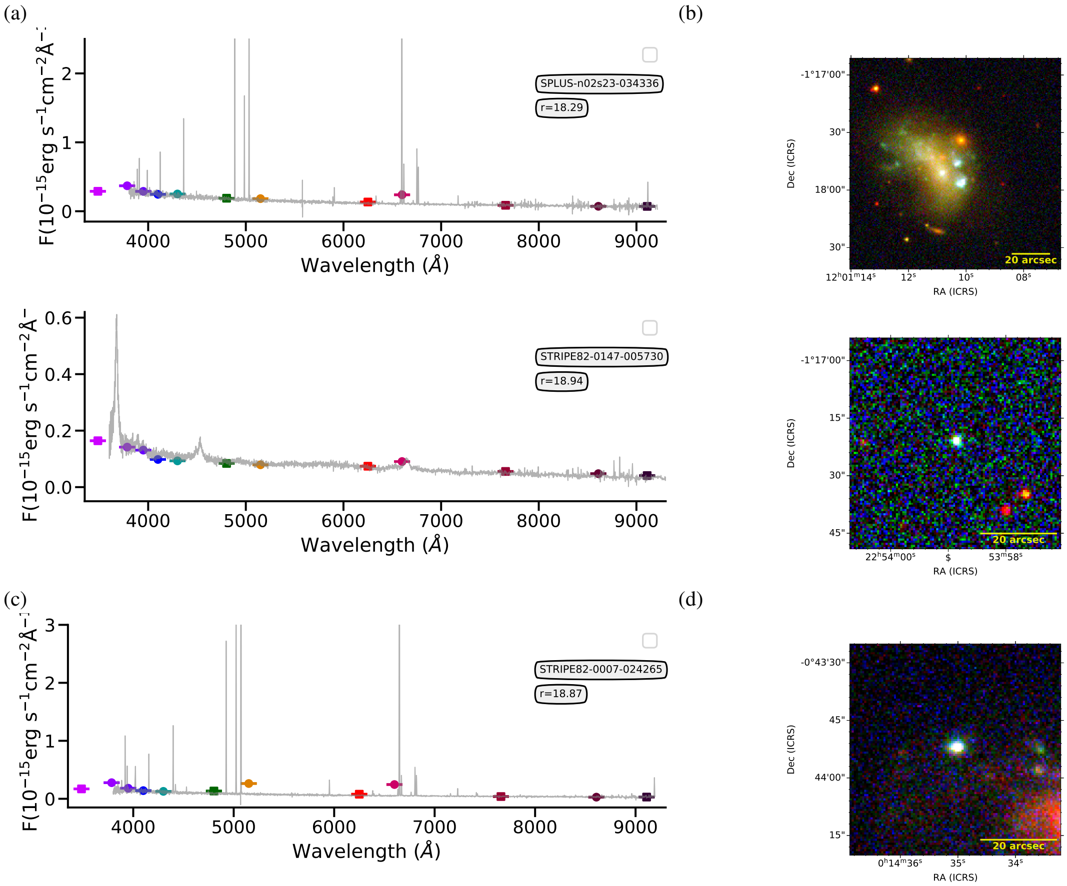

Figure 15. Spectra of the SDSS

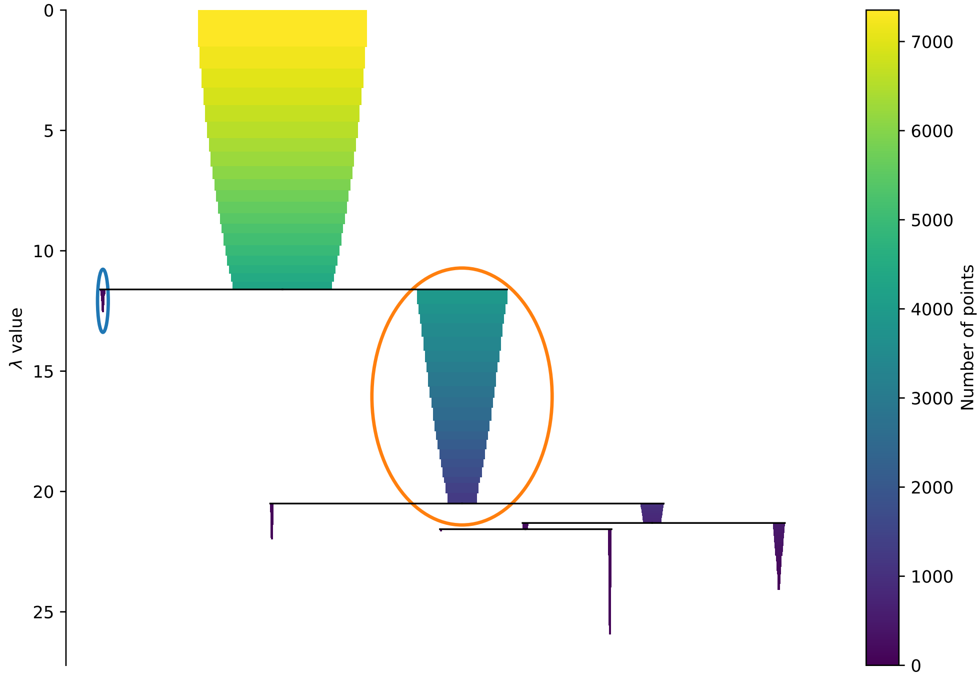

Figure A1. Branches were selected by the HDBSCAN* algorithm.

APPENDIX B: SIMBAD OBJECTS

Table B1: Simbad sources.

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
CTLGD 9478	00:01:59.25	−29:18:40.4	Star	Blue	0.98	0.02
QSO B2359+005	00:02:30.71	00:49:59.2	QSO	Blue	0.74	0.08
[GMB2011] 1808	00:02:47.58	−00:22:23.5	ClG	–	–	–
CTLGD 2037	00:05:08.77	−30:51:04.2	Star	Red	0.15	0.73
SDSS J000637.99-003656.2	00:06:37.99	−00:36:56.2	QSO	–	–	–
LBQS 0004+0036	00:07:10.00	00:53:29.1	QSO	Blue	0.61	0.11
SDSS J000809.34+004935.5	00:08:09.34	00:49:35.3	QSO	–	–	–
2SLAQ J000918.74-003907.2	00:09:18.76	−00:39:07.0	Galaxy	Blue	0.71	0.07
[VV2006] J001040.1-294428	00:10:40.08	−29:44:27.3	QSO	Blue	0.71	0.14
CTLGD 7291	00:10:48.73	−29:47:28.8	Star	Red	0.29	0.35
2QZ J001055.3-304423	00:10:55.37	−30:44:23.5	Galaxy	Blue	0.58	0.07
[VV2006] J001228.8-310241	00:12:28.78	−31:02:40.0	QSO	Blue	0.49	0.07
LBQS 0010+0035	00:13:27.32	00:52:32.2	Seyfert 1	Blue	0.77	0.08
[GPM2009] J0014-0044 2	00:14:28.79	−00:44:43.8	EmG	Blue	0.15	0.06
2SLAQ J001455.99+001903.5	00:14:55.99	00:19:03.7	Star	Blue	0.79	0.07
2SLAQ J001526.52+001813.2	00:15:26.52	00:18:13.4	QSO	Blue	0.51	0.09
[VV2006] J001535.5+005355	00:15:35.55	00:53:56.1	QSO	Blue	0.77	0.03
SDSS J001628.25+010801.9	00:16:28.24	01:08:02.0	Galaxy	Blue	0.70	0.13
[VV2006] J001641.9-312657	00:16:41.87	−31:26:56.6	QSO	Blue	0.74	0.09
2SLAQ J001731.27-004859.3	00:17:31.26	−00:48:59.2	QSO	Blue	0.76	0.11
LEDA 1156	00:17:39.97	00:30:22.5	StarburstG	Blue	0.94	0.01
SDSS J001753.82+005057.6	00:17:53.82	00:50:57.7	QSO	–	–	–
2SLAQ J001912.39+000319.6	00:19:12.39	00:03:19.8	QSO	Blue	0.75	0.07
2SLAQ J001940.23-005435.9	00:19:40.24	−00:54:35.8	QSO	Blue	0.70	0.05
[VV2006] J001950.1-004040	00:19:50.06	−00:40:40.7	QSO	–	–	–
2SLAQ J002237.90+000519.0	00:22:37.90	00:05:19.2	QSO	Blue	0.56	0.03
UM 240	00:25:07.40	00:18:45.2	EmObj	Blue	0.74	0.12
2MASX J00251994+0031312	00:25:19.92	00:31:31.7	Seyfert 1	Blue	0.82	0.03
LEDA 3107905	00:27:53.84	−00:58:00.2	Galaxy	Blue	0.96	0.02
SDSS J002916.79-010021.5	00:29:16.81	−01:00:23.1	Galaxy	Blue	1.00	0.00
SDSS J002940.01+010528.5	00:29:40.02	01:05:28.7	QSO	Blue	0.55	0.05
[VV2010c] J002951.5+004159	00:29:51.45	00:42:00.0	AGN	Red	0.34	0.18
SDSS J003117.70+001705.0	00:31:17.69	00:17:05.1	QSO	–	–	–
2QZ J003137.5-292815	00:31:37.50	−29:28:15.3	Unknown	Blue	0.67	0.03
2dFGRS TGS283Z142	00:31:50.70	−28:55:36.7	Galaxy	Blue	0.90	0.01
2QZ J003152.5-293534	00:31:52.56	−29:35:33.3	Galaxy	Blue	0.86	0.07
2SLAQ J003208.53-005303.7	00:32:08.53	−00:53:03.6	QSO	Blue	0.36	0.06
SDSS J003234.62-001557.1	00:32:34.62	−00:15:57.1	QSO	Blue	0.41	0.08
LEDA 559945	00:32:34.69	−42:40:10.4	Galaxy	Blue	0.70	0.04
[VV2006] J003242.7+003111	00:32:42.74	00:31:11.1	QSO	Blue	0.21	0.07
2dFGRS TGS365Z059	00:33:54.71	−29:56:12.7	Galaxy	Blue	0.78	0.02
SWIRE J003517.14-420518.6	00:35:17.11	−42:05:19.0	AGN	Red	0.03	0.66
[VV2006] J003545.9+002306	00:35:45.86	00:23:06.0	QSO	Blue	0.82	0.02

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2MASS J00362543-0029075	00:36:25.39	−00:29:07.1	AGN	Red	0.16	0.75
2dFGRS TGS440Z027	00:36:38.44	−32:34:44.7	Galaxy	Blue	0.28	0.08
[VV2006] J003714.1-005602	00:37:14.11	−00:56:04.0	QSO	–	–	–
[VV2006] J003722.2-001140	00:37:22.17	−00:11:40.6	QSO	Blue	0.70	0.04
UM 260	00:37:41.13	00:33:20.0	EmObj	Blue	0.70	0.08
SDSS J003859.34-004252.2	00:38:59.35	−00:42:52.0	QSO	Blue	0.12	0.04
SDSS J003930.30+012021.6	00:39:30.28	01:20:20.9	BlueCompG	Blue	0.31	0.06
IRAS 00370+0035	00:39:34.78	00:51:36.9	FIR	Blue	0.82	0.04
IRAS 00370+0035	00:39:34.78	00:51:36.9	FIR	Blue	0.82	0.04
2QZ J004215.6-321257	00:42:15.62	−32:12:57.2	Galaxy	Blue	0.91	0.03
GALEX 2673249256393934953	00:42:43.87	01:17:02.2	QSO	Blue	0.75	0.08
2dFGRS TGS501Z235	00:43:21.88	−33:19:02.9	Galaxy	Blue	0.58	0.14
2SLAQ J004335.13-003729.7	00:43:35.16	−00:37:29.6	CataclyV*	Blue	0.55	0.14
SDSS J004415.83-004303.1	00:44:15.81	−00:43:03.1	QSO	–	–	–
[VV2006] J004544.4-315729	00:45:44.35	−31:57:29.2	QSO	Blue	0.78	0.09
2SLAQ J004626.30-011417.0	00:46:26.30	−01:14:16.8	Galaxy	Blue	0.86	0.03
[VV98] J004826.9-341340	00:48:26.97	−34:13:38.7	QSO	Blue	0.70	0.11
SDSS J004918.52+011308.9	00:49:18.52	01:13:09.1	QSO	Blue	0.59	0.09
LEDA 3034	00:51:49.42	00:33:53.8	Seyfert 1	Blue	0.85	0.02
QSO B0049-272	00:51:55.64	−26:57:43.3	QSO	Blue	0.21	0.05
[BKD2008] WR 353	00:51:59.72	−00:29:20.8	PartofG	Blue	0.54	0.08
ESO 411-27	00:52:51.61	−27:19:32.8	Galaxy	Blue	0.98	0.02
SDSS J005343.78+012147.6	00:53:43.76	01:21:47.5	QSO	Blue	0.60	0.07
RESOLVE rf554	00:54:15.54	−01:04:56.0	Galaxy	Blue	0.97	0.03
2QZ J005440.1-320042	00:54:40.12	−32:00:42.2	EmG	Blue	0.56	0.04
QSO B0052-307	00:54:43.95	−30:30:54.1	QSO	Blue	0.67	0.10
[VV2006] J005532.1-311538	00:55:32.08	−31:15:37.8	QSO	Blue	0.77	0.08
[TYZ2012] II 11	00:55:41.32	−00:56:30.6	Galaxy	Blue	0.80	0.02
[CT83] 219	00:55:51.35	−30:56:42.8	UV	Blue	0.58	0.07
RGO 8439	00:55:53.16	−28:54:57.3	Star	Blue	0.99	0.01
2dFGRS TGS502Z028	00:55:53.31	−33:39:01.5	Galaxy	Blue	0.70	0.14
[VV2006] J005609.9-312209	00:56:09.93	−31:22:08.6	QSO	Blue	0.33	0.07
[VV2006] J005639.0-315759	00:56:39.05	−31:57:58.6	QSO	Blue	1.00	0.00
[GPM2009] 0057-0022	00:57:12.60	−00:21:57.7	Galaxy	Blue	0.78	0.13
[VV2000] J005840.5-300203	00:58:40.42	−30:02:00.1	QSO	Blue	0.35	0.06
LEDA 3530	00:59:04.10	01:00:04.2	GinCl	Blue	0.97	0.03
2dFGRS TGS503Z245	00:59:13.57	−34:19:15.7	Galaxy	Blue	0.97	0.03
2MASX J00593609-3020390	00:59:36.09	−30:20:39.0	Galaxy	Red	0.05	0.75
LBQS 0057-0135	00:59:48.81	−01:19:05.2	QSO	Blue	0.44	0.08
QSO B0057-3948	00:59:53.21	−39:31:57.3	QSO	Blue	0.85	0.05
CAIRNS J005959.59-005157.2	00:59:59.58	−00:51:57.1	GinCl	Red	0.00	1.00
SCMS 679	01:00:04.44	−33:39:32.5	Star	Blue	0.53	0.05
2QZ J010009.9-320131	01:00:09.94	−32:01:31.1	Unknown	Blue	1.00	0.00
2dFGRS TGS561Z059	01:00:16.17	−34:57:40.6	Galaxy	Blue	0.52	0.06
2SLAQ J010121.76-000301.7	01:01:21.76	−00:03:01.8	Galaxy	Blue	0.14	0.05
QSO B0059-304B	01:02:14.65	−30:07:53.8	QSO	Blue	0.88	0.01
2SLAQ J010230.03-003206.8	01:02:30.02	−00:32:06.8	Seyfert 1	Blue	0.50	0.08
2MASX J01023175+0120363	01:02:31.78	01:20:36.1	GinCl	Blue	0.85	0.02
[VV2006] J010336.4-005508	01:03:36.39	−00:55:08.8	QSO	Blue	0.55	0.06
SDSS J010413.86-011552.1	01:04:13.86	−01:15:52.0	QSO	Blue	0.96	0.04
QSO B0103+00	01:06:19.23	00:48:23.4	QSO	Red	0.03	0.04
6dFGS gJ010653.4-324342	01:06:53.44	−32:43:41.9	AGN	Blue	0.64	0.03
LIRAS J010658.95+010438.3	01:06:58.93	01:04:38.2	AGN	Red	0.12	0.74
[VV2006] J010705.6+000609	01:07:05.55	00:06:09.0	QSO	Blue	0.74	0.08
UGC 695	01:07:46.47	01:03:50.3	LSB G	Blue	0.88	0.07
SDSS J010748.62+004453.5	01:07:48.62	00:44:53.7	BClG	Red	0.14	0.44
MCG+00-04-011	01:09:01.58	01:22:41.5	GinCl	Blue	0.74	0.07
MCG+00-04-011	01:09:01.58	01:22:41.5	GinCl	Blue	0.74	0.07
2SLAQ J010907.59+000649.8	01:09:07.59	00:06:50.0	QSO	Blue	0.55	0.07

