RevMexAA (Serie de Conferencias), **24**, 249–250 (2005)

SEARCHING FOR HIGH REDSHIFT CLUSTERS

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Distant clusters of galaxies provide a powerful method to study the formation and evolution of galaxies, and large scale structure of the Universe. However, the number of known clusters at high redshift ($z > 0.5$) is still very reduced. As a preparatory work for detailed studies with GTC, we are searching for high redshift clusters in public wide optical surveys. We will complement this with near IR observations in 4 m-class telescopes. Here, we present some preliminary results. In a field of 35×35 arcmin^2 we have detected 8 clusters of galaxies at redshift $z > 0.5$.

Introduction

The study of high redshift clusters ($z > 0.5$) is an important tool to understand both galaxy and cluster formation and evolution. For instance its number and distribution in mass and redshift allow to discriminate between different cosmological scenarios. Fig. 1 presents the expected density of clusters for a standard cosmological lambda cold dark matter model. Although the number of known high redshift clusters has increased in the last years, this number is still reduced and makes difficult statistical studies. The detection of representative numbers ($\sim 50-100$) of such clusters would require the analysis of deep images covering several square degrees. Appropriate surveys in the optical exist now and will be available in the near future at near infrared wavelengths. In this contribution, we summarize our work in this area, and presents the analysis of a region of the sky 35×35 arcmin^2 in several optical filters in which we have detected 8 candidates to be clusters of galaxies at $z > 0.5$. Additional details are given in Gutiérrez & Juncosa, this volumen.

Data

We are analyzing the NOAO Deep Survey (http://www.noao.edu/noao/noaodeep/) and the Deep Lens Survey (http://dls.bell-labs.com/). The NOAO Deep Survey covers an area of 18 square degrees in the B_w, R, I, J, H, K filters with 5σ limiting magnitude $R \sim 25$ mag. So far, 1 square degree in the optical have been released. The Deep Lens Survey has an area of 27 square degrees (6 of them are public now), in the B, V, R and z' filters (some fields have been observed also in the I band). The limiting magnitude is $R \sim 26.5$ mag.

Analysis and results

The results presented here have been obtained determining the photometric redshifts [5] and looking for overdensities in the (RA, $Dec.$, $redshift$) space. So far, we have analyzed a region of 35×35 arcmin^2 in which we have found several candidates to be high redshift clusters. Fig. 2 shows the field analyzed and the positions of the cluster candidates at $z > 0.5$. A list with the estimated redshifts, number of members detected and the significance of each cluster candidate is presented in Table 1. The color-magnitude ($V-I$ *vs.* I) diagram and the distribution in redshift in one of the regions in which a cluster candidate is present are shown in Figs. 3 and 4 respectively.

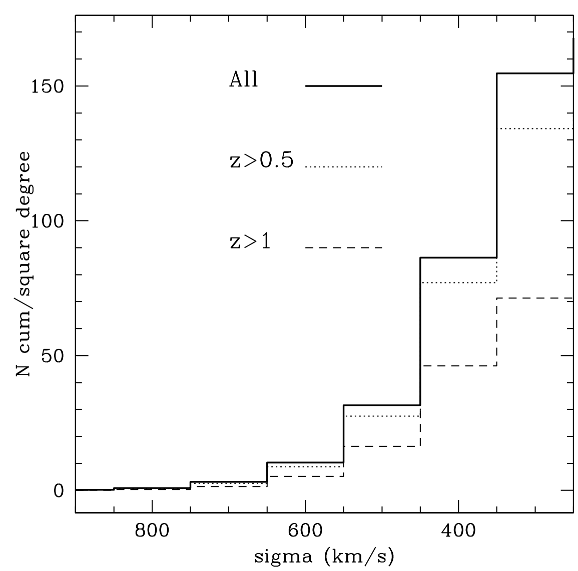

Fig. 1. Expected density of clusters and galaxy groups as a function of the velociy dispersion (or equivalently mass). The diagrams are based on simulations by the Virgo Consortium (see the following e-address http://www.mpagarching.mpg.de/Virgo/) assuming a flat model with $\Omega_{CDM} = 0.3$ and $\Omega_\Lambda = 0.7$.

