Velocity dispersions estimates of APM galaxy clusters

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ABSTRACT

We present 83 new galaxy radial velocities in the field of 18 APM clusters with redshifts between 0.06 and 0.13. The clusters have Abell identifications and the galaxies were selected within 0.75 h⁻¹ Mpc in projection from their centers. We derive new cluster velocity dispersions for 13 clusters using our data and published radial velocities.

We analyze correlations between cluster velocity dispersions and cluster richness counts as defined in Abell and APM catalogs. The correlations show a statistically significant trend although with a large scatter suggesting that richness is a poor estimator of cluster mass irrespectively of cluster selection criteria and richness definition. We find systematically lower velocity dispersions in the sample of Abell clusters that do not fulfill APM cluster selection criteria suggesting artificially higher Abell richness counts due to contamination by projection effects in this subsample.

Key words: galaxies: clustering – galaxies: dynamics – cosmology: observations – cosmology: theory.

1 INTRODUCTION

Studies of the dynamics of clusters of galaxies play an important role in the analysis of large scale structure formation. Cluster velocity dispersion measurements σ provide cluster mass estimates and a direct normalization of the primordial mass power spectrum (see for instance Eke et al. 1996). Samples of Abell clusters have been extensively used in these analyses. However, studies of selection effects in the Abell catalog (Sutherland 1988, Dalton 1992) have shown the presence of serious projection effects and plate calibration systematics. On the other hand, numerical simulations (van Haarlem et al. 1997) provide evidence that cluster surveys in two dimensions are subject to strong projection biases if the cluster search radius is as large as Abell’s radius R_A=1.5 h⁻¹ Mpc. Thus, clusters selected with this criteria are subject to a frequent superposition of groups that may produce artificial large velocity dispersions. Nevertheless, these authors find that clusters obtained from two dimensional analysis but with a significantly smaller search radius, R=0.5 h⁻¹ Mpc, have similar distributions of velocity dispersions than those clusters selected in three dimensions. Several studies based on different observational samples Frenk et al. (1990), Girardi et al. (1993), Zabludoff et al. (1993), Collins et al. (1995), Mazure et al. (1996), Fadda et al. (1996) have provided insights on the kinematics of galaxies in clusters. These works have been based on Abell clusters where spurious high velocity dispersions may be expected due to projection effects.

The Edinburgh–Durham cluster catalog (Lumsden et al. 1992) although free from subjective visual systematics, would also be biased toward artificial large velocity dispersions due to superpositions given that the same search radius than in Abell’s catalog is used in the cluster identifications. Other automated survey, the APM cluster catalog (Dalton et al. 1994, 1997) has an intermediate search radius 0.75 h⁻¹ Mpc although galaxies in the outer ring 0.50–0.75 h⁻¹ Mpc have a smaller weight in the calculation of cluster richness. Thus, it might be expected that the distribution of APM cluster velocity dispersions would be more representative of the true distribution. There are 31 APM identifications (Mazure et al. 1996) in the ESO Nearby Abell Cluster Survey (ENACS). In a quantitative analysis of these data the authors conclude that the large spread between velocity dispersion and richness, both APM and Abell, is probably or at least partially intrinsic to the clusters.

In order to improve the sample of APM clusters with velocity dispersion estimates we have undergone an obser-
vational program to obtain radial velocities of galaxies in the field of APM clusters. We present in this paper new measurements of radial velocities of galaxies in the fields of 18 APM clusters. Our data combined with radial velocities from the literature allow us to determine cluster velocity dispersions for 17 APM clusters (13 of these without previous estimates). In section 2 we present the galaxy data set and a statistical analysis of the new velocity dispersion estimates and those from the literature providing correlations between $\sigma$ and richness counts $C$. A brief discussion of the results is given in section 3.