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
LEDA 1185205	01:09:07.95	01:07:15.5	HII G	Blue	0.75	0.13
SDSS J010918.56+005419.3	01:09:18.56	00:54:19.4	QSO	Blue	0.64	0.08
2SLAQ J010925.95-003739.0	01:09:25.96	−00:37:39.0	QSO	Blue	0.69	0.04
2QZ J011014.0-302445	01:10:13.97	−30:24:44.5	EmG	Blue	0.60	0.05
2QZ J011119.0-300019	01:11:19.02	−30:00:18.2	EmG	Blue	0.83	0.05
SDSS J011128.38+000143.7	01:11:28.35	00:01:43.3	QSO	Blue	0.13	0.10
2dFGRS TGS505Z356	01:12:12.64	−33:56:31.1	Galaxy	Red	0.43	0.13
2SLAQ J011230.55+001441.5	01:12:30.55	00:14:41.7	QSO	Blue	0.84	0.03
PB 6318	01:12:58.01	00:58:37.0	Star	Blue	0.65	0.04
2dFGRS TGS447Z027	01:13:13.03	−32:26:09.9	Galaxy	Blue	0.86	0.05
UGC 772	01:13:40.42	00:52:39.0	LSB G	–	–	–
2SLAQ J011402.35-004750.9	01:14:02.35	−00:47:50.8	Seyfert 1	Blue	0.55	0.07
[VV2006] J011405.3-310903	01:14:05.25	−31:09:02.8	QSO	Blue	0.21	0.05
2dFGRS TGS505Z120	01:14:36.11	−32:38:41.0	Galaxy	Blue	0.79	0.09
SDSS J011531.90-005144.5	01:15:31.89	−00:51:44.3	HII G	Blue	0.89	0.06
2SLAQ J011533.07-005134.9	01:15:33.06	−00:51:34.8	Galaxy	Blue	0.56	0.08
[BKD2008] WR 354	01:15:33.79	−00:51:31.5	HII G	Blue	0.22	0.07
[BKD2008] WR 354	01:15:33.79	−00:51:31.5	HII G	Blue	0.22	0.07
2SLAQ J011542.18+002300.2	01:15:42.18	00:23:00.4	QSO	Blue	0.69	0.04
2dFGRS TGS505Z064	01:16:38.40	−32:55:39.1	Galaxy	Blue	0.94	0.02
2dFGRS TGS505Z018	01:17:40.21	−33:04:40.7	Galaxy	Blue	0.67	0.08
2dFGRS TGS377Z137	01:17:56.44	−30:26:25.8	Galaxy	Blue	0.87	0.08
2dFGRS TGS506Z276	01:18:05.71	−33:03:09.1	Galaxy	Blue	0.88	0.07
2SLAQ J011818.13+001455.2	01:18:18.12	00:14:55.5	QSO	Blue	0.62	0.03
2SLAQ J011829.63+004549.4	01:18:29.62	00:45:49.4	Seyfert 1	Blue	0.67	0.14
2dFGRS TGS506Z243	01:18:49.15	−33:20:13.1	Galaxy	Blue	0.83	0.07
2MASX J01195427-3414599	01:19:54.23	−34:15:00.0	EmG	Blue	0.99	0.01
2dFGRS TGS506Z158	01:20:09.99	−33:14:10.7	Galaxy	Blue	1.00	0.00
2SLAQ J012110.74-005037.2	01:21:10.74	−00:50:37.1	QSO	Blue	0.71	0.02
[HB93] 0119-341B	01:21:52.19	−33:56:15.8	Star	Red	0.33	0.18
SDSS J012213.85+005731.4	01:22:13.87	00:57:31.6	HII G	Blue	1.00	0.00
2dFGRS TGS565Z149	01:22:17.09	−34:02:41.6	Galaxy	Blue	0.87	0.05
2SLAQ J012226.76+000327.5	01:22:26.75	00:03:27.9	QSO	Blue	0.86	0.04
QSO B0120-002	01:23:01.78	00:03:23.6	QSO	Blue	0.81	0.08
2dFGRS TGS297Z222	01:23:50.87	−29:11:46.4	Galaxy	Blue	0.05	0.03
MCG+00-04-113	01:23:54.75	00:16:56.4	GinCl	Blue	0.70	0.05
SDSS J012356.34+001230.6	01:23:56.35	00:12:31.0	Galaxy	Blue	0.99	0.01
ESO 352-67	01:23:57.47	−33:48:07.5	Galaxy	Blue	0.89	0.06
SDSS J012405.73+005905.0	01:24:05.73	00:59:04.9	Galaxy	–	–	–
QSO B0121-324	01:24:16.18	−32:12:21.7	QSO	Blue	0.61	0.08
2dFGRS TGS507Z113	01:24:30.16	−33:38:45.5	Galaxy	Red	0.45	0.39
QSO B0122-3232	01:25:04.59	−32:17:14.6	QSO	Blue	0.41	0.09
2QZ J012526.2-304433	01:25:26.24	−30:44:32.8	EmG	Blue	0.57	0.07
2QZ J012549.3-280944	01:25:49.29	−28:09:43.6	Galaxy	–	–	–
LEDA 1180903	01:26:27.03	00:58:51.9	Galaxy	Blue	0.98	0.02
2dFGRS TGS566Z338	01:26:37.73	−34:35:13.8	Galaxy	Blue	0.89	0.02
6dFGS gJ012646.5-003845	01:26:46.51	−00:38:44.7	HII G	Blue	0.54	0.08
ESO 413-7	01:27:59.31	−29:05:12.0	GinCl	Blue	1.00	0.00
6dFGS gJ012926.6-011159	01:29:26.54	−01:11:59.0	GinCl	Red	0.42	0.24
SDSS J013034.18-002106.6	01:30:34.17	−00:21:06.5	QSO	Blue	0.64	0.04
2dFGRS TGS509Z295	01:31:21.84	−33:06:06.2	Galaxy	Blue	0.81	0.07
2dFGRS TGS508Z142	01:31:45.65	−32:56:56.8	Galaxy	Blue	0.96	0.02
LEDA 679811	01:31:47.24	−33:10:55.1	Galaxy	Blue	1.00	0.00
2dFGRS TGS509Z242	01:32:53.43	−33:26:42.7	Galaxy	Blue	0.62	0.12
2MASS J01330450+0003553	01:33:04.52	00:03:56.1	low-mass*	Red	0.13	0.47
2SLAQ J013400.41-010358.2	01:34:00.46	−01:03:59.2	Galaxy	Blue	0.99	0.01
RESOLVE rf246	01:34:52.04	−00:38:55.2	Galaxy	Blue	0.66	0.12
[VV2006] J013500.8-004054	01:35:00.83	−00:40:54.2	QSO	Blue	0.17	0.04
FBQS J0135-0019	01:35:17.53	−00:19:39.0	Seyfert 1	Blue	0.45	0.11

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2QZ J013531.1-313651	01:35:31.16	−31:36:51.0	Galaxy	Blue	0.46	0.07
SDSS J013701.72-012059.3	01:37:01.71	−01:20:59.1	QSO	Blue	0.85	0.07
[VV2006] J013729.4-320715	01:37:29.40	−32:07:15.7	QSO	Blue	0.56	0.05
[VV2006] J013837.3+002818	01:38:37.28	00:28:18.5	QSO	Blue	0.82	0.08
2SLAQ J013951.07+002537.9	01:39:51.07	00:25:38.0	QSO	Blue	0.96	0.04
2E 458	01:40:17.06	−00:50:03.0	Seyfert 1	Blue	0.27	0.05
SDSS J014125.63+000755.6	01:41:25.64	00:07:55.8	QSO	Red	0.04	0.85
[VV2006] J014224.7-320414	01:42:24.73	−32:04:13.7	QSO	Blue	0.55	0.09
[VV2006] J014303.6-295255	01:43:03.49	−29:52:54.8	QSO	Blue	0.45	0.07
ESO 353-36	01:43:18.29	−34:12:22.4	EmG	Red	0.06	0.37
SDSS J014721.12-004505.3	01:47:21.12	−00:45:05.3	QSO	Red	0.33	0.35
[VV2006] J014739.2-285259	01:47:39.21	−28:52:59.2	QSO	Blue	0.75	0.05
[VV2006] J014739.2-285259	01:47:39.21	−28:52:59.3	QSO	Blue	0.84	0.05
SDSS J014806.25-002841.6	01:48:06.25	−00:28:41.6	Galaxy	Blue	0.70	0.04
[VV2006] J014812.2+000154	01:48:12.24	00:01:53.5	QSO	Blue	0.07	0.03
2QZ J014844.1-275610	01:48:44.17	−27:56:11.0	Star	Blue	0.73	0.07
IC 1734	01:49:17.03	−32:44:33.1	Galaxy	Blue	0.59	0.06
[VV2006] J014921.5-003220	01:49:21.53	−00:32:20.9	QSO	Blue	0.81	0.08
[RGD2013] J015239.744+010557.768	01:52:39.74	01:05:57.9	Galaxy	Red	0.15	0.63
[RGD2013] J015253.854+011215.480	01:52:53.85	01:12:15.5	Galaxy	Red	0.05	0.87
2QZ J015257.7-284838	01:52:57.76	−28:48:37.8	Seyfert 1	Blue	0.52	0.08
2SLAQ J015331.85+002252.8	01:53:31.85	00:22:53.0	QSO	Blue	0.91	0.02
SDSS J015400.48-004509.5	01:54:00.50	−00:45:10.0	HII G	Blue	0.66	0.04
2SLAQ J015409.27+002645.2	01:54:09.27	00:26:45.3	QSO	Blue	0.72	0.05
[VV2006] J015410.9-285214	01:54:10.94	−28:52:14.6	QSO	Blue	0.54	0.07
[VV2006] J015415.4-285254	01:54:15.48	−28:52:54.9	QSO	Blue	0.61	0.07
SDSS J015440.44-000643.9	01:54:40.45	−00:06:43.6	EmG	Blue	0.35	0.08
2SLAQ J015526.89+000615.4	01:55:26.87	00:06:15.8	Galaxy	Blue	0.79	0.02
2SLAQ J015529.12-003927.3	01:55:29.07	−00:39:27.1	Galaxy	Blue	0.70	0.07
SDSS J015813.75+010143.5	01:58:13.75	01:01:43.4	RRLyr	Blue	0.94	0.01
[VV2006] J015832.1-301703	01:58:32.15	−30:17:02.8	QSO	Blue	0.76	0.09
[VV2006] J015832.1-301703	01:58:32.16	−30:17:02.7	QSO	Blue	0.61	0.04
[VV2006] J015850.2-300438	01:58:50.22	−30:04:38.1	QSO	–	–	–
[VV2006] J015935.4+000401	01:59:35.48	00:04:01.5	QSO	Blue	0.63	0.08
SDSS J020025.40+002916.5	02:00:25.40	00:29:16.8	QSO	Red	0.05	0.68
[VV2006] J020055.0-293527	02:00:55.02	−29:35:26.5	QSO	Blue	0.64	0.05
ESO 414-22	02:01:14.49	−31:43:42.9	GinGroup	Blue	0.66	0.09
[VV98] J020115.4+003136	02:01:15.53	00:31:35.1	QSO	Blue	0.34	0.06
2SLAQ J020200.06-000921.2	02:02:00.06	−00:09:21.2	QSO	Blue	0.59	0.04
[VV96] J020435.5-455923	02:04:35.46	−45:59:24.0	QSO	Blue	0.73	0.05
LEDA 1193771	02:05:00.83	01:24:03.7	Galaxy	Blue	0.59	0.06
2dFGRS TGS514Z164	02:07:20.33	−33:01:54.3	Galaxy	–	–	–
2SLAQ J020804.48-000023.2	02:08:04.49	−00:00:23.0	QSO	Blue	0.53	0.04
2SLAQ J020827.06-005208.1	02:08:27.07	−00:52:07.9	QSO	Blue	0.77	0.06
SDSS J020921.99-005455.5	02:09:22.00	−00:54:55.4	QSO	Blue	0.97	0.03
2dFGRS TGS515Z070	02:12:25.05	−33:04:59.0	Galaxy	–	–	–
2dFGRS TGS515Z311	02:14:24.22	−33:14:52.0	Galaxy	Blue	0.86	0.09
2dFGRS TGS461Z092	02:14:47.63	−32:42:35.2	Galaxy	Blue	0.82	0.06
2SLAQ J021529.02-005314.8	02:15:29.02	−00:53:14.9	QSO	Blue	0.63	0.05
2dFGRS TGS460Z130	02:16:01.62	−31:36:51.8	Galaxy	Blue	0.92	0.02
2dFGRS TGS387Z025	02:16:13.75	−30:50:56.8	Galaxy	Blue	1.00	0.00
SDSS J021617.19-011046.9	02:16:17.19	−01:10:46.7	QSO	Blue	0.96	0.01
2SLAQ J021810.52-010147.4	02:18:10.52	−01:01:47.2	QSO	Blue	0.68	0.06
V* AX For	02:19:28.00	−30:45:46.0	CataclyV*	Blue	0.45	0.07
2QZ J022112.5-302559	02:21:12.54	−30:25:59.0	EmG	Blue	0.80	0.08
2SLAQ J022316.91-010049.7	02:23:16.93	−01:00:49.6	Galaxy	Blue	0.85	0.06
SHOC 120	02:24:17.14	00:06:26.1	Seyfert 1	–	–	–
LEDA 667000	02:24:52.74	−34:06:34.3	Galaxy	Blue	0.78	0.06
SDSS J022530.93-005007.0	02:25:30.92	−00:50:07.1	Galaxy	Blue	0.61	0.07

