Constructing the Universe with Clusters of Galaxies, IAP 2000 meeting, Paris (France) July 2000
Florence Durret & Daniel Gerbal eds.

A NEW DEEP WIDE MULTICOLOR FIELD OF THE COMA CLUSTER CORE

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We present a new deep wide angle (40'×1deg) multicolor U, B, V, R and I survey of the Coma cluster core. It is one of the deepest multicolor survey and one of the largest CCD field available to date for the Coma cluster. Although this cluster is probably the most studied rich cluster, open questions, as the slope of the faint end of the luminosity function, subsist. Our purpose is to use this new deep and large sample to determine the most realistic luminosity function, constrain the very faint population behavior and study environmental effects in this cluster.

1 The Data

We obtained B, V, R and I images with CFH12K and UH8K at CFHT (I in collaboration with M. West, UH) and U images at the WYIN telescope (Kitt-Peak observatory). The detection limit is 25.5 in B at the 2.5σ above the sky noise. The magnitude completeness limit is between R=22 and 23 in the 5 bands.

We cover an area of 40'x1deg in B, V, R and I. The U data are 3 fields of 10'x10' located near the center and to the north of the cluster (see fig1 and 2).

We used also a deep wide multicolor field image of 40'x30' in the same bands from the Virmos imaging survey as a comparison field. The magnitude limits of this image are similar to the Coma images and these two sets of data have been treated exactly in the same way to have exactly the same zero points.

In order to compare our system of magnitudes with other comparable systems, we used the Bernstein et al. (1995 : B95 hereafter) study. Our R and B magnitudes are very similar with the B95 R and b_j CCD magnitudes (see fig3 for R). The statistical difference is less than 0.2 magnitudes as shown in fig4 for the R band.

We performed first the star/galaxy separation using the same parameter as B95. This parameter (fixed aperture magnitude - total magnitude) is constant and close to 0 for the stars down to B=21 or even fainter, while the same parameter is decreasing for the galaxies (see fig4). This is explained by the very compact star luminosity profile compared to the galaxies which are more diffuse objects. This allows an efficient star-galaxy separation down to B=21. For the fainter magnitudes (B$\sim$28.), the star fraction becomes less than 5% in standard fields. However, we plan to perform a more efficient separation using an adaptative aperture magnitude to be compared with the total magnitude. This parameter will take into account the very small size of the faint objects and will be more efficient to the faint end of the fig 4 diagram.

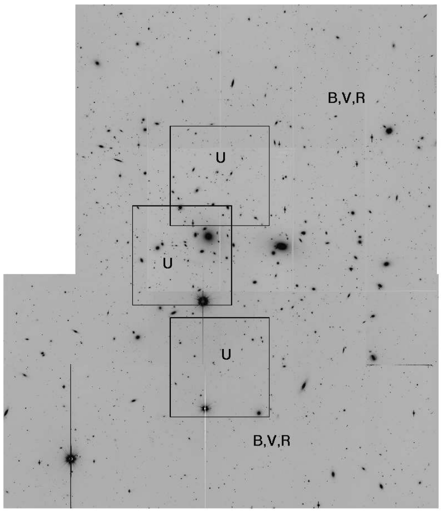

Figure 1: General view of the Coma cluster. The field is 40'x1deg from the 2 R images we obtained. The places where we also have U data are marked by the 3 square windows.

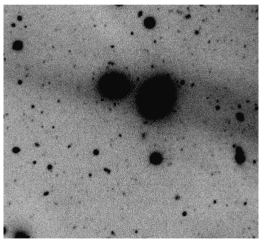

Figure 2: Field centered on one of the tidal disruption feature located near the 2 central cD galaxies. Field of about 3'x3'.