2 DATA AND ANALYSIS

We aim to estimate velocity dispersions of APM clusters for a wide range of richness. Therefore, we have selected a sample of APM clusters (Dalton et al. 1994, 1997, hereafter APM IV and APM V respectively) with redshifts between 0.06 and 0.13 and uniformly distributed in richness. To avoid confusion, cluster names are as in NASA/IPAC Extragalactic Database (NED). Our sample comprises 23 APM clusters for which we have selected galaxies with $b_j < 19.5$ from the Edinburgh–Durham Southern Galaxy Catalogue (Heydon-Dumbleton et al. 1989, hereafter COSMOS) within 0.75 Mpc $h^{-1}$ in projection from the cluster centers (Dalton et al. 1994).

We have chosen the APM clusters in our sample to have Abell identifications (Abell 1958, Abell et al. 1989) in order to perform a comparative analysis between the cluster dynamics and richness. In Table 1 we show basic information of our original sample. We list in column 1 and 2, the cluster identifications (APM and Abell respectively); columns 3 and 4, coordinates of cluster centers; columns 5 and 6, mean cluster redshift and the number of objects used in these calculations from Ebeling & Maddox (1995); and columns 7 and 8, the richness parameter from Abell and APM V. As it can be seen from the Table, most of the mean cluster redshifts are based on measurements of two members and it is very important to improve these cluster redshifts.

The spectroscopic observations were carried out during 1996 and 1997 using a REOSC spectrograph in the 2.15 m telescope at CASLEO Observatory, Argentina. We have used a 600 line mm$^{-1}$ grating with a resolution of 3.3 Å. We observed the galaxies twice with typical exposure times of about 20 minutes to avoid collecting many cosmic rays. The spectral range was 4000 Å to 7500 Å and the spectra were calibrated using comparison lines from a He–Ne–Ar lamps with an accuracy of 15 km s$^{-1}$. We also observed galaxies with known radial velocities to be used as templates.

The data reductions were performed using the standard procedure to remove bias images, correct by flat-field and make illumination corrections using IRAF routines. Radial velocities were obtained following the cross-correlation method of Tonry & Davis (1979).

Table 2 shows radial velocities obtained with galaxies in common with other authors, listing the identification, coordinates, $b_j$ magnitude, our heliocentric radial velocities and the measurements from other authors, respectively. Our measurements are in good agreement with those from literature, with a mean difference of $52\pm60$ km s$^{-1}$, lesser than quoted errors.

We provide in Table 3 our new radial velocity measurements of galaxies in the fields of our selected APM clusters. For each cluster, column 1 lists galaxy identification, using names taken from the Guide Star Catalog (Leeget et al. 1990), APM (Maddox et al. 1990a, Maddox et al. 1990b), APMBGC (Loveday 1999) or the catalogue of principal galaxies (Paturel 1989, PGC) whenever available; columns 2 and 3, the equatorial coordinates; column 4, $b_j$ magnitude when available; column 5, the observed heliocentric radial velocity, $V$, and the associated standard deviation. Those galaxies marked with an asterisk in column 2 are not in COSMOS Survey. Quoted coordinates are from our own identification.

We have also searched for available redshifts in the area of APM clusters using the NASA/IPAC Extragalactic Database in order to improve our $\sigma$ estimates. We have identified 52 galaxies from The Las Campanas Redshift Survey (Schectman et al. 1994) within 0.75h$^{-1}$ Mpc in projection in the fields of the clusters APMCC 160, APMCC 173, APMCC 352, APMCC 746, APMCC 042 and APM 221539.0-390817.

Based on the ROSTAT routine (see Beers et al. 1990) we have used robust mean and scale estimators. We have applied relativistic corrections and we have taken into account velocity errors. Considering the typical number of redshift confirmed cluster members (usually $<20$) we have considered the trimmed estimator for the mean velocity and the gapper for the velocity dispersion. Errors are based on the statistical jackknife.

When possible, we have analyzed the velocity and the projected distributions in order to detect subclustering. In the cluster APMCC 746 we find a substructure separated from the main cluster in both radial velocity and projected coordinates. This structure was previously identify as the group of galaxies AM 2159-224 (Arp and Madore, 1987). We obtained a mean radial velocity for this group $V = 21124$ km/s, with a difference of 476 km/s with respect to the main cluster. Thus, mean radial velocity and $\sigma$ of cluster APMCC 746 were computed after removing this structure.