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
[BKD2008] WR 346	02:26:28.28	01:09:37.6	PartofG	Blue	1.00	0.00
[BKD2008] WR 346	02:26:28.28	01:09:37.6	PartofG	Blue	1.00	0.00
LEDA 546974	02:26:46.27	−43:35:29.6	Galaxy	Blue	0.65	0.07
SDSS J022714.48+010536.1	02:27:14.47	01:05:36.3	EmG	Blue	0.66	0.07
RESOLVE rf668	02:27:19.29	01:01:32.2	Galaxy	Blue	0.98	0.02
[VV2006] J022738.3-313627	02:27:38.28	−31:36:26.4	QSO	Blue	0.46	0.06
[VV2006] J022758.2+000226	02:27:58.20	00:02:25.6	QSO	–	–	–
LCRS B022613.7-392927	02:28:14.52	−39:16:04.0	Galaxy	Blue	0.68	0.05
[BKD2008] WR 315	02:28:28.73	−01:08:58.6	PartofG	Blue	0.91	0.01
2SLAQ J022945.34+000856.2	02:29:45.34	00:08:56.4	Star	Blue	0.54	0.09
2QZ J022954.6-303558	02:29:54.69	−30:35:58.4	Seyfert 1	Blue	0.34	0.06
Pul -3 180355	02:29:57.00	−01:00:32.3	Star	Red	0.04	0.06
2dFGRS TGS463Z130	02:30:09.77	−31:36:18.2	Galaxy	Blue	1.00	0.00
SDSS J023020.93+001355.5	02:30:20.93	00:13:55.8	Seyfert 1	Blue	0.20	0.06
UGC 2009	02:32:09.34	−01:23:10.3	Galaxy	Red	0.03	0.88
2dFGRS TGS518Z089	02:32:18.08	−33:50:43.0	Galaxy	Blue	0.59	0.14
SDSS J023230.63-011654.5	02:32:30.63	−01:16:54.5	QSO	Blue	0.61	0.05
6dFGS gJ023241.8-391744	02:32:41.88	−39:17:42.8	Galaxy	Blue	0.51	0.08
SDSS J023248.71+005138.8	02:32:48.71	00:51:38.8	Galaxy	Blue	0.57	0.06
V* HP Cet	02:33:22.62	00:50:59.4	Nova	Blue	0.54	0.09
NGC 986	02:33:34.29	−39:02:40.9	EmG	Blue	0.93	0.07
[VV2006] J023335.4-010744	02:33:35.37	−01:07:44.6	QSO	Blue	0.50	0.06
SDSS J023628.77-005829.7	02:36:28.75	−00:58:30.0	Galaxy	Blue	0.78	0.08
[VV2006] J023635.7-003203	02:36:35.69	−00:32:03.4	QSO	–	–	–
SDSS J024059.15+004545.8	02:40:59.14	00:45:45.9	QSO	Blue	0.99	0.01
[VV2006] J024235.0-010351	02:42:34.91	−01:03:51.9	QSO	Blue	0.56	0.03
[EKS96] NGC 1068 91	02:42:46.94	00:01:26.2	HII	Blue	0.14	0.06
[ZBF2015] NGC1073 1	02:43:35.61	01:22:37.9	HII	Blue	0.27	0.06
[ZBF2015] NGC1073 16	02:43:37.69	01:22:22.5	HII	Blue	0.94	0.06
[ZBF2015] NGC1073 21	02:43:42.74	01:21:34.4	HII	Blue	0.50	0.07
[ZBF2015] NGC1073 10	02:43:44.03	01:22:40.5	HII	Blue	0.80	0.05
6dFGS gJ024605.3-330500	02:46:05.28	−33:04:59.4	Galaxy	Blue	0.83	0.01
2MASS J02462415-0029539	02:46:24.14	−00:29:52.9	Star	Blue	0.76	0.03
Gaia DR2 2497764348684940160	02:46:24.75	−00:30:16.3	QSO	Blue	0.53	0.07
[BKD2008] WR 316	02:46:25.42	−00:30:09.8	PartofG	Blue	0.57	0.04
2SLAQ J024626.59-003000.2	02:46:26.57	−00:30:00.4	Star	Blue	1.00	0.00
2SLAQ J025100.64+001707.2	02:51:00.64	00:17:07.3	QSO	Blue	0.70	0.07
2SLAQ J025216.75+001741.2	02:52:16.73	00:17:41.2	Galaxy	Blue	0.89	0.06
2SLAQ J025252.02-002211.7	02:52:52.00	−00:22:11.6	QSO	Blue	0.85	0.05
SHOC 143	02:54:26.13	−00:41:22.7	Seyfert 1	Blue	0.88	0.08
NVSS J025557+004132	02:55:57.24	00:41:33.5	RadioG	Red	0.12	0.32
QSO B0253+0058	02:56:07.25	01:10:38.8	QSO	Blue	0.66	0.08
HBQS 0253+0022	02:56:25.32	00:34:29.4	HII	Blue	0.99	0.01
LEDA 1170514	02:56:28.43	00:36:28.2	Galaxy	Blue	0.64	0.05
2dFGRS TGS522Z138	02:57:45.54	−33:28:55.5	Galaxy	Red	0.43	0.28
2MASSI J0259103-002239	02:59:10.38	−00:22:39.8	Seyfert 1	Blue	0.54	0.09
2SLAQ J030309.82+001337.5	03:03:09.83	00:13:37.8	Galaxy	–	–	–
UGC 2517	03:04:12.47	−01:11:33.8	Galaxy	Red	0.53	0.20
2SLAQ J030417.77-004931.7	03:04:17.77	−00:49:31.5	Galaxy	Blue	0.62	0.11
LEDA 1142424	03:04:34.76	−00:28:30.7	Seyfert 1	Blue	0.98	0.02
LBQS 0302-0019	03:04:49.85	−00:08:13.4	QSO	Blue	0.95	0.02
2MASS J03045799+0057131	03:04:57.98	00:57:14.0	Blue	Blue	0.99	0.01
MCG+00-08-089	03:05:18.24	−00:09:34.1	Galaxy	Blue	0.72	0.04
LBQS 0303+0110	03:06:12.72	01:21:57.3	QSO	Blue	0.70	0.07
WISE J030629.21-335332.3	03:06:29.22	−33:53:32.3	AGN	Blue	0.67	0.11
SDSS J030630.33-000622.9	03:06:30.33	−00:06:22.9	Galaxy	Red	0.12	0.72
SDSS J030715.63+004352.1	03:07:15.60	00:43:52.6	Galaxy	Blue	1.00	0.00
2SLAQ J030757.55+000712.0	03:07:57.55	00:07:12.1	QSO	Blue	0.74	0.04
2SLAQ J031129.69-001701.4	03:11:29.70	−00:17:01.5	QSO	Blue	0.72	0.05

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2QZ J031130.9-315250	03:11:30.92	−31:52:51.1	WD*	Blue	0.58	0.13
ESO 417-20	03:12:48.61	−31:29:10.7	GinGroup	Blue	0.96	0.03
SDSS J031258.36-000453.6	03:12:58.36	−00:04:53.6	Galaxy	Blue	0.76	0.02
2dFGRS TGS398Z109	03:13:56.08	−31:28:12.6	Galaxy	Blue	0.32	0.09
2SLAQ J031428.25+004506.6	03:14:28.25	00:45:07.0	Galaxy	Blue	1.00	0.00
2dFGRS TGS471Z114	03:16:15.31	−31:12:33.3	Galaxy	Blue	0.81	0.04
2SLAQ J031618.00-003025.2	03:16:18.01	−00:30:24.9	Galaxy	Blue	1.00	0.00
2dFGRS TGS524Z054	03:16:50.65	−33:18:03.8	Galaxy	Blue	0.94	0.02
2dFGRS TGS524Z054	03:16:50.66	−33:18:04.0	Galaxy	Blue	0.96	0.04
2SLAQ J031829.06-000040.3	03:18:29.06	−00:00:40.5	Galaxy	Blue	0.65	0.04
[VV2006] J031845.2-001844	03:18:45.17	−00:18:45.3	QSO	Blue	0.97	0.03
2SLAQ J031937.30-002641.1	03:19:37.29	−00:26:41.0	QSO	Blue	0.37	0.08
SDSS J032244.90+004442.4	03:22:44.90	00:44:42.3	QSO Candidate	Blue	0.94	0.03
6dFGS gJ032504.2-365540	03:25:04.15	−36:55:39.9	GinPair	Blue	0.64	0.08
6dFGS gJ032512.9-362210	03:25:13.07	−36:22:09.7	Galaxy	Blue	0.75	0.12
[JPB2015] 051.4803133-32.8829964	03:25:55.27	−32:52:58.9	GlCl	Blue	0.83	0.08
SDSS J033226.29-011126.2	03:32:26.29	−01:11:26.0	QSO	Blue	0.52	0.07
SDSS J033226.29-011126.2	03:32:26.30	−01:11:26.3	QSO	Blue	0.53	0.05
SDSS J033310.10+000849.1	03:33:10.08	00:08:49.2	Seyfert 2	Red	0.13	0.37
[VV2006] J033458.5-000744	03:34:58.48	−00:07:43.9	QSO	Blue	0.77	0.02
[VV2006] J033821.6+003106	03:38:21.51	00:31:06.6	QSO	Blue	0.64	0.04
2XMM J033841.3-353134	03:38:41.36	−35:31:34.4	BLLac	Blue	0.26	0.06
2XMM J033841.3-353134	03:38:41.37	−35:31:34.2	BLLac	Blue	0.25	0.05
[VV2006] J033927.5-344707	03:39:27.45	−34:37:07.0	QSO	Blue	0.55	0.04
CXO J034012.4-353740	03:40:12.39	−35:37:40.1	HMXB	Blue	0.18	0.05
SDSS J034019.89+010330.7	03:40:19.89	01:03:30.7	EmG	Blue	0.72	0.11
[VV2006] J034023.0-351606	03:40:22.99	−35:16:07.0	QSO	Blue	0.55	0.08
2XMM J034050.4-352620	03:40:50.48	−35:26:21.7	AGN	Blue	0.59	0.08
ESO 358-51	03:41:32.55	−34:53:19.0	GinGroup	Blue	0.88	0.07
2MASS J03424773+0109331	03:42:47.72	01:09:33.0	Seyfert 1	Blue	0.16	0.07
2SLAQ J034304.64+002512.1	03:43:04.65	00:25:12.3	Star	Blue	0.43	0.09
LCRS B034214.4-381736	03:44:04.68	−38:08:11.9	Galaxy	Red	0.00	1.00
[VV2006] J034408.3-003106	03:44:08.25	−00:31:05.8	QSO	Blue	0.93	0.03
SDSS J034427.73-002740.4	03:44:27.73	−00:27:40.2	Galaxy	Red	0.53	0.25
SDSS J034517.02-001549.8	03:45:17.01	−00:15:49.7	QSO	Blue	1.00	0.00
6dFGS gJ034545.4-362046	03:45:45.38	−36:20:46.1	GinCl	Blue	0.84	0.02
SDSS J034602.53-000058.7	03:46:02.53	−00:00:58.6	Seyfert 2	Red	0.18	0.50
2MASX J03472195-3251054	03:47:21.94	−32:51:05.2	GinCl	Red	0.29	0.56
SDSS J034907.92+010943.3	03:49:07.93	01:09:43.2	LSB G	Blue	0.96	0.04
MCG+00-10-021	03:49:08.87	01:09:46.3	LSB G	Blue	0.85	0.05
FASTT 83	03:51:19.36	00:32:16.6	EB*	Red	0.12	0.54
LEDA 607287	03:55:02.55	−38:35:40.2	Galaxy	Red	0.17	0.75
Gaia DR2 4857261601188886016	03:55:16.01	−37:29:44.7	Candidate WD*	–	–	–
[ZJM2003] SA 95-2230	03:55:38.45	00:28:34.9	Star	Blue	0.98	0.02
2dFGRS TGS817Z154	03:56:05.58	−49:28:40.7	Galaxy	Blue	0.98	0.01
SDSSCGB 74387.1	03:56:50.79	−00:14:34.9	Galaxy	Red	0.37	0.27
2dFGRS TGS848Z501	03:57:22.10	−37:01:54.1	Galaxy	Blue	0.97	0.03
6dFGS gJ035732.5-000047	03:57:32.27	−00:00:47.6	Galaxy	Blue	0.69	0.06
UGC 2913	03:59:03.91	01:21:33.6	Galaxy	Blue	0.55	0.09
UGC 2913	03:59:03.91	01:21:33.6	Galaxy	Blue	0.55	0.09
ESO 201-14	04:00:29.38	−49:01:48.4	EmG	Blue	0.78	0.05
2MASS J04004608-3424277	04:00:46.07	−34:24:27.7	AGN Candidate	Blue	0.53	0.11
6dFGS gJ040053.2-351416	04:00:53.13	−35:14:16.2	Galaxy	Blue	0.80	0.04
QSO B0401-3505	04:03:10.56	−34:56:56.8	QSO	Blue	0.67	0.04
LCRS B040209.0-382209	04:03:56.75	−38:13:58.5	Galaxy	Blue	0.54	0.14
6dFGS gJ040441.2-345756	04:04:41.14	−34:57:55.8	Galaxy	Blue	0.80	0.07
6dFGS gJ040520.4-364859	04:05:20.40	−36:48:59.0	Galaxy	Blue	0.39	0.11
6dFGS gJ040520.4-364859	04:05:20.40	−36:48:58.8	Galaxy	Blue	0.40	0.12
Gaia DR2 4845009910624639232	04:05:27.97	−38:11:22.1	Star	Blue	0.99	0.01

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
[VV96] J041130.5-335331	04:11:30.51	−33:53:31.1	QSO	Blue	0.76	0.04
2dFGRS TGS894Z351	04:11:58.37	−37:58:44.0	Galaxy	Blue	0.96	0.04
ESO 420-11	04:12:53.30	−31:18:30.2	GinGroup	Blue	0.97	0.03
2dFGRS TGS894Z291	04:13:00.00	−38:19:42.5	Galaxy	Blue	0.98	0.02
Gaia DR2 4872129059981617536	04:20:06.78	−32:51:20.0	Candidate WD*	–	–	–
LEDA 685147	04:20:56.84	−32:50:42.8	Galaxy	–	–	–
2MASX J04255940-4316225	04:25:59.40	−43:16:22.6	Galaxy	Blue	0.98	0.02
LEDA 579779	04:26:32.58	−41:01:56.6	Galaxy	Blue	1.00	0.00
LEDA 125483	04:26:44.34	−42:15:41.2	Galaxy	Blue	1.00	0.00
LEDA 568379	04:26:44.87	−42:05:40.5	Galaxy	Blue	0.98	0.01
LEDA 554934	04:26:44.91	−42:58:38.4	Galaxy	Blue	0.90	0.03
MCG-07-10-009	04:27:42.24	−42:38:20.4	Galaxy	Blue	0.83	0.06
2MASX J04282877-4314283	04:28:28.71	−43:14:29.1	Galaxy	Blue	0.70	0.04
6dFGS gJ043139.6-301514	04:31:39.57	−30:15:14.1	CataclyV*	Blue	0.27	0.08
LEDA 697927	04:32:44.32	−32:01:20.1	Galaxy	Red	0.10	0.85
ESO 251-12	04:33:09.79	−43:46:13.6	Galaxy	Blue	0.82	0.05
ESO 304-2	04:35:19.80	−42:12:11.8	Galaxy	Blue	1.00	0.00
LEDA 494343	04:35:41.79	−47:52:43.9	Galaxy	Blue	0.89	0.05
[HM2015b] 236 3	04:37:11.17	−46:41:06.8	Galaxy	Blue	0.38	0.06
LEDA 692923	04:37:18.21	−32:22:10.3	Galaxy	Blue	1.00	0.00
Gaia DR2 4790561549357871744	04:37:35.04	−44:20:28.8	Candidate RRLyr	Blue	0.99	0.01
LEDA 681270	04:38:23.53	−33:05:08.6	Galaxy	Blue	0.83	0.02
6dFGS gJ043927.4-425912	04:39:27.45	−42:59:11.8	Galaxy	Blue	0.41	0.06
LEDA 606705	04:45:44.98	−38:38:48.7	Galaxy	Blue	1.00	0.00
LEDA 88363	04:48:23.05	−44:52:57.7	Galaxy	Blue	0.97	0.03
2dFGRS TGS880Z325	04:50:02.35	−47:28:39.0	Galaxy	Blue	0.68	0.10
LEDA 512705	04:51:48.86	−46:37:36.8	Galaxy	Blue	1.00	0.00
Gaia DR2 4811451372635865984	04:52:31.12	−44:11:04.3	Star	Blue	0.48	0.11
LEDA 686311	04:53:19.46	−32:46:32.8	Galaxy	Blue	0.85	0.04
[VV98] J045444.5-481300	04:54:43.04	−48:13:20.2	Seyfert 1	Blue	0.68	0.06
SN 2012at	04:54:52.74	−37:19:15.5	SN	Blue	0.56	0.13
2MASX J04550020-3715351	04:55:00.19	−37:15:35.4	GinPair	Blue	0.88	0.05
LEDA 715392	04:55:26.51	−30:35:28.6	Galaxy	Blue	0.20	0.07
ESO 499-24	09:57:01.69	−26:29:28.5	Galaxy	Blue	0.89	0.03
LEDA 859547	09:57:06.62	−19:07:06.1	Galaxy	Blue	0.84	0.08
LEDA 1022680	09:57:23.46	−07:12:51.4	Galaxy	Blue	0.18	0.06
2MASX J09583711-4704597	09:58:37.10	−47:05:00.4	Galaxy	Blue	0.63	0.07
[CMI2006b] H42-f02-1939	09:59:46.82	−19:28:00.0	Galaxy	Blue	0.99	0.01
CRTS J095950.7-383024	09:59:50.88	−38:30:22.9	RRLyr	Blue	0.97	0.03
LEDA 605183	10:00:05.44	−38:47:28.7	Galaxy	Blue	0.57	0.08
NGC 3095	10:00:05.83	−31:33:10.8	GinGroup	Red	0.08	0.49
LEDA 154528	10:00:49.12	−30:32:41.9	Galaxy	Blue	0.75	0.07
SDSS J100059.08+032751.4	10:00:59.07	03:27:51.5	Galaxy	Blue	0.74	0.08
ESO 567-3	10:01:09.07	−19:26:29.7	LSB G	Blue	0.99	0.01
LEDA 1011555	10:01:34.08	−07:52:55.7	Galaxy	Blue	0.90	0.08
Gaia DR2 5670829935783719936	10:02:11.73	−19:25:37.1	Star	Blue	0.32	0.06
2QZ J100215.7-001056	10:02:15.83	−00:10:55.8	QSO	Blue	0.63	0.09
VVDS 100108471	10:02:25.38	01:19:36.8	Galaxy	Blue	1.00	0.00
ESO 262-15	10:02:38.71	−45:29:53.9	GinGroup	Red	0.17	0.48
[BCP93] F2 H6	10:02:51.82	−26:09:23.9	HII	Blue	1.00	0.00
[EBU2007] 7	10:02:54.69	−26:08:59.6	BlueSG*	Blue	0.24	0.09
[H69] NGC 3109 12	10:02:56.31	−26:08:58.5	HII	Blue	0.26	0.09
[PRS2007] HII 44	10:02:59.47	−26:08:46.4	HII	Blue	0.43	0.11
[PRS2007] HII 44	10:02:59.48	−26:08:46.4	HII	Blue	0.48	0.10
PSO J150.7588-26.1494	10:03:02.10	−26:08:58.7	AGN Candidate	Blue	0.67	0.08
2MASX J10030450-1949377	10:03:04.51	−19:49:38.1	Galaxy	Blue	0.84	0.04
2dFGRS TGN094Z280	10:03:15.05	−05:54:32.8	Galaxy	Blue	0.96	0.04
[EBU2007] 3	10:03:17.64	−26:10:01.7	BlueSG*	Blue	0.26	0.08
[VV96] J100342.1-150808	10:03:41.93	−15:08:08.9	QSO	Blue	0.43	0.07