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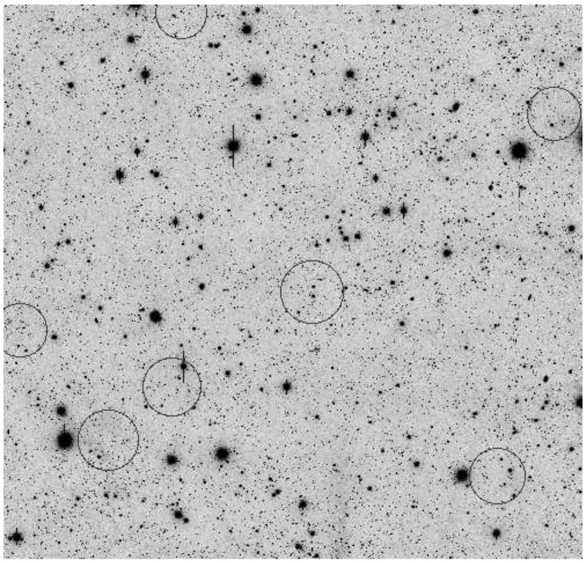

Fig. 2. Deep Lens Survey image in the R filter covering an area of 35x35 arcmin. The circles enclosed the position where cluster candidates at $z > 0.5$ have been found.

TABLE 1

CLUSTER CANDIDATES AT $Z > 0.5$

Redshift	Num. obj. zone	Reliability
0.90	6	> 0.99
0.85	5	0.98
0.55	6	0.90
0.60	5	0.86
0.80	4	0.82
1.50	3	0.82
1.40	3	0.80

Table 1. Candidates to be clusters of galaxies at redshift > 0.5 in one of the fields of the Deep Lens Survey.

REFERENCES

Gutiérrez, C. M., & Juncosa, R. 2004, RevMexAA Ser. Conf., 24

Fernández-Soto, A., Lanzetta, K., & Yahil, A. 1999, ApJ, 513, 34

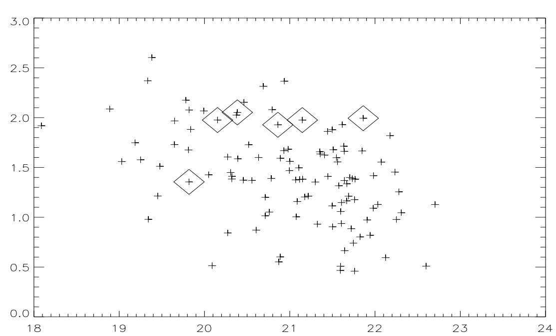

Fig. 3. Color-magnitude diagram of all the galaxies (*crosses*) enclosed in one of the circles shown in Figure 2; objects identified as cluster members galaxies (*diamonds*) follow a tight $V - I$ *vs.* I relation.

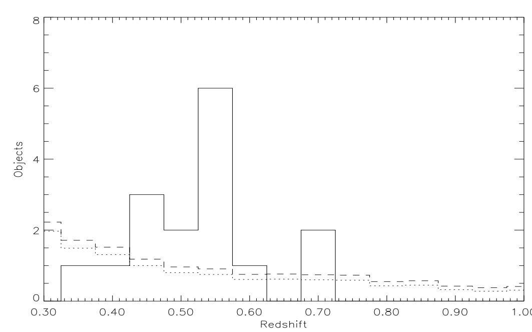

Fig. 4. The figure shows as a function of redshift: (*dotted*) the mean number of objects in a region of 2×2 arcmin^2 of the Deep Lens Survet field shown in Fig. 2. (*Dashed*) the expected 1σ upper limit for a random *poisson* distribution, and (*solid*) the actual distribution of objects in such region. A clear overdensity exists at $z \sim 0.6$.