We have not computed velocity dispersions for several clusters in our sample. APMCC 107 has several substructures and more redshifts are needed to derive an accurate velocity dispersion. The clusters: APM 032010.5-454456, APMCC 604 and APMCC 864 have few redshift measurement to estimates the velocity dispersion.

Finally, we have computed new velocity dispersion estimates for 13 clusters. In 11 clusters, the estimates rely on our new radial velocity measurements, and in 2 of them on the Las Campanas Redshift Survey (Schectman et al. 1996). In Table 4 we list cluster identification; our new estimates of mean cluster redshift and velocity dispersions; and the number of objects used in these measurements. The mean redshifts, given in this Table, provide a more confident source of APM cluster redshifts given a larger number of members. There is a general good agreement between the cluster mean redshifts and the estimates quoted in Ebeling & Maddox (1995). Redshift uncertainties are smaller than 0.001 and are not quoted in the Table.

We also present velocity dispersions for four APM clusters in common with Fadda et al. (1999), the largest survey for determination of cluster velocity dispersions. Table 5 shows our results for these clusters listing cluster identifi-
the same area and redshifts of the APM cluster survey that were not identified by the APM selection criteria.

Figure 1 shows the correlation between $\sigma$ and $C$. Figure 1a corresponds to APM richness counts $C_{\text{APM}}$, with solid circles representing our new velocity dispersions and open circles those obtained from the literature. Figure 1b and 1c correspond to Abell richness count $C_{\text{Abell}}$, where only richness class $R > 0$ are considered in 1c. In Figures 1b and 1c are also shown as crosses Abell clusters in the same survey area and redshift range than the APM survey that did not fulfill the APM V cluster selection criteria. In these Figures there is a clear tendency of these clusters to have systematically lower values of velocity dispersion compared to those clusters in the APM survey, suggesting that "non-APM" clusters have artificially larger Abell richness counts.

In Figure 1a, b and c are also shown the corresponding least-squares power-law fits. The values of the best fitting parameters of the form $\log(\sigma) = a \times \log(C) + b$ for the correlations shown in this Figure are: APM $a=0.307\pm0.134$, $b=2.242\pm0.256$; Abell $a=0.068\pm0.048$, $b=2.680\pm0.084$ and Abell ($C_{\text{Abell}} > 30$) $a=0.180\pm0.097$, $b=2.471\pm0.180$. The corresponding rms scatter around these fits are 0.016, 0.018 and 0.017 respectively. It can be appreciated a poor correlation between $\sigma$ and richness counts irrespective of the different procedures indicating that this scatter is partially intrinsic to the clusters. This should be taken into account when deriving mass estimates and abundances from cluster richness (Bahcall and Cen 1993), which could introduce spurious biasing effects against low $\sigma$ objects as discussed by Mazure et al. (1996).

3 DISCUSSION

The measurements of galaxy redshifts in the field of APM clusters contribute to our understanding of the dynamics of these systems and provide a deeper insight in the problem of cluster identification from projected data. The estimated velocity dispersions obtained from our analysis with typical number of galaxies $\approx 10 - 20$ are in good agreement with estimates derived from the literature as seen in Table 5.

The new observations presented in this paper together with previous published data allows for a comparative analysis of the correlation between cluster velocity dispersion and richness defined by different selection algorithms. The correlation between Abell cluster richness and velocity dispersions is very poor. Automated cluster catalogs such as APM are free from subjective effects which may blur significantly the correlation between richness and $\sigma$. However, APM richness counts do not provide a significantly better correlation with $\sigma$, suggesting the presence of an intrinsic spread related to galaxy formation or evolution in clusters. Therefore, the observed spread in the richness - $\sigma$ correlations raise serious concern on the use of richness in cluster mass determinations irrespectively of cluster selection criteria and richness definition.