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2MASX J10035230-3124480	10:03:52.32	−31:24:48.5	Galaxy	Blue	0.99	0.01
2MASX J10041992-4425311	10:04:19.86	−44:25:32.6	Galaxy	Blue	0.90	0.07
2MASX J10050765-1951299	10:05:07.68	−19:51:30.2	Galaxy	Blue	0.64	0.06
2dFGRS TGN421Z115	10:05:17.31	01:38:21.7	Galaxy	Blue	0.88	0.05
2MFGC 7816	10:05:28.51	−38:07:30.1	Galaxy	Blue	1.00	0.00
[VV2006] J100539.9+040914	10:05:39.88	04:09:14.7	QSO	Blue	0.59	0.07
CRTS J100548.9-254146	10:05:48.99	−25:41:47.1	RRLyr	Blue	0.99	0.01
2MASX J10061715-0634276	10:06:17.20	−06:34:27.7	Galaxy	Blue	0.95	0.05
6dFGS gJ100622.2-264958	10:06:22.20	−26:49:57.2	Galaxy	Blue	0.99	0.01
6dFGS gJ100631.4-320236	10:06:31.39	−32:02:35.9	GinGroup	Red	0.42	0.24
NGC 3125	10:06:33.37	−29:56:07.8	HII G	Blue	0.53	0.10
1RXH J100633.9-295612	10:06:33.90	−29:56:11.6	X	Blue	0.73	0.07
2MASX J10071106-1904039	10:07:11.07	−19:04:04.6	Galaxy	Blue	0.87	0.05
LEDA 699275	10:07:27.24	−31:55:26.9	Galaxy	Blue	0.94	0.06
CRTS J100733.7-301921	10:07:33.84	−30:19:19.4	EB*	Blue	0.80	0.03
RX J1007.5-2017	10:07:34.65	−20:17:32.4	CataclyV*	Blue	0.48	0.11
RX J1007.5-2017	10:07:34.66	−20:17:32.5	CataclyV*	Blue	0.18	0.08
2MASX J10081071-3331017	10:08:10.76	−33:31:02.2	Galaxy	Red	0.54	0.20
2MASX J10082199-1448362	10:08:22.01	−14:48:36.1	Galaxy	Blue	0.75	0.06
LEDA 768685	10:08:30.09	−26:21:33.0	Galaxy	Blue	0.97	0.03
2MASX J10091380-4300089	10:09:13.81	−43:00:09.0	GinGroup	Red	0.21	0.33
LEDA 648630	10:09:50.26	−35:27:43.3	Galaxy	Blue	0.97	0.03
LEDA 3094360	10:09:58.73	−20:30:59.5	Galaxy	Blue	0.84	0.06
ESO 435-50	10:10:50.41	−30:25:24.4	Galaxy	Blue	0.73	0.06
LEDA 654529	10:10:51.81	−35:00:28.1	Galaxy	Blue	1.00	0.00
NGC 3146	10:11:09.90	−20:52:14.0	EmG	Blue	0.75	0.06
LEDA 729120	10:11:13.49	−29:27:27.9	Galaxy	Blue	0.65	0.13
CRTS J101200.8-365725	10:12:00.81	−36:57:25.2	EB*	Red	0.32	0.28
LEDA 691325	10:12:03.36	−32:28:06.8	Galaxy	Blue	1.00	0.00
Gaia DR2 5407412036686860672	10:12:47.58	−47:33:51.1	Star	Blue	0.63	0.10
LEDA 655538	10:12:59.65	−34:56:06.6	Galaxy	Blue	0.99	0.01
2MASX J10134201-3451194	10:13:41.91	−34:51:18.3	EmG	Blue	0.72	0.08
LEDA 658182	10:13:54.08	−34:44:23.0	Galaxy	Blue	0.85	0.04
LEDA 713928	10:14:25.56	−30:42:30.1	Galaxy	Blue	0.67	0.03
2MASX J10142679-2329036	10:14:26.81	−23:29:04.9	Galaxy	Blue	0.99	0.01
ESO 263-21	10:14:41.74	−44:51:14.1	EmG	Blue	0.80	0.03
IC 2559	10:14:45.36	−34:03:33.0	EmG	Red	0.29	0.36
ESO 263-22	10:14:48.13	−43:31:49.5	Galaxy	Blue	0.69	0.06
ESO 263-23	10:14:57.32	−43:37:09.2	Galaxy	Red	0.35	0.23
ESO 567-32	10:15:44.54	−20:17:44.0	EmG	Red	0.06	0.34
Gaia DR2 5407327747940309248	10:15:58.31	−47:58:09.1	Star	Blue	0.32	0.08
IC 2560	10:16:18.68	−33:33:49.8	Seyfert 2	Red	0.33	0.28
ESO 567-39	10:17:13.15	−21:04:00.3	EmG	Blue	0.72	0.04
LEDA 702814	10:18:05.73	−31:38:49.0	Galaxy	Blue	0.64	0.07
[VV96] J101821.7-214008	10:18:21.76	−21:40:07.7	QSO	Blue	0.48	0.08
CRTS SSS120320 J101854-400644	10:18:53.51	−40:06:43.7	Candidate CV*	Blue	0.29	0.10
ESO 375-7	10:19:01.23	−37:40:19.2	Galaxy	Blue	1.00	0.00
CTS 1011	10:19:21.17	−22:08:33.4	HII G	Blue	0.43	0.12
CTS 1011	10:19:21.28	−22:08:35.9	HII G	Blue	0.58	0.14
NGC 3208	10:19:41.31	−25:48:52.9	EmG	Blue	0.62	0.06
6dFGS gJ102028.5-232845	10:20:28.52	−23:28:45.3	Galaxy	Blue	1.00	0.00
LEDA 800754	10:20:32.72	−23:26:54.0	Galaxy	Blue	0.48	0.09
CRTS SSS120215 J102042-335002	10:20:42.16	−33:50:02.4	Candidate CV*	Blue	0.61	0.08
Gaia DR2 5668001579559758720	10:20:43.31	−20:47:54.6	Star	Blue	0.54	0.07
ESO 500-30	10:20:48.90	−23:27:57.1	EmG	Red	0.63	0.18
6dFGS gJ102109.3-325140	10:21:09.27	−32:51:39.9	Galaxy	Blue	0.96	0.04
6dFGS gJ102121.0-213628	10:21:21.03	−21:36:27.7	Galaxy	Blue	0.99	0.01
LEDA 592969	10:22:02.22	−39:52:45.9	Galaxy	Blue	0.89	0.06
6dFGS gJ102239.9-302931	10:22:39.94	−30:29:30.6	AGN Candidate	Blue	0.45	0.08

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
ESO 263-30	10:22:59.54	−42:49:38.9	Galaxy	Blue	0.83	0.03
ESO 317-19	10:23:02.34	−39:09:59.8	GinGroup	Blue	0.84	0.06
ESO 375-18	10:23:40.27	−35:49:33.5	EmG	Red	0.40	0.39
ESO 375-18	10:23:40.27	−35:49:33.5	EmG	Red	0.29	0.45
ESO 263-32	10:24:21.47	−43:55:01.6	Galaxy	Blue	0.85	0.02
ESO 500-34	10:24:31.43	−23:33:09.6	Seyfert 2	Red	0.05	0.52
CRTS J102513.4-354014	10:25:13.46	−35:40:16.7	EB*	Blue	0.99	0.01
6dFGS gJ102607.5-243321	10:26:07.41	−24:33:20.2	Galaxy	Blue	0.75	0.08
ESO 436-21	10:26:21.70	−29:11:57.8	GinCl	Blue	0.96	0.01
NAME OT J102706-434341	10:27:05.83	−43:43:41.3	CataclyV*	Blue	0.75	0.05
ESO 500-42	10:27:20.27	−23:48:19.6	Galaxy	Blue	0.97	0.01
SN 2001db	10:27:50.35	−43:54:20.8	SN	Red	0.57	0.34
SN 2001db	10:27:50.37	−43:54:20.8	SN	Red	0.40	0.30
[LWZ2002] 5	10:27:51.28	−43:53:58.5	X	Blue	0.70	0.11
NGC 3256	10:27:51.29	−43:54:14.0	IG	Red	0.35	0.40
NGC 3256	10:27:51.30	−43:54:13.7	IG	Red	0.37	0.38
[LDT2000] R02	10:27:51.73	−43:54:13.6	X	Blue	0.94	0.06
[LDT2000] R02	10:27:51.73	−43:54:13.3	X	Blue	0.94	0.06
[EF2003] B3	10:27:52.88	−43:54:11.5	HII	Blue	0.45	0.07
[EF2003] B3	10:27:52.89	−43:54:11.2	HII	Blue	0.46	0.07
[EF2003] B3	10:27:52.89	−43:54:11.2	HII	Blue	0.46	0.07
ESO 436-26	10:28:42.96	−31:02:17.7	AGN	Red	0.33	0.27
CRTS CSS140309 J102844-161303	10:28:43.86	−16:13:03.3	CataclyV*	Blue	0.13	0.07
[SHM2017] J157.24190-30.14112	10:28:58.05	−30:08:27.7	RRLyr	Blue	0.19	0.04
ESO 317-34	10:29:00.71	−40:04:57.9	GinGroup	Blue	0.97	0.03
IC 2582	10:29:11.07	−30:20:32.7	EmG	Blue	0.79	0.05
LEDA 636268	10:30:30.59	−36:28:47.1	Galaxy	Blue	0.76	0.08
LEDA 636268	10:30:30.59	−36:28:47.1	Galaxy	Blue	0.65	0.05
LEDA 83158	10:30:57.69	−34:42:28.5	GinGroup	Blue	0.74	0.05
ESO 317-39	10:31:00.18	−40:10:42.5	Galaxy	Red	0.13	0.29
ESO 436-32	10:31:29.90	−32:42:47.1	EmG	Blue	0.51	0.11
NGC 3281	10:31:52.11	−34:51:13.0	Seyfert 2	Red	0.05	0.36
LEDA 571751	10:31:57.37	−41:48:41.1	Galaxy	Blue	0.62	0.02
[BM98] 2	10:32:59.22	−27:32:36.9	GinCl	Blue	0.95	0.02
6dFGS gJ103317.5-430444	10:33:17.40	−43:04:43.1	Galaxy	Blue	0.64	0.07
ESO 375-64	10:34:00.75	−35:16:57.6	GinGroup	Blue	0.62	0.07
ESO 375-64	10:34:00.75	−35:16:57.3	GinGroup	Blue	0.64	0.07
LEDA 754029	10:34:26.74	−27:30:04.0	GinCl	Blue	0.98	0.02
ESO 436-42	10:34:38.75	−28:35:00.1	EmG	Blue	0.76	0.04
ESO 568-18	10:34:54.59	−20:32:55.6	EmG	Blue	0.98	0.01
2MASX J10345852-4054438	10:34:58.52	−40:54:43.3	Galaxy	Blue	0.73	0.06
6dFGS gJ103502.9-293024	10:35:02.88	−29:30:23.8	GinCl	Blue	0.97	0.03
ESO 437-3	10:35:07.72	−27:59:28.7	EmG	Blue	0.70	0.04
ESO 375-69	10:35:18.72	−36:52:42.5	EmG	Blue	0.95	0.05
ESO 501-22	10:35:21.68	−27:41:44.5	GinCl	Blue	0.96	0.04
LEDA 712419	10:35:31.70	−30:50:00.0	Galaxy	Blue	0.62	0.03
LEDA 535830	10:35:34.16	−44:34:41.1	Galaxy	Blue	0.77	0.08
LEDA 784823	10:36:02.66	−24:54:24.1	Galaxy	Blue	0.81	0.03
LEDA 743415	10:36:06.94	−28:17:45.0	Galaxy	Blue	0.87	0.06
ESO 501-32	10:36:22.11	−25:22:35.4	EmG	Blue	0.81	0.05
[CZ2003] 1060C-393 25	10:36:30.34	−27:54:04.0	GinCl	Blue	0.82	0.06
6dFGS gJ103645.4-281005	10:36:45.48	−28:10:02.7	GinCl	Blue	0.90	0.03
LEDA 769967	10:36:54.86	−26:14:26.0	HII G	Blue	0.14	0.05
6dFGS gJ103656.1-265414	10:36:56.08	−26:54:13.6	Galaxy	Blue	0.99	0.01
LEDA 742546	10:37:01.84	−28:22:01.7	GinCl	Blue	0.87	0.05
6dFGS gJ103704.4-312157	10:37:04.45	−31:21:57.3	Galaxy	Blue	0.81	0.03
NGC 3314	10:37:12.87	−27:41:02.2	EmG	Blue	0.64	0.11
6dFGS gJ103719.9-281420	10:37:19.89	−28:14:19.9	GinCl	Blue	1.00	0.00
LEDA 753354	10:37:22.21	−27:32:41.9	Galaxy	Blue	0.70	0.08