2 Results

We discuss here preliminary results for the luminosity function in R of a central subarea of about 30'×30' of the Coma cluster. We plan to compute this function using several methods to discriminate between cluster and field galaxies (spectroscopy, 2 points correlation function, CMR relation, photometric redshifts), but we used first statistical subtractions. This classical method was used for example in B95. We selected here a deep CFH12K Virmos field of 40'×30' to compute the field counts with the same conditions as for the Coma images. We estimated the variance of these counts by splitting the Virmos field in 16 sub-areas of about 10'×10'. The resulting field counts are consistent with literature compilations as the one of Metcalfe et al. (2000) (see fig5). The difference between the Coma and field counts gives, in principle, the luminosity function of the Coma cluster core (see fig6). The Virmos variance applied to our counts gives an estimation of the error.

First, we recover with a good confidence level the hole in the Coma luminosity function

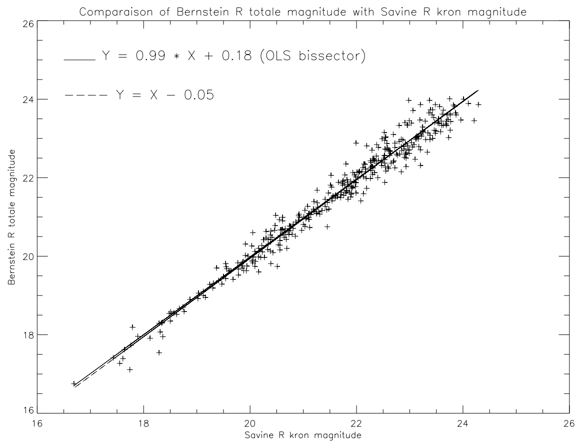

Figure 3: Relation between our R kron magnitudes and the Bernstein R magnitudes. The best fit are the lines.

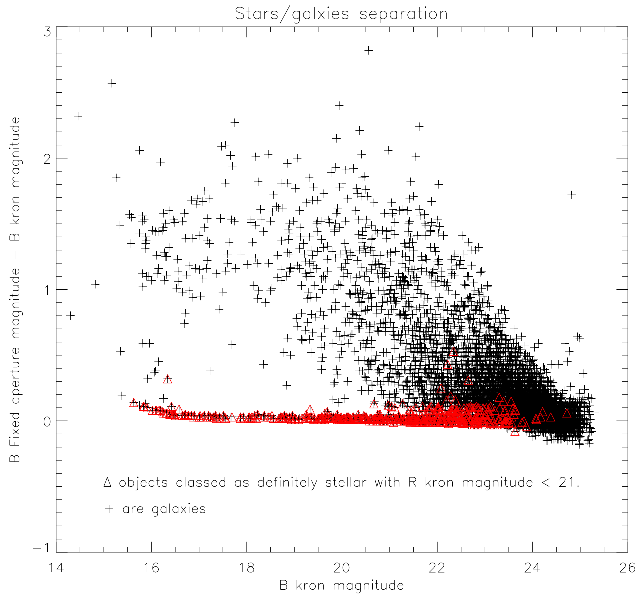

Figure 4: Star/galaxy separation: the horizontal bottom feature is the star location.

around R=16.5. This feature was already outlined by several autors like Rood (1969), Godwin et al. (1977), Biviano et al. (1995) and recently by Lobo et al. (1997) who find the hole at V=17. This shape is probably due to the merging of relatively faint galaxies in order to contribute to the excess of brighter galaxies.

Second, despite the large error bars (fig6), the luminosity function does not seem to increase at magnitudes fainter than R=19. On one hand, this is in contradiction with other studies as Lobo et al. (1997) which used the CMR relation at the bright end and field subtraction for the faint end to remove background galaxies. On another hand, this result is in agreement with studies using spectroscopical subtraction of the field galaxies (e.g. Adami et al. 1998, 2000, Secker et al. 1997). They propose as an explanation of the lack of faint galaxies in the cluster inner core the possible tidal disruptions of these objects by the central cD galaxies. The explanation could be also a cut-off in the initial fluctuation spectrum toward the low mass objects, preventing the formation of faint galaxies.