We observe a systematic trend to lower values of $\sigma$ in the sample of Abell clusters that did not satisfy APM cluster selection criteria. This effect may be related to the fact that these objects are subject to larger contamination by projection effects as has been previously determined (Sutherland 1988, Dalton 1992, Van Haarlem et al. 1997).
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Table 1. APM cluster sample

| APM Id. | Abell Id. | α(2000) | δ(2000) | <z> | N   | C_{Abell} | C_{APMCC} |
|---------|-----------|---------|---------|-----|-----|-----------|-----------|
| APMCC 015 | A2734 | 00 11 30.07 | -28 51 29.74 | 0.062 | 2 | 58 | 63.6 |
| APMCC 042 | A2755 | 00 17 44.70 | -35 09 30.30 | 0.095 | 3 | 120 | 124.0 |
| APMCC 050 | A0022 | 00 20 35.10 | -25 41 57.30 | 0.131 | 141 | 58 | 108.6 |
| APMCC 073 | A0042 | 00 28 37.72 | -23 36 43.89 | 0.109 | 154 | 83.2 |
| APMCC 107 | A2819 | 00 46 04.10 | -63 35 13.00 | 0.087 | 2 | 90 | 128.9 |
| APMCC 123 | S0106 | 00 56 24.95 | -37 53 43.71 | 0.118 | 2 | 53.7 |
| APMCC 132 | S0112 | 00 57 56.70 | -66 48 05.60 | 0.067 | 2 | 16 | 51.1 |
| APMCC 160 | S0144 | 01 17 35.15 | -37 59 55.99 | 0.077 | 26 | 51.8 |
| APMCC 173 | A2911 | 01 26 17.83 | -37 55 25.16 | 0.079 | 2 | 72 | 77.9 |
| APMCC 352 | A3098 | 03 13 38.60 | -38 18 20.90 | 0.083 | 2 | 38 | 48.2 |
| APMCC 359 | S0333 | 03 15 32.43 | -29 15 27.50 | 0.067 | 2 | 24 | 41.6 |
| APM 031451.8-510556 | A3110 | 03 16 23.30 | -50 54 57.20 | 0.075 | 37 | |
| APMCC 369 | S0336 | 03 17 39.10 | -44 31 27.10 | 0.076 | 1 | 5 | 77.5 |
| APM 032010.5-454456 | S0345 | 03 21 51.60 | -45 34 16.20 | 0.069 | 3 | |
| APMCC 400 | S0356 | 03 29 30.00 | -46 00 32.30 | 0.072 | 2 | 10 | 64.2 |
| APMCC 604 | A3703 | 20 39 44.50 | -61 13 59.60 | 0.071 | 52 | 42.4 |
| APMCC 746 | S0987 | 22 02 07.60 | -22 35 52.10 | 0.070 | 15 | 20 | 54.4 |
| APM 221539.0-390817 | A3856 | 22 18 36.22 | -38 53 14.03 | 0.126 | 2 | 125 | |
| APMCC 815 | A3910 | 22 45 55.30 | -45 54 45.70 | 0.091 | 3 | 47 | 79.7 |
| APMCC 824 | A3922 | 22 49 45.90 | -51 47 58.40 | 0.085 | 2 | 51 | 87.5 |
| APMCC 864 | S1096 | 23 11 50.23 | -29 03 49.04 | 0.117 | 1 | 63.0 | |
| APMCC 988 | A2599 | 23 26 47.02 | -23 50 59.10 | 0.098 | 2 | 51 | 58.5 |
| APMCC 915 | S1140 | 23 39 39.20 | -45 59 08.20 | 0.067 | 1 | 3 | 54.7 |

Sources from radial velocities, V_r(lit)
1. Dalton et al. (1994)
2. Schectman et al. (1996)
3. Collins et al. (1995)
4. Paturel et al. (1995, LEDA)
5. Loveday et al. (1996)
6. Di Nella et al. (1996)
7. Katgert et al. (1998)