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
WISE J103754.92-242544.5	10:37:54.92	−24:25:44.6	MIR	Red	0.14	0.47
ESO 501-61	10:38:05.84	−25:05:40.1	IG	Blue	0.94	0.02
[WLH83] 1036-378A	10:38:14.37	−38:05:25.5	HII	Blue	0.93	0.03
LEDA 740766	10:38:28.68	−28:30:55.0	GinCl	Blue	0.97	0.03
2MASX J10383034-2332546	10:38:30.34	−23:32:54.7	Galaxy	Blue	0.91	0.05
ESO 501-65	10:38:33.42	−27:44:13.8	EmG	Blue	0.86	0.06
WPVS 78	10:38:41.50	−25:35:32.2	EmG	Blue	0.49	0.12
6dFGS gJ103857.2-200242	10:38:57.24	−20:02:41.8	Galaxy	Blue	0.91	0.02
LEDA 838980	10:39:13.02	−20:38:12.5	Galaxy	Blue	0.64	0.04
MCG-04-25-054	10:39:26.01	−23:45:16.8	EmG	Blue	0.60	0.06
2MASS J10395999-4701261	10:39:59.97	−47:01:26.3	CataclyV*	Blue	0.55	0.12
2MASS J10395999-4701261	10:39:59.97	−47:01:26.3	CataclyV*	Blue	0.55	0.12
ESO 437-37	10:40:31.01	−29:16:10.5	IG	Blue	0.90	0.03
ESO 568-20	10:40:58.70	−21:47:04.3	EmG	Red	0.22	0.50
6dFGS gJ104102.1-304740	10:41:02.12	−30:47:40.1	Galaxy	Blue	0.82	0.05
CRTS J104104.0-341120	10:41:03.86	−34:11:23.4	RRLyr	Blue	1.00	0.00
ESO 568-21	10:41:15.17	−21:01:22.9	Seyfert 1	Blue	0.95	0.03
ESO 437-42	10:41:27.71	−31:46:49.1	Galaxy	Blue	0.82	0.05
ESO 437-42	10:41:27.71	−31:46:49.1	Galaxy	Blue	0.82	0.05
LEDA 3081775	10:41:35.15	−37:28:09.5	Galaxy	Blue	0.81	0.05
6dFGS gJ104139.4-274638	10:41:39.43	−27:46:38.2	Galaxy	Blue	0.66	0.07
ESO 568-22	10:42:06.62	−22:06:20.1	IG	Blue	0.74	0.05
LEDA 31904	10:42:19.50	−36:19:13.7	Galaxy	Blue	0.97	0.03
6dFGS gJ104238.0-235609	10:42:37.99	−23:56:08.4	Galaxy	Blue	0.90	0.02
ESO 437-50	10:43:31.00	−30:46:20.0	EmG	Blue	0.76	0.03
ESO 437-50	10:43:31.00	−30:46:20.0	EmG	Blue	0.76	0.03
6dFGS gJ104409.7-204909	10:44:09.71	−20:49:09.5	Galaxy	Blue	0.82	0.04
ESO 569-2	10:45:00.21	−22:09:08.2	IG	Blue	1.00	0.00
6dFGS gJ104534.8-241702	10:45:34.75	−24:17:01.3	Galaxy	Blue	0.80	0.07
6dFGS gJ104617.1-282524	10:46:17.11	−28:25:23.6	EmG	Blue	0.73	0.04
LEDA 718607	10:46:30.26	−30:19:17.8	Galaxy	Blue	0.83	0.04
ESO 376-20	10:46:38.45	−36:21:11.9	EmG	Blue	0.69	0.07
ESO 501-96	10:46:47.54	−23:19:39.8	Galaxy	Blue	0.94	0.06
Gaia DR2 5391507429181636352	10:47:23.91	−41:59:49.3	Star	Blue	0.56	0.07
EC 10453-2041	10:47:44.36	−20:57:48.8	EmG	Blue	0.53	0.09
2MASX J10475221-2004542	10:47:52.11	−20:04:53.3	HII G	Blue	0.87	0.02
2MASX J10475221-2004542	10:47:52.13	−20:04:53.5	HII G	Blue	1.00	0.00
[KRB2015] A	10:48:23.47	−25:09:43.6	Radio	Red	0.62	0.19
2MASX J10482527-2151000	10:48:25.30	−21:51:00.5	Galaxy	Blue	0.73	0.04
SN 2018aqi	10:48:25.45	−25:09:36.1	SN	Red	0.20	0.07
LEDA 688498	10:48:42.32	−32:38:37.4	Galaxy	Blue	1.00	0.00
LEDA 738826	10:49:46.88	−28:40:37.1	Galaxy	Blue	0.50	0.08
2MASX J10503963-1832342	10:50:39.64	−18:32:34.4	Galaxy	Red	0.43	0.22
LEDA 844461	10:51:00.37	−20:14:21.3	Galaxy	Blue	1.00	0.00
6dFGS gJ105101.9-282017	10:51:01.81	−28:20:16.5	Galaxy	Blue	0.85	0.03
LEDA 851789	10:51:27.40	−19:41:37.0	Galaxy	Blue	0.99	0.01
6dFGS gJ105149.2-215323	10:51:49.07	−21:53:17.5	Galaxy	Blue	0.67	0.05
6dFGS gJ105233.0-230900	10:52:33.04	−23:08:59.6	Galaxy	Blue	0.29	0.08
MASTER OT J105440.86-391319.0	10:54:40.84	−39:13:19.0	Candidate SN*	Blue	0.76	0.08
6dFGS gJ105521.6-232527	10:55:21.62	−23:25:27.3	Galaxy	Blue	0.87	0.06
6dFGS gJ105521.6-232527	10:55:21.63	−23:25:27.3	Galaxy	Blue	0.90	0.04
2MASX J10563839-2047119	10:56:38.39	−20:47:12.2	Galaxy	Blue	0.87	0.03
LEDA 849870	10:56:48.51	−19:50:00.4	Galaxy	Blue	0.85	0.08
ESO 376-28	10:57:04.32	−33:09:20.3	Galaxy	Red	0.45	0.30
ESO 264-52	10:57:13.91	−47:40:11.3	Galaxy	Red	0.63	0.14
LEDA 648093	10:57:36.52	−35:30:15.8	Galaxy	Blue	1.00	0.00
2MASX J10584423-1909304	10:58:44.25	−19:09:31.1	Galaxy	Blue	1.00	0.00
EC 10566-3120	10:58:59.03	−31:36:34.1	CataclyV*	Blue	0.52	0.08
2MASX J10590982-2759589	10:59:09.86	−27:59:59.3	Galaxy	Blue	0.91	0.04

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
Gaia DR2 5386613537284200960	11:01:51.26	−46:53:04.5	Candidate RRLyr	Blue	1.00	0.00
Gaia DR2 3537117430403448320	11:01:57.97	−23:47:27.3	PM*	Blue	0.53	0.10
V* TU Crt	11:03:36.57	−21:37:45.9	CataclyV*	Blue	0.58	0.09
NGC 3513	11:03:46.16	−23:14:42.1	GinPair	Blue	0.76	0.04
FAUST 2807	11:03:59.06	−18:46:36.1	UV	Blue	1.00	0.00
ESO 570-5	11:07:13.10	−19:49:07.2	IG	Blue	0.89	0.05
NGC 3529	11:07:19.13	−19:33:20.0	EmG	Blue	0.96	0.03
NGC 3529	11:07:19.14	−19:33:19.5	EmG	Blue	0.96	0.02
NGC 3565	11:07:47.84	−20:01:20.2	IG	Blue	0.89	0.04
ESO 570-10	11:10:50.57	−21:58:28.3	Galaxy	Blue	0.86	0.08
LEDA 821419	11:10:57.23	−21:56:53.3	Galaxy	Blue	0.89	0.03
6dFGS gJ111351.0-212655	11:13:50.97	−21:26:54.8	Galaxy	Blue	0.88	0.07
NGC 3597	11:14:42.00	−23:43:39.9	EmG	Blue	0.67	0.08
[VV96] J111644.8-171127	11:16:43.58	−17:11:41.5	QSO	Blue	0.41	0.07
LEDA 861413	11:17:15.01	−18:58:24.4	Galaxy	–	–	–
LEDA 809402	11:17:35.06	−22:45:06.2	Galaxy	Red	0.29	0.49
CRTS J112256.0-242841	11:22:56.09	−24:28:40.0	EB*	Blue	1.00	0.00
LEDA 786212	11:29:34.18	−24:46:39.1	Galaxy	Blue	0.50	0.08
[VV2010c] J113128.4-195903	11:31:28.46	−19:59:02.8	AGN	Blue	0.58	0.07
CRTS SSS110509 J113219-213943	11:32:19.01	−21:39:42.9	Candidate CV*	–	–	–
2dFGRS TGN444Z198	11:34:24.52	01:09:15.7	Galaxy	Blue	0.88	0.04
MGC 22410	11:36:12.70	00:04:54.9	Star	Blue	1.00	0.00
UGC 6578	11:36:36.73	00:49:02.1	EmG	Blue	0.58	0.13
GAMA 6821	11:36:36.79	00:48:55.8	Galaxy	Blue	0.08	0.04
V* RZ Leo	11:37:22.18	01:48:58.9	CataclyV*	Blue	0.17	0.05
Gaia DR2 3541998025080414336	11:37:49.97	−20:07:37.1	Candidate WD*	Blue	0.37	0.10
2dFGRS TGN238Z266	11:38:54.33	−01:38:34.1	Galaxy	Blue	0.49	0.08
CRTS J113855.5-211148	11:38:55.60	−21:11:47.7	RRLyr	Blue	0.97	0.03
SDSS J113901.39+012017.8	11:39:01.39	01:20:17.7	Galaxy	Blue	0.37	0.11
LBQS 1136-0109	11:39:04.35	−01:26:25.0	QSO	Blue	0.81	0.03
6dFGS gJ114135.0-181141	11:41:35.04	−18:11:40.5	Galaxy	Blue	0.95	0.02
2dFGRS TGN238Z191	11:41:45.67	−01:54:04.8	HII G	Blue	0.86	0.06
ESO 571-16	11:42:09.14	−18:10:08.7	Galaxy	Red	0.05	0.40
SDSS J114212.38+002002.5	11:42:12.33	00:20:03.4	PartofG	Blue	0.98	0.02
2QZ J114214.5-023154	11:42:14.64	−02:31:53.3	Galaxy	Blue	0.90	0.02
CRTS J114238.0-202722	11:42:37.96	−20:27:21.8	RRLyr	Blue	0.99	0.01
2QZ J114250.9+013057	11:42:50.95	01:30:58.2	Seyfert 1	Blue	0.80	0.08
SDSS J114329.34-020319.7	11:43:29.34	−02:03:19.5	QSO	–	–	–
SDSS J114329.34-020319.7	11:43:29.35	−02:03:19.9	QSO	–	–	–
SDSSCGB 59619.2	11:43:46.11	−01:16:34.0	Galaxy	–	–	–
GAMA 396970	11:43:47.41	01:30:53.9	Galaxy	Blue	0.59	0.06
LINEAR 2118419	11:44:08.82	01:24:20.7	RRLyr	Blue	0.98	0.02
2QZ J114450.8+014324	11:44:50.95	01:43:24.8	EmG	Blue	0.58	0.07
Gaia DR2 3544179185567992320	11:44:55.76	−17:56:39.4	Candidate WD*	Blue	0.46	0.11
2dFGRS TGN310Z256	11:45:08.04	−00:59:18.2	Galaxy	Blue	0.48	0.09
SDSS J114511.70-005402.6	11:45:11.72	−00:54:02.5	Galaxy	Red	0.15	0.75
2MASX J11451524-2044471	11:45:15.26	−20:44:47.5	Galaxy	Blue	0.70	0.08
Z 12-78	11:45:26.30	00:00:14.8	Galaxy	Blue	0.95	0.05
SDSS J114600.44+001037.4	11:46:00.45	00:10:37.0	Galaxy	Red	0.29	0.55
2dFGRS TGN310Z211	11:46:07.72	−00:27:28.7	Galaxy	Blue	0.97	0.03
SDSS J114643.10+011118.6	11:46:43.12	01:11:18.8	QSO	Blue	0.80	0.05
2QZ J114711.4-002706	11:47:11.47	−00:27:05.8	EmG	Blue	0.98	0.02
2MASX J11481815-0138230	11:48:18.21	−01:38:23.8	Seyfert 1	Blue	0.81	0.06
SDSS J114818.33-013830.8	11:48:18.35	−01:38:30.5	Galaxy	Blue	0.52	0.08
[VV2006] J114939.6+014624	11:49:39.60	01:46:25.5	QSO	Blue	0.56	0.06
2dFGRS TGN378Z115	11:50:23.78	−00:31:41.9	HII G	Blue	0.54	0.11
[P78] ACO 1392 C	11:50:36.30	−00:34:06.6	GinCl	Blue	0.58	0.13
SDSS J115036.42-003402.0	11:50:36.39	−00:34:02.6	Galaxy	Blue	0.57	0.13
[VV2006] J115049.2-005149	11:50:49.29	−00:51:49.1	QSO	Blue	0.34	0.08

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
LEDA 807513	11:51:13.02	−22:53:25.2	Galaxy	Red	0.34	0.44
SDSS J115129.42-000333.8	11:51:29.45	−00:03:33.6	Galaxy	Red	0.20	0.34
2dFGRS TGN242Z154	11:51:32.96	−02:22:21.9	Galaxy	Blue	0.26	0.09
LEDA 37102	11:51:33.35	−02:22:21.7	Seyfert 1	Blue	0.06	0.03
SDSS J115216.86+012327.2	11:52:16.88	01:23:27.5	Galaxy	Red	0.11	0.59
2QZ J115217.3-025303	11:52:17.34	−02:53:02.7	EmG	Blue	0.97	0.02
ESO 572-7	11:52:27.62	−20:06:14.1	GinGroup	Blue	0.80	0.03
Mrk 1307	11:52:37.30	−02:28:09.4	Seyfert 1	Blue	0.24	0.08
SDSS J115237.67-022806.3	11:52:37.67	−02:28:06.8	HII G	Blue	0.27	0.09
2dFGRS TGN311Z206	11:52:47.52	−00:40:07.7	Seyfert 1	Blue	0.25	0.09
2dFGRS TGN311Z206	11:52:47.53	−00:40:07.8	Seyfert 1	Blue	0.26	0.09
2dFGRS TGN176Z274	11:53:14.07	−03:24:32.6	Galaxy	Blue	0.66	0.07
2dFGRS TGN243Z103	11:53:28.66	−03:13:48.9	Galaxy	Blue	1.00	0.00
[VV2006] J115345.5-024320	11:53:45.44	−02:43:20.4	QSO	Blue	0.84	0.04
UM 465B	11:54:12.31	00:08:12.4	GinPair	Blue	0.88	0.07
SDSS J115456.54+001106.0	11:54:56.59	00:11:05.5	Galaxy	–	–	–
SDSS J115511.13+002905.1	11:55:11.19	00:29:05.5	Galaxy	Blue	0.30	0.09
SDSS J115511.67+002925.0	11:55:11.70	00:29:25.0	Galaxy	Blue	0.39	0.09
2dFGRS TGN243Z202	11:57:11.86	−02:41:12.9	Galaxy	Blue	0.57	0.13
SDSS J115712.38-024111.2	11:57:12.29	−02:41:11.3	Galaxy	Blue	0.58	0.14
ESO 572-25	11:57:28.04	−19:37:26.5	Galaxy	Blue	0.52	0.08
2QZ J115737.0-020138	11:57:37.08	−02:01:37.3	Galaxy	Blue	0.80	0.07
2QZ J115737.0-020138	11:57:37.09	−02:01:37.2	Galaxy	Blue	0.84	0.04
[VV2006] J115748.0+014320	11:57:48.02	01:43:20.9	QSO	Blue	0.56	0.05
[VV2006] J115754.2-013815	11:57:54.26	−01:38:16.0	QSO	–	–	–
LEDA 839904	11:57:56.69	−20:33:56.4	Galaxy	Blue	0.39	0.11
2MASX J11580803-1753363	11:58:08.00	−17:53:36.2	Galaxy	Blue	0.83	0.04
6dFGS gJ115823.8-193103	11:58:23.80	−19:31:03.2	Galaxy	Blue	0.54	0.07
ESO 572-34	11:58:58.18	−19:01:47.7	EmG	Blue	0.55	0.13
GAMA 137854	11:59:23.49	−01:43:22.3	Galaxy	Blue	0.59	0.16
SN 1996W	11:59:28.93	−19:15:22.8	SN	Blue	0.85	0.04
LEDA 836770	12:00:19.81	−20:48:07.5	Galaxy	Blue	0.78	0.05
2MASX J12002013-0106229	12:00:20.20	−01:06:23.8	Galaxy	Blue	0.89	0.04
SDSS J120021.76-024331.0	12:00:21.77	−02:43:30.9	QSO	Blue	0.81	0.03
[BKD2008] WR 14	12:00:26.30	−01:06:07.0	PartofG	Blue	0.51	0.08
[VV2006] J120038.3+011246	12:00:38.29	01:12:46.5	QSO	Blue	0.68	0.08
QSO B1158-1842	12:00:44.95	−18:59:44.5	QSO	Blue	0.53	0.07
2dFGRS TGN244Z048	12:00:47.47	−03:25:12.1	Galaxy	Blue	0.99	0.01
[RDS2004] MGS sure 22	12:00:47.72	−00:01:24.3	HI	Blue	0.97	0.03
UGC 7000	12:01:10.85	−01:17:50.2	GinPair	Blue	1.00	0.00
QSO B1158+007	12:01:23.26	00:28:28.5	QSO	Blue	0.78	0.08
LEDA 802182	12:01:30.48	−23:19:06.8	Galaxy	Blue	0.71	0.02
[CEB2007] Cluster 2	12:01:50.41	−18:52:12.4	Cl*	Blue	0.54	0.08
CXOU J120150.4-185221	12:01:50.41	−18:52:19.8	HMXB	Blue	0.56	0.07
[ZBF2015] Arp244 82	12:01:50.49	−18:52:02.5	HII	Blue	0.94	0.06
[NU2000] 9 3	12:01:51.13	−18:52:28.8	Radio	Blue	0.85	0.03
[NU2000] 13 5	12:01:51.24	−18:51:45.3	Radio	Blue	0.60	0.04
[MLT2008] S2-2	12:01:51.90	−18:52:28.2	Cl*	Blue	0.78	0.03
[ZBF2015] Arp244 123	12:01:52.28	−18:52:19.4	HII	Blue	0.99	0.01
[ZBF2015] Arp244 80	12:01:52.96	−18:52:03.5	HII	Red	0.31	0.60
[ZBF2015] Arp244 5	12:01:52.98	−18:52:08.7	HII	Blue	0.98	0.02
[ZBF2015] Arp244 14	12:01:53.52	−18:51:44.2	HII	Blue	0.92	0.03
[WZ2002] 1	12:01:53.57	−18:53:09.0	Radio	Red	0.29	0.29
[BEK2006] Complex 6	12:01:54.54	−18:52:07.5	Cl*	Blue	0.56	0.03
[WS95] 89	12:01:54.54	−18:53:03.8	PartofG	Blue	0.57	0.07
[WBC2014] 180.48062-18.88025	12:01:55.35	−18:52:48.7	MolCld	Blue	0.34	0.06
[ZBF2015] Arp244 6	12:01:55.54	−18:52:22.9	HII	Blue	0.85	0.02
[ZFB2014] GMC 98	12:01:55.68	−18:52:14.0	MolCld	Blue	0.67	0.02
[WZ2002] 9	12:01:55.70	−18:52:42.8	Radio	Blue	0.35	0.06