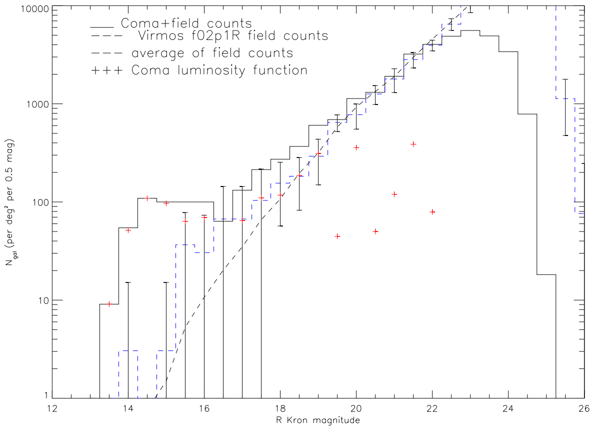

Figure 5: Solid line histogram: counts along the Coma cluster line of sight. Dashed histogram: Virmos field counts with error bars. Crosses: Coma luminosity function. Dashed line: Metcalfe et al. field counts.

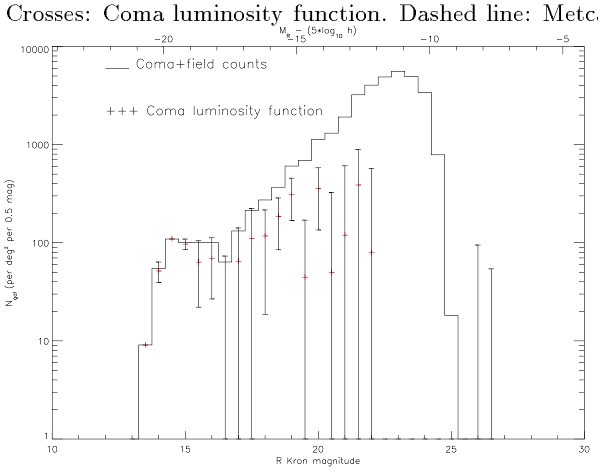

Figure 6: Solid line histogram: counts along the Coma cluster line of sight. Crosses: Coma cluster luminosity function with Virmos field error bars. The upper axis is the absolute R magnitudes. The points of the Coma luminosity function are not visible between R=22 and 25 because they are negative.

3 Perspectives

The use of the whole field of view will give us access to more external areas of the Coma cluster in order to check the tidal disruption hypothesis because the disruption is likely to be less efficient as we are more distant from the cluster center. At the same time, we will check with other field subtraction methods (e.g. Color Magnitude Relation) wether the shape of our luminosity function is dependent on the way we use to reject field galaxies. The same data will also allow to study environemental effects as possible galaxy alignements. Finally, our data are well suited to sample the distant population along the line of sight. This issue will be adressed using also an extensive comparison with X-ray data available for this cluster (ROSAT PSPC and HRI as well as new XMM and Chandra data).

Acknowledgments

J.C. Cuillandre, H. McCracken, J.P. Picat, G. Mathez, R. Pello, L. Van Waerbeke, C. Conselice and J. Gallagher have participated to this work. We would like to thank L. Tresse, C. Lobo, S. Arnouts, A. Boselli, F. Durret and D. Gerbal for their help.

References

1. C Adami *et al*, *Astronomy and Astrophysics*, 353, 930 (2000).
2. C. Adami *et al*, *Astronomy and Astrophysics*, 334, 765 (1998).
3. G.M. Bernstein *et al*, *Astronomical Journal*, 110, 1507 (1995).
4. A. Biviano *et al*, *Astronomy and Astrophysics*, 297, 610 (1995).
5. J.G. Godwin and J.V. Peach, *Mon. Not. of the Royal Astron. Soc.*, 181, 323 (1977).
6. C. Lobo *et al*, *Astronomy and Astrophysics*, 317, 385 (1997).
7. N. Metcalfe *et al*, *Mon. Not. of the Royal Astron. Soc.*, (2000).
8. H.J. Rood, *Astrophysical Journal*, 158, 657 (1969).
9. J. Secker *et al*, ucb proc., 115S, (1997).