Table 2. Radial velocities in common with other authors

| Name | α(2000) | δ(2000) | b_j | V_r | V_r(lit) |
|------|---------|---------|-----|-----|---------|
| APMBGC 409-109-058 | 00 11 55.2 | -28 43 50.3 | 15.85 | 19741±147 | 19871(7) |
| B011514.6-381709 | 01 17 31.1 | -38 01 20.0 | 17.38 | 22405±296 | 22457±120(2) |
| PGC 0012161 | 01 26 09.9 | -37 56 42.6 | 17.38 | 24334±209 | 24307±39(3) |
| APMBGC 248-116+062 | 03 16 31.1 | -50 54 41.0 | 13.88 | 22065±149 | 22050(4) |
| APM 232411.28-240749 | 23 26 49.3 | -23 51 18.0 | 17.23 | 26874±254 | 26591(1) |
Table 3. New radial velocities for galaxy in APM clusters

| Name    | α(2000) | δ(2000) | b_j  | V_r  |
|---------|---------|---------|------|------|
| APMCC 015 |         |         |      |      |
| 00 10 24.3 | -28 49 35.1 | 16.75 | 17886±199 |
| 00 10 32.4 | -28 51 54.2 | 16.85 | 17819±286 |
| 00 12 04.9 | -28 47 05.3 | 17.15 | 19366±215 |
| 00 11 35.0* | -29 01 24.0 | – | 17436±225 |
| 00 11 18.5* | -28 50 22.0 | – | 18188±428 |
| APMCC 050 |         |         |      |      |
| 00 20 38.9 | -25 35 30.0 | 15.80 | 19351±169 |
| 00 20 35.0 | -25 39 26.8 | 17.70 | 34254±181 |
| APMCC 073 |         |         |      |      |
| 00 28 51.6 | -23 36 24.9 | 16.40 | 17659±204 |
| 00 27 53.8 | -23 41 47.6 | 17.50 | 33573±131 |
| 00 28 59.1 | -23 31 56.3 | 17.50 | 19561±281 |
| 00 28 11.9 | -23 42 07.8 | 17.60 | 27035±224 |
| APMCC 107 |         |         |      |      |
| 8844.0365 | 00 45 12.9 | -63 33 13.0 | 15.37 | 22423±289 |
| 8844.0574 | 00 45 22.1 | -63 37 27.0 | 15.16 | 23492±395 |
| 8844.0773 | 00 44 56.9 | -63 28 36.0 | 15.05 | 23100±350 |
| 8845.0436 | 00 46 20.3 | -63 28 06.0 | 14.20 | 25912±365 |
| APMCC 123 |         |         |      |      |
| 00 55 30.7 | -37 49 52.6 | 16.82 | 30759±558 |
| APMCC 132 |         |         |      |      |
| 8848.0146 | 00 57 11.9 | -66 43 49.0 | 14.78 | 19949±280 |
| 8848.0287 | 00 58 20.7 | -66 48 00.0 | 14.77 | 19863±269 |
| 8848.0376 | 00 57 46.1 | -66 47 50.0 | 15.12 | 18771±298 |
| 8848.1300 | 00 58 11.9 | -66 48 17.0 | 14.86 | 20850±309 |
| APMCC 160 |         |         |      |      |
| 01 17 12.9 | -38 04 17.2 | 17.78 | 23421±276 |
| 01 17 26.0* | -38 01 40.0 | – | 32923±298 |
| APMCC 359 |         |         |      |      |
| 03 16 08.9 | -29 18 20.3 | 15.96 | 19354±127 |
| 03 16 13.9 | -29 13 50.2 | 16.96 | 20109±181 |
| APM 031451.8-510556 | | | | |
Table 3 – continued