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
[ZBF2015] Arp244 10	12:01:56.29	−18:52:38.8	HII	Blue	1.00	0.00
CRTS J120206.7-230305	12:02:06.75	−23:03:06.0	EB*	Blue	0.95	0.02
SDSS J120250.38+001931.6	12:02:50.39	00:19:31.5	Galaxy	Red	0.05	0.39
SDSS J120515.80-024222.6	12:05:15.80	−02:42:22.6	WD*	Blue	0.38	0.08
LEDA 913203	12:06:37.73	−15:17:17.2	Galaxy	Blue	0.97	0.03
6dFGS gJ120650.7-141256	12:06:50.66	−14:12:55.9	Galaxy	Blue	0.79	0.04
[VV2006] J120700.4+011155	12:07:00.41	01:11:56.4	QSO	Blue	0.75	0.07
SDSS J120920.53-002855.3	12:09:20.55	−00:28:55.3	QSO	Blue	0.83	0.05
[VV2006] J121010.8-003909	12:10:10.82	−00:39:09.7	QSO	Blue	0.07	0.06
SDSS J121026.38-000513.2	12:10:26.41	−00:05:13.2	Galaxy	Blue	0.70	0.04
SDSS J121043.55-003907.2	12:10:43.59	−00:39:08.5	Seyfert 1	Red	0.03	0.06
2QZ J121101.0+012024	12:11:01.05	01:20:25.0	EmG	Blue	0.96	0.04
Mrk 1313	12:12:14.73	00:04:20.6	Seyfert 1	Blue	0.77	0.08
2dFGRS TGN246Z007	12:12:15.90	−00:33:53.2	Galaxy	Blue	0.54	0.07
2MASS J12125978+0149231	12:12:59.78	01:49:23.2	EB*	Red	0.63	0.21
SDSS J121304.91-003901.2	12:13:04.93	−00:39:01.2	Galaxy	Red	0.06	0.64
2dFGRS TGN247Z167	12:13:38.79	−01:17:36.3	Galaxy	Blue	0.86	0.03
6dFGS gJ121348.2-143140	12:13:48.16	−14:31:39.8	Galaxy	Blue	0.62	0.06
SDSS J121435.24-015924.4	12:14:35.26	−01:59:24.4	QSO	Blue	0.86	0.09
[VV2006] J121515.2-013542	12:15:15.23	−01:35:40.8	QSO	Blue	0.57	0.04
2QZ J121539.4-022149	12:15:39.47	−02:21:47.2	Galaxy	Blue	0.78	0.05
2QZ J121607.5-022559	12:16:07.54	−02:25:57.6	Galaxy	Blue	1.00	0.00
SDSS J121759.99+002558.1	12:18:00.05	00:25:57.7	Galaxy	–	–	–
2dFGRS TGN181Z079	12:18:07.07	−03:06:28.8	Galaxy	Red	0.12	0.71
LEDA 927634	12:18:19.06	−14:12:19.9	Galaxy	Blue	0.97	0.03
LEDA 927634	12:18:19.06	−14:12:20.0	Galaxy	Blue	0.96	0.04
QSO B1216+0216	12:18:55.80	02:00:02.1	QSO	Blue	0.31	0.09
[VV2006] J121942.5-001821	12:19:42.47	−00:18:21.4	QSO	Blue	0.79	0.07
2dFGRS TGN385Z034	12:19:53.13	01:46:24.0	HII G	Blue	0.88	0.05
SDSS J122003.72+010632.0	12:20:03.73	01:06:32.4	Galaxy	Red	0.07	0.21
2dFGRS TGN385Z025	12:20:11.53	01:57:31.1	LSB G	Blue	0.54	0.13
2dFGRS TGN181Z173	12:20:28.80	−01:50:21.0	Galaxy	Blue	0.82	0.06
LEDA 1143004	12:20:30.39	−00:27:03.0	Galaxy	–	–	–
[VV2006] J122130.9+010727	12:21:30.97	01:07:28.1	QSO	Blue	0.66	0.04
Gaia DR2 3521773745637847552	12:21:34.41	−14:57:50.5	Star	Blue	0.09	0.04
LEDA 3294456	12:21:55.83	−01:35:36.0	Galaxy	Blue	0.54	0.08
Gaia DR2 3521681421020417408	12:22:39.34	−15:29:12.1	Star	Blue	0.43	0.09
SDSS J122322.39-000801.6	12:23:22.39	−00:08:01.7	Galaxy	Blue	0.69	0.03
MCG+00-32-004	12:24:12.47	00:34:01.0	Galaxy	Blue	0.96	0.04
2SLAQ J122421.12+002354.1	12:24:21.13	00:23:54.4	QSO	Blue	0.55	0.11
NGC 4385	12:25:42.74	00:34:21.9	AGN	Blue	0.60	0.04
2QZ J122547.3-012007	12:25:47.38	−01:20:05.7	Galaxy	Blue	0.72	0.03
SHOC 373a	12:26:22.64	−01:15:17.3	HII G	Blue	0.34	0.09
SHOC 373b	12:26:22.73	−01:15:12.3	HII G	Blue	0.21	0.07
[VV2006] J122625.7+011604	12:26:25.67	01:16:04.6	QSO	Blue	0.57	0.09
2SLAQ J122641.43-002005.1	12:26:41.45	−00:20:05.1	Seyfert 1	Blue	0.60	0.06
MCG+00-32-013	12:27:04.54	−00:54:21.5	GinPair	Blue	0.84	0.07
MCG+00-32-013	12:27:04.56	−00:54:22.0	GinPair	Blue	0.87	0.03
[VV2006] J122707.1+010811	12:27:07.13	01:08:11.3	QSO	Blue	0.16	0.04
[MIO2012] R1	12:27:46.07	01:36:01.5	Cl*	Blue	0.57	0.12
2dFGRS TGN387Z059	12:28:15.92	01:49:43.7	Galaxy	Blue	1.00	0.00
2QZ J122851.2-022630	12:28:51.34	−02:26:29.2	EmG	Blue	0.93	0.07
2dFGRS TGN250Z094	12:29:14.65	−01:21:55.2	Galaxy	Blue	0.51	0.08
2dFGRS TGN250Z087	12:29:46.33	−01:17:42.0	LSB G	Blue	0.76	0.15
2dFGRS TGN321Z099	12:29:58.88	00:01:37.9	RadioG	Red	0.08	0.68
2dFGRS TGN388Z078	12:30:54.31	00:57:50.5	Galaxy	Blue	0.66	0.08
[BKD2008] WR 29	12:31:48.01	−02:58:13.0	PartofG	Blue	0.80	0.03
2QZ J123202.6+003124	12:32:02.70	00:31:24.7	EmG	Blue	0.79	0.07
2dFGRS TGN251Z016	12:32:23.64	−01:44:24.3	HII G	Blue	0.77	0.03

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
GALEX 2414740977348515009	12:32:36.17	−03:18:39.4	Blue	Blue	0.57	0.05
MGC 34804	12:32:41.58	00:03:26.4	Star	Blue	0.74	0.11
[DCD2013] CSS J123702.3-151643	12:37:02.41	−15:16:43.5	RRLyr	Blue	0.90	0.01
Gaia DR2 3527007524064861312	12:39:19.45	−14:47:31.1	Star	–	–	–
2MASX J12442692-1252359	12:44:26.92	−12:52:35.9	Galaxy	Blue	1.00	0.00
LEDA 924051	12:50:47.04	−14:29:01.5	Galaxy	Blue	1.00	0.00
LEDA 932206	12:58:59.15	−13:51:42.3	Galaxy	Blue	0.52	0.08
CRTS SSS120721 J125901-133442	12:59:00.82	−13:34:42.0	Candidate CV*	Blue	0.48	0.09
6dFGS gJ125904.7-144623	12:59:04.67	−14:46:23.5	Galaxy	Blue	0.73	0.04
2MASX J12593269-1514196	12:59:32.75	−15:14:19.3	Galaxy	Blue	0.31	0.10
LEDA 914340	13:00:03.04	−15:12:17.2	Galaxy	Blue	0.98	0.02
NGC 4887	13:00:39.30	−14:39:59.3	GinPair	Blue	0.98	0.02
LEDA 936912	13:01:07.09	−13:31:02.4	Galaxy	Blue	0.33	0.09
[VV96] J130243.5-135553	13:02:43.59	−13:55:52.8	QSO	Blue	0.54	0.07
LEDA 45114	13:03:33.44	−14:19:23.1	EmObj	Blue	0.76	0.08
2MASX J13044961-1311288	13:04:49.65	−13:11:28.2	Galaxy	Blue	0.72	0.06
LCRS B130214.7-120615	13:04:52.39	−12:22:18.7	Galaxy	Blue	1.00	0.00
LEDA 949391	13:05:58.52	−12:40:08.5	Galaxy	Blue	0.62	0.07
LEDA 105081	13:10:08.77	−12:12:20.4	Galaxy	Blue	0.90	0.02
UGCA 332	13:11:58.29	−12:03:51.4	EmG	Blue	0.90	0.04
LEDA 976320	13:12:28.41	−10:35:24.4	Galaxy	Blue	0.86	0.07
LCRS B131057.8-121222	13:13:36.14	−12:28:15.2	EmObj	Blue	0.49	0.12
LEDA 126038	13:15:07.97	−12:31:05.1	Galaxy	Blue	1.00	0.00
LEDA 981336	13:17:40.89	−10:10:59.5	Galaxy	Blue	1.00	0.00
SDSS J131742.35-002015.8	13:17:42.37	−00:20:15.7	Galaxy	–	–	–
6dFGS gJ131743.9-010002	13:17:43.96	−01:00:01.1	AGN	Blue	0.08	0.04
2MASX J13192221-1509232	13:19:22.29	−15:09:23.6	Galaxy	Blue	0.96	0.04
MCG-02-34-029	13:19:42.72	−11:28:28.5	GinGroup	Blue	0.98	0.02
2SLAQ J131957.59-003446.7	13:19:57.60	−00:34:46.6	Star	Blue	0.97	0.03
QSO B1317-122	13:19:59.20	−12:29:16.8	QSO	Blue	0.46	0.09
NGC 5088	13:20:20.33	−12:34:18.1	Galaxy	Blue	0.89	0.03
SDSS J132023.46-004730.9	13:20:23.47	−00:47:30.8	QSO	–	–	–
6dFGS gJ132134.7-151056	13:21:34.68	−15:10:55.5	Galaxy	Blue	1.00	0.00
6dFGS gJ132137.8-145120	13:21:37.83	−14:51:19.7	Galaxy	Blue	0.97	0.01
2dFGRS TGN263Z056	13:22:17.11	−00:32:54.4	EmG	–	–	–
[SHM2017] J200.93368-12.05326	13:23:44.09	−12:03:11.8	RRLyr	Blue	0.96	0.03
LEDA 46982	13:25:48.67	−11:36:37.8	BlueCompG	Blue	0.06	0.03
LEDA 46982	13:25:48.68	−11:36:38.0	BlueCompG	Blue	0.06	0.03
LEDA 991902	13:26:05.10	−09:22:12.6	Galaxy	Blue	0.54	0.09
BPS CS 22889-0007	13:31:59.47	−09:53:02.6	RRLyr	Blue	0.99	0.01
NVSS J133618-072251	13:36:18.64	−07:22:51.8	Radio	Blue	0.73	0.08
LCRS B133356.3-061328	13:36:33.05	−06:28:45.2	Galaxy	Red	0.07	0.85
GALEX 2697385722761974216	13:39:09.19	−08:19:40.8	Blue	Blue	0.65	0.03
LEDA 1025584	13:41:04.99	−07:01:05.8	Galaxy	Blue	0.65	0.02
[DCD2013] CSS J134330.9-151858	13:43:31.01	−15:18:58.9	RRLyr	Blue	1.00	0.00
V* HS Vir	13:43:38.44	−08:14:03.7	CataclyV*	Blue	0.86	0.06
SN 2018evt	13:46:39.20	−09:38:36.0	SN	Blue	0.83	0.04
GALEX 2697315366902694354	13:47:49.82	−04:10:10.6	Blue	Blue	0.61	0.05
2dFGRS TGN202Z201	13:49:42.20	−02:11:59.1	Galaxy	Blue	0.74	0.03
GALEX 2699039396840082228	13:50:33.33	−12:16:42.9	Blue	Blue	0.55	0.07
6dFGS gJ135123.7-060412	13:51:23.70	−06:04:11.7	Galaxy	Blue	0.98	0.02
2dFGRS TGN202Z136	13:51:35.65	−02:33:15.0	Galaxy	Blue	0.99	0.01
SDSSCGB 287.4	13:52:03.90	−02:07:22.3	Galaxy	Blue	0.79	0.09
SDSSCGB 287.2	13:52:04.24	−02:07:48.9	Galaxy	Blue	0.65	0.07
LEDA 126156	13:54:11.29	−03:26:27.2	Galaxy	Blue	0.80	0.08
LEDA 126156	13:54:11.40	−03:26:27.0	Galaxy	Blue	0.90	0.04
QSO B1352-104	13:54:46.53	−10:41:02.6	QSO	Blue	0.41	0.06
VV 99b	13:55:33.98	−05:58:17.0	GinPair	Blue	0.87	0.07
2dFGRS TGN141Z158	13:55:37.68	−04:11:43.8	Galaxy	Blue	0.33	0.10

