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EVOLUTIONARY EFFECTS ON BRIGHTEST CLUSTER GALAXY (BCG) DETECTIONS IN THE CFHTLS-DEEP FIELDS

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Abstract. Brightest cluster galaxies (BCGs) are the most massive and most luminous galaxies in the universe. These galaxies dominate galaxy clusters and lie at the top of the potential well of clusters. Investigating these galaxies can improve our understandings on galaxy cluster evolution. In this work, evolutionary effects on BCG detections are emphasized. For detecting BCGs, CFHTLS (Canada-France-Hawaii Telescope Legacy Survey) galaxy clusters, detected by Olsen et al. (2007) were used. To make a proper BCG detection, modeled galaxy colors should be evolved according to redshift. In this work, it is shown how unevolved galaxy colors can effect BCG detection.

1. BRIGHTEST CLUSTER GALAXIES

The central galaxies of galaxy clusters are mainly gigantic elliptical galaxies. These central dominated galaxies are called Brightest Cluster Galaxies (BCGs) because they are the brightest galaxies in the cluster and in the universe (Nelson et al. 2002). Due to their central location in galaxy clusters, BCGs are expected to cannibalize other cluster galaxies during the evolution of cluster.

2. CANADA-FRANCE-HAWAII TELESCOPE LEGACY SURVEY

Canada-France-Hawaii Telescope Legacy Survey (CFHTLS) is a major program consisted of three sub-programs (Deep, Wide, Very Wide). CFHTLS-Deep is the deepest survey project so far. Magnitude limit reached with CFHTLS is i=28. With this deepness, galaxy clusters up to z=1.5 can be studied which is very important for the observational cosmology studies. Observations are expected to end in mid-2009.

There are four Deep-fields in the Deep survey. These fields are being observed several times so the survey becomes continuously deeper and deeper. All the images are collected and reduced by Terapix-IAP in Paris. Object catalogues are also extracted from images and distributed over the community via Canadian Astronomy Data Center (CADC).

Within CFHTLS, *ugriz* filter set is used. A big mosaic camera, called MegaCam, is dedicated to the survey. It consists of 36 CCDs and has $1^\circ \times 1^\circ$ field of view at the prime focus of the 3.6 m Canada-France-Hawaii Telescope at Mauna Kea, Hawaii.

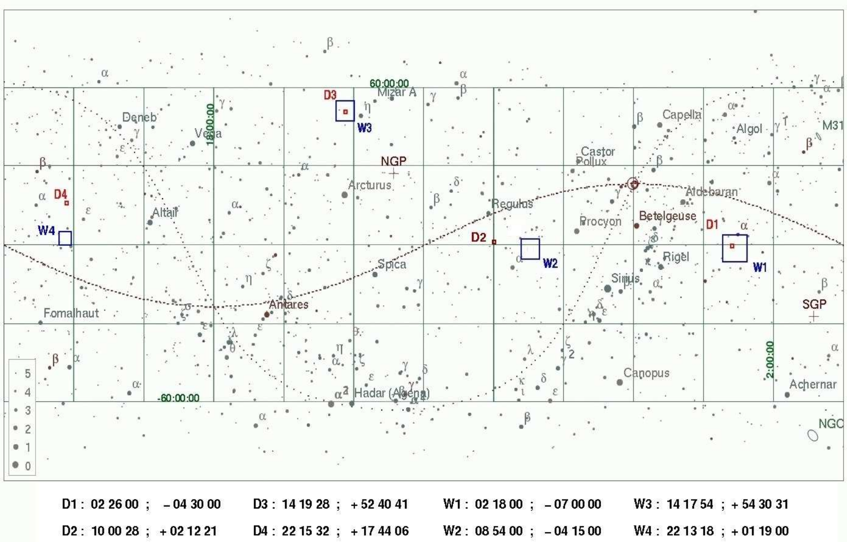

Figure 1: CFHTLS Deep and Wide fields.

3. DETECTING BCGs

To study BCGs, one first needs to detect these galaxies in an automatic way. Since the CFHTLS is a quite big survey it produces big amounts of data and images. Therefore a detection procedure has to be carried out in an automatic way. For this purpose, a Fortran program and a script were written.

To make a proper detection, some criteria should be applied to the galaxy catalogues extracted by SExtractor (Bertin and Arnouts 1996). These criteria are the following: i) distance to the cluster center, ii) i band magnitude, iii) photometric redshift, iv) color (evolution).

After several tests it is revealed that a combination of these criteria should be applied. Applying only one or two may lead to a false detection.

Since BCGs are elliptical galaxies, some galaxy models can be used to determine magnitude and color as a function of redshift. Photometric redshifts are also computed in a similar way. Within the CFHTLS the photometric redshifts are also distributed to the community from Terapix.