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
VV 100a	13:55:45.46	−06:00:15.9	Galaxy	Blue	0.74	0.07
VV 100d	13:55:46.68	−06:00:40.8	Galaxy	Blue	0.56	0.14
[VV2006] J135602.8-022624	13:56:02.79	−02:26:23.3	QSO	–	–	–
2dFGRS TGN203Z232	13:56:53.48	−02:38:52.2	Galaxy	Blue	0.62	0.05
2dFGRS TGN142Z266	13:58:08.62	−04:08:43.6	Galaxy	Blue	0.75	0.02
SDSSCGB 16922.1	13:58:41.49	−01:31:15.7	Galaxy	Red	0.28	0.36
LEDA 1020082	14:02:45.08	−07:22:25.8	Galaxy	Blue	0.52	0.08
2MASS J14265388+0525172	14:26:53.89	05:25:17.4	QSO	Blue	0.45	0.10
UGC 9252	14:27:10.82	05:07:59.3	Galaxy	Blue	1.00	0.00
[LAM2019] J1428+0500 B	14:28:55.39	05:00:21.9	Possible lensImage	Blue	0.62	0.10
GALEX 2429518413625830432	14:28:55.46	05:00:19.9	Blue	Blue	0.81	0.07
DES J142943.42+052122.7	14:29:43.44	05:21:22.9	GinCl	Red	0.37	0.42
SDSS J142958.66+044611.0	14:29:58.65	04:46:11.3	BClG	Red	0.08	0.18
LEDA 1290447	14:41:28.04	05:51:52.3	Galaxy	Blue	1.00	0.00
SDSS J145344.51+045645.8	14:53:44.52	04:56:46.0	QSO	Blue	0.71	0.03
SDSSCGB 43444.3	14:55:33.70	04:46:43.2	AGN	Red	0.38	0.38
SDSS J200143.74+004918.4	20:01:43.73	00:49:18.4	QSO	Blue	0.36	0.07
SDSS J200432.38+001041.3	20:04:32.39	00:10:41.4	low-mass*	–	–	–
[SHM2017] J302.70083-00.21773	20:10:48.20	−00:13:03.9	RRLyr	Blue	1.00	0.00
[SHM2017] J302.70083-00.21773	20:10:48.20	−00:13:03.9	RRLyr	Blue	1.00	0.00
[SSV2012] 4869177	20:22:35.51	−00:40:09.9	RRLyr	Blue	0.92	0.02
[SSV2012] 4472518	20:22:37.80	−00:02:50.5	RRLyr	Blue	0.99	0.01
UGC 11566	20:28:12.02	00:17:18.2	Galaxy	Blue	0.88	0.05
SDSS J202906.80+005453.5	20:29:06.81	00:54:53.6	QSO	Blue	0.97	0.03
2SLAQ J204340.03+002853.4	20:43:40.04	00:28:53.6	Seyfert 1	Blue	0.53	0.08
SDSS J204626.10+002337.7	20:46:26.11	00:23:37.8	QSO	Red	0.24	0.39
2SLAQ J204720.76+000007.7	20:47:20.76	00:00:07.8	CataclyV*	Blue	1.00	0.00
2SLAQ J204720.76+000007.7	20:47:20.76	00:00:07.7	CataclyV*	Blue	0.70	0.07
2SLAQ J204910.96+001557.2	20:49:10.95	00:15:57.5	Seyfert 1	Blue	0.41	0.07
[VV2006] J204956.6-001201	20:49:56.62	−00:12:01.7	QSO	Blue	0.46	0.09
[VV2006] J204956.6-001201	20:49:56.62	−00:12:01.7	QSO	Blue	0.53	0.08
[VV2006] J205316.7+005920	20:53:16.77	00:59:21.1	QSO	–	–	–
2SLAQ J205352.03-001601.5	20:53:52.04	−00:16:01.5	QSO	Blue	0.68	0.11
2SLAQ J205614.55-004050.9	20:56:14.55	−00:40:50.6	Star	–	–	–
2SLAQ J205712.69+001211.3	20:57:12.69	00:12:11.4	QSO	Blue	0.50	0.11
SDSS J205740.76+005418.5	20:57:40.75	00:54:19.0	QSO	Red	0.13	0.68
Gaia DR2 6794425304909258752	20:58:06.45	−30:08:18.1	Candidate WD*	Blue	0.40	0.07
LEDA 687146	20:58:24.54	−32:43:22.5	Galaxy	Blue	1.00	0.00
2MASX J20584976-4420243	20:58:49.69	−44:20:24.7	Galaxy	Blue	0.98	0.02
6dFGS gJ205957.5-213935	20:59:57.53	−21:39:34.9	Galaxy	Blue	0.72	0.06
SDSS J210014.12+004446.0	21:00:14.11	00:44:45.9	CataclyV*	Blue	0.57	0.10
SDSSCGB 52599.6	21:01:55.95	−00:31:24.9	Galaxy	Red	0.15	0.64
LEDA 598660	21:01:56.43	−39:23:40.3	Galaxy	Blue	0.70	0.03
QSO B2059-330	21:02:41.71	−32:52:44.1	QSO	Blue	0.76	0.07
QSO B2059-330	21:02:41.72	−32:52:44.4	QSO	Blue	0.98	0.02
LEDA 528866	21:03:02.23	−45:14:41.1	Galaxy	Blue	0.88	0.04
Gaia DR2 6808104805812408064	21:03:56.66	−21:47:27.1	Star	Blue	0.89	0.03
ESO 286-33	21:04:08.52	−43:32:03.2	IG	Blue	0.68	0.05
ESO 286-35	21:04:11.17	−43:35:33.8	GinGroup	Blue	0.58	0.15
LEDA 720203	21:04:21.46	−30:11:50.0	Galaxy	Red	0.06	0.19
[GPM2009] J2104-0035 1	21:04:55.31	−00:35:21.8	EmG	Blue	0.75	0.15
LEDA 520361	21:05:20.69	−45:59:19.3	Galaxy	Blue	0.63	0.06
ESO 286-44	21:05:38.68	−42:46:52.4	Galaxy	Blue	0.71	0.13
PN G006.0-41.9	21:05:53.57	−37:08:40.4	PN	Blue	0.04	0.02
EC 21035-4032	21:06:48.02	−40:20:03.7	Star	Blue	0.38	0.11
2MASX J21071198-4733258	21:07:11.98	−47:33:25.2	GinPair	Blue	0.94	0.01
2MASX J21071385-4733258	21:07:13.86	−47:33:25.3	GinPair	Blue	1.00	0.00
[GPM2009] J2112-0016 2	21:12:00.92	−00:16:49.2	EmG	Blue	0.97	0.03
6dFGS gJ211224.6-412854	21:12:24.59	−41:28:53.3	AGN	Blue	0.66	0.05

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
CRTS J211328.1+000332	21:13:28.17	00:03:32.6	EB*	Blue	1.00	0.00
ESO 402-20	21:15:19.13	−33:13:34.6	Galaxy	Blue	0.93	0.07
CTCV J2118-3412	21:18:04.28	−34:13:43.5	CatacylV*	Blue	0.53	0.06
AT20G J212302-291504	21:23:02.82	−29:15:04.0	Radio(cm)	Blue	0.52	0.08
CRTS CSS120613 J212655-012054	21:26:54.54	−01:20:54.1	Candidate CV*	Blue	0.32	0.06
LEDA 710984	21:27:08.26	−30:57:08.4	Galaxy	Blue	1.00	0.00
2SLAQ J212954.20-010323.3	21:29:54.22	−01:03:23.3	EmG	Blue	0.70	0.03
LBQS 2128-4555	21:31:29.53	−45:41:50.5	QSO	Blue	0.63	0.07
2SLAQ J213242.28-010309.0	21:32:42.29	−01:03:09.2	Galaxy	Blue	0.87	0.05
2SLAQ J213245.24+000146.4	21:32:45.26	00:01:46.8	Seyfert 1	Blue	0.28	0.07
2MASS J21333817+0126291	21:33:38.14	01:26:29.0	QSO	Blue	0.97	0.03
SDSS J213455.08+001056.9	21:34:55.09	00:10:56.8	QSO	Blue	0.76	0.03
WISEA J213649.75-012852.2	21:36:49.75	−01:28:52.2	QSO	Blue	1.00	0.00
QSO B2134-453	21:38:07.49	−45:08:18.0	QSO	–	–	–
2MASS J21381896+0112224	21:38:18.96	01:12:22.5	Seyfert 1	Blue	0.44	0.10
CRTS J213937.6-023913	21:39:37.58	−02:39:13.0	Candidate CV*	Blue	0.36	0.08
2SLAQ J214106.46+004733.3	21:41:06.44	00:47:33.5	QSO	Blue	0.45	0.08
SDSSCGB 15831.2	21:41:42.73	00:45:34.9	Galaxy	Blue	0.91	0.02
SDSS J214155.04-011734.3	21:41:55.04	−01:17:34.2	QSO	Blue	1.00	0.00
SDSS J214155.04-011734.3	21:41:55.04	−01:17:34.3	QSO	Blue	0.47	0.06
SN 2017hxv	21:44:22.94	−29:54:59.0	SN	Red	0.12	0.19
2SLAQ J214455.94+002305.8	21:44:55.92	00:23:06.1	EmG	Blue	0.86	0.05
6dFGS gJ214540.0-291937	21:45:40.01	−29:19:36.9	Galaxy	Red	0.17	0.22
2SLAQ J214830.60-004752.6	21:48:30.61	−00:47:52.6	EmG	Blue	0.90	0.03
2SLAQ J214830.60-004752.6	21:48:30.61	−00:47:52.5	EmG	–	–	–
SDSS J215002.69+011343.8	21:50:02.70	01:13:43.8	QSO	Blue	0.98	0.02
2SLAQ J215010.52-001000.6	21:50:10.53	−00:10:00.6	QSO	Blue	0.48	0.10
2dFGRS TGS406Z223	21:53:05.55	−31:28:17.9	Galaxy	Blue	0.54	0.09
2dFGRS TGS406Z223	21:53:05.55	−31:28:17.9	Galaxy	Blue	0.54	0.09
2dFGRS TGS406Z223	21:53:05.55	−31:28:17.9	Galaxy	Blue	0.54	0.09
2dFGRS TGS406Z223	21:53:05.55	−31:28:17.9	Galaxy	Blue	0.54	0.09
2MASX J21541799+0056318	21:54:18.00	00:56:31.9	Galaxy	Blue	1.00	0.00
LEDA 214792	21:56:13.83	−01:09:42.8	Galaxy	Blue	0.85	0.03
LEDA 214792	21:56:13.85	−01:09:43.2	Galaxy	Blue	0.97	0.03
SDSSCGB 16345.1	21:56:19.79	−01:10:03.6	Galaxy	Blue	0.78	0.12
SDSSCGB 16345.1	21:56:19.81	−01:10:03.7	Galaxy	Blue	0.79	0.12
2dFGRS TGS059Z257	21:57:20.89	−25:08:02.4	Galaxy	Blue	0.96	0.04
SDSS J215824.23-004413.7	21:58:24.28	−00:44:13.7	HII G	Blue	0.94	0.03
SDSS J215902.90-003318.4	21:59:02.89	−00:33:18.0	Galaxy	Blue	0.73	0.08
LEDA 214793	21:59:03.11	−01:57:18.3	Galaxy	Blue	0.66	0.05
LEDA 1136721	22:01:50.08	−00:42:26.7	Galaxy	Blue	0.96	0.04
2dFGRS TGS114Z230	22:02:07.08	−26:26:38.0	Galaxy	Blue	0.59	0.11
PB 5049	22:03:15.14	01:17:21.0	Star	Blue	0.06	0.03
2dFGRS TGS115Z105	22:04:53.68	−25:03:05.2	Galaxy	Blue	0.97	0.03
2SLAQ J220529.34-003110.6	22:05:29.34	−00:31:10.7	QSO	Blue	0.66	0.05
NGC 7204	22:06:55.31	−31:03:10.6	IG	Red	0.25	0.29
2dFGRS TGS251Z159	22:07:34.55	−28:39:29.3	Galaxy	Blue	0.58	0.14
NGC 7208	22:08:24.43	−29:03:03.6	GinGroup	Blue	0.96	0.04
2dFGRS TGS333Z140	22:08:51.96	−30:38:58.8	Galaxy	–	–	–
[VV2006] J220852.0-010603	22:08:51.97	−01:06:03.7	QSO	Blue	0.46	0.09
[VV2006] J220852.0-010603	22:08:51.97	−01:06:03.7	QSO	Blue	0.48	0.08
MCG-05-52-033a	22:08:55.90	−27:13:22.0	GinPair	Blue	0.78	0.06
2dFGRS TGS061Z180	22:09:19.05	−24:07:12.4	QSO	Red	0.16	0.17
2dFGRS TGS116Z088	22:09:22.91	−25:25:04.6	Galaxy	Blue	0.58	0.08
2QZ J220948.6-301357	22:09:48.63	−30:13:55.8	WD*	Blue	0.21	0.08
SDSSCGB 41857.2	22:09:51.35	01:09:00.0	Galaxy	Red	0.38	0.38
SDSS J220954.57-012717.6	22:09:54.57	−01:27:17.6	QSO	Blue	0.57	0.03
2QZ J221000.7-311400	22:10:00.75	−31:14:00.0	EmG	Blue	0.63	0.05
2dFGRS TGS116Z082	22:10:03.74	−25:20:07.3	Galaxy	Blue	0.99	0.01

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2QZ J221005.7-275439	22:10:05.76	−27:54:38.7	Galaxy	Blue	0.95	0.03
6dFGS gJ221058.1-250431	22:10:58.01	−25:04:31.1	Galaxy	Blue	0.78	0.03
2QZ J221058.3-273930	22:10:58.33	−27:39:29.4	Galaxy	Blue	0.81	0.07
LSQ 12dwl	22:12:41.57	00:30:43.1	SN	Blue	0.51	0.10
[VV2006] J221335.7-282542	22:13:35.65	−28:25:41.7	QSO	Blue	0.41	0.08
2dFGRS TGS175Z009	22:14:02.86	−27:32:21.4	Galaxy	Blue	1.00	0.00
2dFGRS TGS175Z009	22:14:02.88	−27:32:21.5	Galaxy	Blue	0.96	0.04
NGC 7229	22:14:03.23	−29:22:57.8	EmG	Blue	0.77	0.05
2dFGRS TGS254Z244	22:14:05.10	−29:22:52.9	Galaxy	Blue	0.97	0.03
ESO 467-25	22:14:24.23	−29:58:51.5	EmG	Blue	0.74	0.03
2dFGRS TGS254Z138	22:14:41.93	−28:26:39.6	Galaxy	Blue	1.00	0.00
2dFGRS TGS334Z074	22:14:47.16	−29:41:12.4	Galaxy	Blue	0.76	0.02
2QZ J221517.1-285358	22:15:17.10	−28:53:57.5	EmG	Blue	0.74	0.07
[VV2006] J221532.6-281805	22:15:32.58	−28:18:03.9	QSO	Blue	0.67	0.04
2QZ J221630.0-290054	22:16:30.07	−29:00:53.3	EmG	Red	0.18	0.09
6dFGS gJ221706.5-303447	22:17:06.52	−30:34:46.1	Galaxy	Red	0.34	0.24
[VV2006] J221722.5+010436	22:17:22.44	01:04:36.3	QSO	Blue	0.10	0.05
2dFGRS TGS176Z011	22:17:41.15	−27:21:54.6	Galaxy	Blue	0.76	0.03
SDSS J221813.90+001625.1	22:18:13.91	00:16:25.3	Galaxy	–	–	–
2MASX J22181503+0115169	22:18:15.03	01:15:16.9	Galaxy	Blue	0.80	0.04
SDSS J221817.26+003623.6	22:18:17.26	00:36:23.7	AGN	Red	0.08	0.20
2QZ J221819.4-271544	22:18:19.39	−27:15:44.2	Seyfert 1	Blue	0.44	0.09
2SLAQ J221846.76-011119.0	22:18:46.74	−01:11:18.8	Galaxy	Blue	0.77	0.03
2SLAQ J221846.76-011119.0	22:18:46.74	−01:11:18.8	Galaxy	Blue	0.84	0.03
SDSS J221852.63-010310.1	22:18:52.65	−01:03:10.5	Galaxy	Blue	0.69	0.11
2QZ J221925.9-305108	22:19:25.92	−30:51:07.7	EmG	Blue	0.66	0.04
SDSSCGB 28259.2	22:19:44.75	−00:14:40.0	Galaxy	Red	0.21	0.38
2QZ J221945.1-293414	22:19:45.08	−29:34:13.4	EmG	Blue	0.97	0.03
[DD2013] W4+2-1 115196	22:19:53.86	00:29:04.8	Galaxy	Blue	0.61	0.11
2SLAQ J222021.37+004040.2	22:20:21.36	00:40:40.5	Star	Blue	0.57	0.06
2QZ J222113.6-280421	22:21:13.62	−28:04:20.9	Seyfert 1	Red	0.27	0.18
2dFGRS TGS337Z130	22:22:54.92	−30:42:28.4	Galaxy	Blue	0.94	0.02
6dFGS gJ222313.7-285844	22:23:13.70	−28:58:44.6	Galaxy	Blue	0.45	0.11
2SLAQ J222332.83-010614.8	22:23:32.84	−01:06:14.8	QSO	Blue	0.52	0.06
2QZ J222336.0-283140	22:23:36.03	−28:31:39.6	EmG	Blue	0.82	0.07
2SLAQ J222403.36-005724.2	22:24:03.35	−00:57:24.2	QSO	Blue	0.56	0.11
2SLAQ J222403.36-005724.2	22:24:03.36	−00:57:24.1	QSO	Blue	0.48	0.11
2QZ J222416.2-292421	22:24:16.26	−29:24:21.7	Candidate CV*	Blue	0.59	0.11
2dFGRS TGS338Z083	22:27:38.90	−31:08:10.3	Galaxy	Blue	0.80	0.06
2SLAQ J222825.11-002217.4	22:28:25.12	−00:22:17.2	Galaxy	Red	0.51	0.18
LEDA 711478	22:28:47.80	−30:54:43.2	Galaxy	Blue	0.41	0.12
LEDA 711478	22:28:47.82	−30:54:43.2	Galaxy	Blue	0.43	0.11
2dFGRS TGS337Z266	22:28:53.67	−30:58:51.4	Galaxy	Blue	0.85	0.05
2dFGRS TGS337Z266	22:28:53.67	−30:58:51.4	Galaxy	Blue	0.80	0.03
SDSS J222923.00-020042.7	22:29:23.00	−02:00:42.4	QSO	–	–	–
2SLAQ J222956.53+003126.5	22:29:56.54	00:31:26.5	QSO	Blue	0.45	0.07
2dFGRS TGS338Z165	22:30:01.84	−29:35:52.7	Galaxy	Blue	0.83	0.02
2dFGRS TGS338Z165	22:30:01.85	−29:35:52.6	Galaxy	Blue	0.80	0.05
NAME Kinman Dwarf	22:30:36.83	−00:06:35.8	BlueCompG	Blue	0.58	0.14
LEDA 1149494	22:31:06.00	−00:11:43.9	Galaxy	Blue	1.00	0.00
2QZ J223114.0-312005	22:31:13.95	−31:20:04.4	Star	Blue	0.77	0.08
[VV2006] J223251.7-303250	22:32:51.74	−30:32:49.6	QSO	Blue	0.31	0.07
2QZ J223342.5-301936	22:33:42.56	−30:19:35.4	Galaxy	Blue	0.80	0.06
2MASS J22340663+0001199	22:34:06.67	00:01:20.8	Star	Red	0.06	0.20
FASTT 1560	22:34:39.93	00:41:27.5	CataclyV*	Blue	0.54	0.07
2dFGRS TGS414Z208	22:34:56.56	−31:08:44.1	Galaxy	Blue	1.00	0.00
2dFGRS TGS414Z208	22:34:56.57	−31:08:44.1	Galaxy	Blue	1.00	0.00
SDSS J223508.41-005359.3	22:35:08.42	−00:53:59.4	Seyfert 2	Red	0.26	0.32
SDSS J223508.41-005359.3	22:35:08.43	−00:53:59.4	Seyfert 2	Red	0.33	0.61

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
2QZ J223532.2-294634	22:35:32.24	−29:46:33.0	EmG	Blue	0.82	0.03
2SLAQ J223543.05-005436.5	22:35:43.04	−00:54:36.6	Galaxy	Blue	0.81	0.11
2SLAQ J223543.05-005436.5	22:35:43.05	−00:54:36.6	Galaxy	Blue	0.67	0.02
2SLAQ J223543.05-005436.5	22:35:43.06	−00:54:36.4	Galaxy	Blue	0.50	0.07
SDSS J223543.94-003931.4	22:35:43.93	−00:39:32.1	low-mass*	Red	0.15	0.18
[EKS96] NGC 7314 28	22:35:44.87	−26:02:27.4	HII	Blue	0.84	0.05
[EKS96] NGC 7314 43	22:35:45.40	−26:02:10.8	HII	Blue	0.68	0.02
[EKS96] NGC 7314 71	22:35:46.29	−26:04:29.1	HII	Blue	0.80	0.09
[EKS96] NGC 7314 130	22:35:48.23	−26:01:24.0	HII	Blue	0.91	0.07
[VV2006] J223633.5+002652	22:36:33.54	00:26:52.8	QSO	Blue	0.69	0.07
SDSS J223649.60+005413.5	22:36:49.60	00:54:13.8	QSO	–	–	–
2SLAQ J223723.84-010120.3	22:37:23.88	−01:01:19.2	Galaxy	Blue	0.97	0.03
SDSS J223729.86-010549.1	22:37:29.86	−01:05:49.3	HB*	–	–	–
PHL 354	22:38:23.25	−00:57:08.2	QSO	Blue	0.34	0.06
PHL 354	22:38:23.26	−00:57:08.1	QSO	Blue	0.43	0.08
2SLAQ J223844.30-005655.3	22:38:44.29	−00:56:55.3	QSO	Blue	0.53	0.08
LEDA 131686	22:41:19.49	−39:58:23.3	Galaxy	Blue	0.72	0.05
2QZ J224149.5-301945	22:41:49.50	−30:19:44.5	Galaxy	Blue	0.66	0.08
[GDB2008] 503	22:43:16.38	−39:51:39.9	Galaxy	Blue	0.80	0.05
[GDB2008] 504	22:43:19.40	−39:52:44.4	Galaxy	Blue	0.49	0.13
[GDB2008] 509	22:43:25.11	−39:55:20.0	Galaxy	Red	0.11	0.88
SDSS J224352.11-002259.7	22:43:52.21	−00:22:59.9	Galaxy	Blue	0.97	0.03
2SLAQ J224531.20-004509.4	22:45:31.20	−00:45:09.4	QSO	Blue	0.58	0.05
2SLAQ J224531.20-004509.4	22:45:31.20	−00:45:09.3	QSO	Blue	0.31	0.06
SDSS J224539.94-002419.7	22:45:39.94	−00:24:19.6	QSO	Blue	0.98	0.02
2MASS J22495608+0002182	22:49:56.08	00:02:18.4	QSO	Blue	0.88	0.07
2SLAQ J225012.91-003959.0	22:50:12.92	−00:39:58.9	Galaxy	Blue	0.78	0.08
SDSS J225149.74-002811.7	22:51:49.75	−00:28:11.4	QSO	Blue	0.97	0.03
2QZ J225157.1-292451	22:51:57.10	−29:24:50.8	EmG	Blue	0.39	0.06
2SLAQ J225257.45+002731.5	22:52:57.44	00:27:31.6	Star	Blue	0.59	0.12
2QZ J225352.9-300944	22:53:52.96	−30:09:43.7	Seyfert 1	Blue	0.26	0.09
[VV2006] J225411.2-312712	22:54:11.15	−31:27:11.3	QSO	Blue	0.71	0.04
SDSS J225411.96-004949.5	22:54:11.96	−00:49:49.4	QSO	Blue	0.50	0.06
SDSS J225411.96-004949.5	22:54:11.96	−00:49:49.3	QSO	Blue	0.99	0.01
2QZ J225503.9-301914	22:55:03.89	−30:19:13.3	EmG	Blue	0.99	0.01
2QZ J225908.1-312717	22:59:08.12	−31:27:16.7	Star	Blue	0.30	0.07
2SLAQ J230030.09-003005.9	23:00:30.09	−00:30:05.8	Galaxy	Blue	0.61	0.07
2SLAQ J230201.20+003047.2	23:02:01.20	00:30:47.3	QSO	Blue	0.63	0.05
[VV2006] J230235.5-285630	23:02:35.44	−28:56:29.7	QSO	Blue	0.60	0.07
2SLAQ J230316.40-001211.5	23:03:16.41	−00:12:11.4	QSO	Blue	0.60	0.08
V* HY Psc	23:03:51.63	01:06:51.4	CataclyV*	Blue	0.67	0.07
SDSS J230428.31+005701.2	23:04:28.34	00:57:01.2	QSO	Blue	0.56	0.11
2SLAQ J230444.16-010251.7	23:04:44.16	−01:02:51.5	QSO	Blue	0.44	0.08
LEDA 1122038	23:08:10.78	−01:17:58.5	Galaxy	Blue	0.74	0.06
SDSS J230855.49+003705.6	23:08:55.49	00:37:05.7	QSO	Blue	1.00	0.00
ESO 469-15	23:08:55.60	−30:51:28.2	GinGroup	Blue	0.73	0.14
[VV2006] J230914.4-305913	23:09:14.31	−30:59:12.5	QSO	Blue	0.61	0.05
2MASS J23094616+0000496	23:09:46.15	00:00:49.1	Seyfert 1	Blue	0.61	0.10
2MASS J23094616+0000496	23:09:46.16	00:00:49.0	Seyfert 1	Blue	0.65	0.11
[GPM2009] J2310-0109 2	23:10:41.99	−01:09:48.0	EmG	Blue	0.78	0.07
[VV2006] J231135.1-312644	23:11:35.12	−31:26:44.1	QSO	Blue	0.58	0.04
2dFGRS TGS422Z155	23:12:08.96	−31:04:13.3	Galaxy	Red	0.43	0.21
2SLAQ J231231.36-011137.5	23:12:31.36	−01:11:37.3	QSO	Blue	0.71	0.05
SDSS J231259.07+010805.6	23:12:59.06	01:08:05.9	QSO	Blue	0.84	0.04
[VV2006] J231311.9-004538	23:13:11.91	−00:45:38.0	QSO	Blue	0.54	0.04
SDSS J231351.87-011031.9	23:13:51.86	−01:10:30.8	HII G	Blue	0.84	0.08
2MASX J23145046+0123280	23:14:50.52	01:23:26.7	LSB G	Blue	1.00	0.00
[VV2006] J231519.4-303857	23:15:19.39	−30:38:57.2	QSO	Blue	0.81	0.05
V* CC Scl	23:15:31.78	−30:48:48.7	CataclyV*	Blue	0.70	0.10

Table B1: –continued

Id Object	RA	Dec	Type	Group – HAC	P(Blue) – HDBSCAN	P(Red) – HDBSCAN
[VV2006] J231652.0+005125	23:16:52.04	00:51:25.9	QSO	Blue	0.80	0.03
3XMM J231742.5+000535	23:17:42.61	00:05:35.3	Seyfert 1	Blue	0.56	0.06
[VV2006] J231942.8-302629	23:19:42.76	−30:26:29.5	QSO	Blue	0.83	0.08
LEDA 71137	23:20:35.21	−00:52:50.9	Galaxy	Blue	0.64	0.08
LEDA 71137	23:20:35.22	−00:52:50.8	Galaxy	Blue	0.56	0.08
2QZ J232126.5-310730	23:21:26.51	−31:07:29.5	Galaxy	Blue	1.00	0.00
[SIG2010] 389821	23:23:31.32	01:08:06.0	RRLyr	Blue	0.86	0.02
GALEX 2417063145906373262	23:24:20.34	−00:06:25.0	HII	Blue	0.10	0.04
[GPM2009] J2324-0006	23:24:21.37	−00:06:29.4	HII G	Blue	0.24	0.08
2SLAQ J232457.75+002153.2	23:24:57.75	00:21:53.4	QSO	Blue	0.20	0.07
2SLAQ J232524.40+004612.0	23:25:24.43	00:46:12.2	Galaxy	Blue	0.87	0.06
2MASS J23255145-0140232	23:25:51.48	−01:40:23.8	CataclyV*	Blue	0.33	0.10
[VV2006c] J232555.5-003710	23:25:55.51	−00:37:10.7	Seyfert 1	–	–	–
SDSS J232743.68-020055.8	23:27:43.70	−02:00:55.7	BlueCompG	Blue	0.13	0.05
6dFGS gJ232744.4-020047	23:27:44.38	−02:00:46.8	Galaxy	Blue	0.10	0.04
LEDA 1127711	23:28:12.30	−01:03:44.8	HII G	Blue	0.79	0.06
GD 1662	23:29:00.44	−29:46:46.0	CataclyV*	Blue	0.55	0.08
SDSS J233104.38-004237.2	23:31:04.40	−00:42:37.1	QSO	Red	0.53	0.09
2MASS J23315973-0048192	23:31:59.77	−00:48:18.5	Galaxy	Blue	0.99	0.01
2QZ J233254.8-305844	23:32:54.78	−30:58:43.8	EmG	Blue	0.58	0.07
SDSS J233256.68+011122.9	23:32:56.68	01:11:23.1	BClG	–	–	–
SDSS J233300.21-002030.5	23:33:00.22	−00:20:30.5	QSO	Blue	0.95	0.05
[VV2006] J233438.5+002341	23:34:38.55	00:23:41.9	QSO	Blue	0.46	0.07
2MASX J23352102+0110271	23:35:20.98	01:10:27.4	Galaxy	Red	0.45	0.31
2SLAQ J233522.69-000635.2	23:35:22.69	−00:06:35.2	QSO	Blue	0.53	0.07
LEDA 135900	23:36:46.97	00:37:23.8	LSB G	Blue	0.99	0.01
[VV2006] J233722.0+002239	23:37:22.02	00:22:39.2	QSO	Blue	0.46	0.06
2XMM J233731.7+002559	23:37:31.79	00:25:59.9	AGN	Blue	0.72	0.13
DES J233747.57+001742.6	23:37:47.57	00:17:42.8	GinCl	–	–	–
RESOLVE rf772	23:40:38.43	−00:53:30.6	Galaxy	Blue	0.66	0.07
[VV2006] J234329.1-300200	23:43:29.16	−30:02:00.1	QSO	Blue	0.53	0.07
2SLAQ J234440.53-001205.8	23:44:40.53	−00:12:06.1	CataclyV*	Blue	0.40	0.06
LEDA 1109937	23:48:23.99	−01:47:31.1	Galaxy	Blue	1.00	0.00
2dFGRS TGS356Z227	23:50:01.55	−30:11:07.1	Galaxy	Blue	0.63	0.07
2SLAQ J235115.66-000000.0	23:51:15.66	−00:00:00.0	Galaxy	Blue	0.23	0.05
2SLAQ J235115.66-000000.0	23:51:15.68	−00:00:00.2	Galaxy	Blue	0.55	0.08
[VV2006] J235546.2-002342	23:55:46.14	−00:23:42.8	QSO	Blue	0.99	0.01
[VV2006] J235718.4+004350	23:57:18.37	00:43:50.5	QSO	Red	0.04	0.10
SDSS J235805.25-012153.9	23:58:05.25	−01:21:53.9	QSO	Blue	0.63	0.04

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