The main problem here is the modelling of elliptical galaxies as a function of redshift. Current spectral synthesis codes are very good at the rest frame but for evolved galaxies they have some problems. These deficiencies in the codes easily lead to false detections of BCGs. Although the codes have some problems with quite evolved galaxies, without color information deduced from those codes it would be more difficult to make a proper detection. This is the main conclusion of one work, i.e. one should use all these four criteria together.

Three of the several false detections, that occured when evolution was not taken into account, are shown in Fig. 2, Fig. 3 and Fig. 4. Generally when the evolution is not taken into account the BCG detection procedure converges to a spiral galaxy, but in Fig. 4 it can be seen that sometimes false detection can be an elliptical galaxy.

It shows again that, without other criteria mentioned above it would be difficult to detect the brightest cluster galaxies.

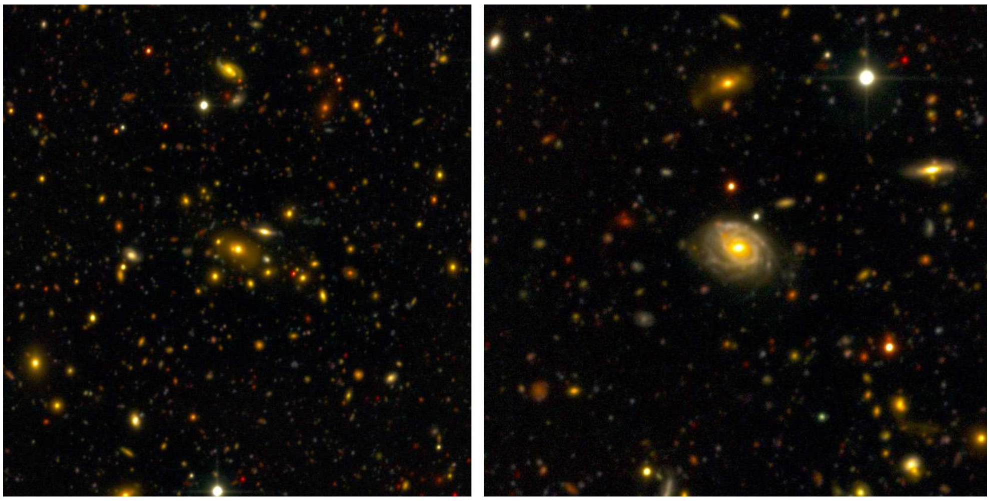

Figure 2: An example for false detection in the galaxy cluster $CL - CFHLS - J141830 + 530835\_0.3$. Left-side image is the proper detection obtained using four criteria mentioned above. Right-side image is the false detection.

Figure 3: Same as with Fig. 2 but for the galaxy cluster $CL - CFHLS - J022508 - 040118\_0.4$.

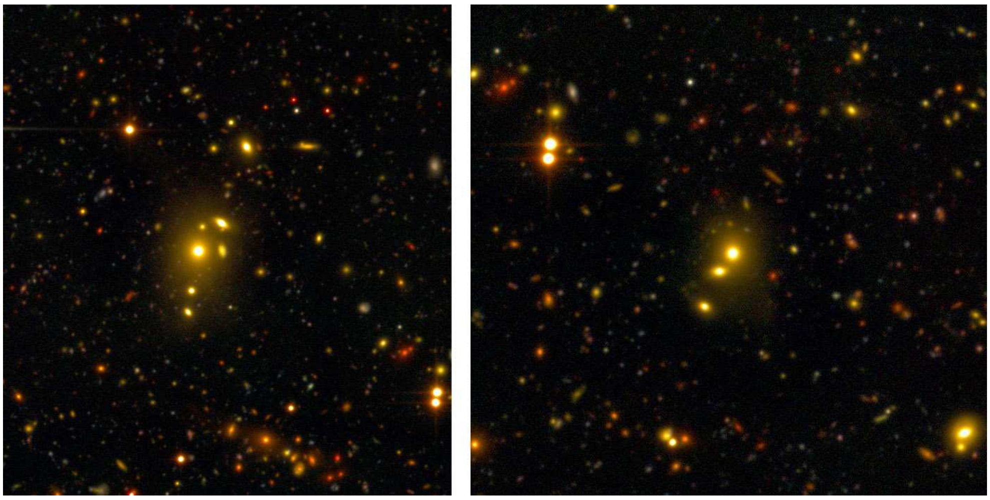

Figure 4: Same as with Fig. 2 but for the galaxy cluster $CL - CFHLS - J022531 - 041422\_0.3$.

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