| Name          | α (2000) | δ (2000) | bj | \( V_r \)        |
|---------------|----------|----------|----|------------------|
| APMCC 369     | 03 17 17.9 | -44 21 22.2 | 17.17 | 24253±167        |
|               | 03 17 01.7 | -44 21 05.1 | 17.57 | 27165±303        |
| APM 032010.5-454456 | 03 21 59.1 | -45 33 22.3 | 16.77 | 18418±157        |
| APMCC 400     | 03 28 58.7 | -45 56 60.0 | 15.03 | 21994±153        |
|               | 03 29 08.1 | -45 58 24.0 | 14.71 | 20771±243        |
|               | 03 30 00.4 | -46 05 47.0 | 13.04 | 20219±176        |
|               | 03 29 16.7 | -46 04 50.1 | 17.67 | 21503±273        |
| APMCC 604     | 9100.0418 | -61 18 10.0 | 14.25 | 22300±305        |
|               | 9100.0429 | -61 17 38.0 | 14.39 | 21439±202        |
|               | 9100.0519 | -61 11 23.0 | 13.87 | 27392±199        |
|               | 9100.0541 | -61 10 54.0 | 13.40 | 22368±224        |
| APMCC 815     | 8447.0322 | -45 58 32.0 | 15.19 | 26954±245        |
|               | 8447.0323 | -45 54 58.0 | 15.26 | 15578±154        |
|               | 8447.0324 | -45 57 03.9 | 16.56 | 15235±154        |
|               | 8447.0325 | -45 58 17.8 | 16.96 | 24534±246        |
|               | 8447.0326 | -45 46 00.1 | 16.96 | 36441±191        |
|               | 8447.0327 | -45 59 51.9 | 17.36 | 35620±341        |
|               | 8447.0328 | -45 52 27.6 | 17.46 | 36578±177        |
|               | 8447.0329 | -45 58 29.8 | 17.46 | 26620±176        |
| APMCC 824     | 8453.0439 | -51 44 08.0 | 14.21 | 28884±223        |
|               | 8453.0440 | -51 44 21.5 | 17.13 | 12740±265        |
|               | 8453.0441 | -51 44 43.4 | 17.43 | 29634±226        |
|               | 8453.0442 | -51 46 25.9 | 17.43 | 28876±223        |
|               | 8453.0443 | -51 46 57.2 | 17.53 | 28644±201        |
|               | 8453.0444 | -51 47 32.5 | 17.73 | 30226±432        |
|               | 8453.0445 | -51 44 36.8 | 17.73 | 29886±353        |
|               | 8453.0446 | -51 44 36.0 | 17.81 | 30886±152        |
|               | 8453.0447 | -51 48 54.0 | 17.81 | 30550±169        |
|               | 8453.0448 | -51 49 27.0 | 17.81 | 29840±249        |
|               | 8453.0449 | -51 49 18.0 | 17.81 | 16630±382        |
| APMCC 864     | 23 11 36.2 | -28 59 53.4 | 17.22 | 31076±173        |
|               | 23 12 17.6 | -29 09 36.7 | 17.52 | 30902±241        |
| APMCC 898     | 23 26 38.0 | -23 46 04.0 | 17.33 | 37686±276        |
|               | 23 27 12.5 | -23 44 49.0 | 17.83 | 34467±228        |
|               | 23 26 45.0 | -23 56 56.8 | 18.13 | 32545±177        |
Table 3 – continued

| Name       | α(2000) | δ(2000) | bj | \(V_r\) |
|------------|---------|---------|----|--------|
| APMCC 915  |         |         |    |        |
| 8456.0477  | 23 39 28.8 | -45 57 59.0 | 12.70 | 19186±375 |
| 8456.0637  | 23 40 00.8 | -45 52 33.0 | 15.20 | 17477±184 |
|            | 23 39 51.5 | -45 59 39.0 | 17.20 | 15942±206 |
|            | 23 39 24.6 | -46 03 17.8 | 17.20 | 20648±293 |
|            | 23 40 15.9 | -45 52 03.5 | 17.30 | 17293±169 |
|            | 23 40 10.9 | -45 59 38.0 | 17.30 | 20939±198 |
|            | 23 39 30.8 | -45 53 43.8 | 17.40 | 20654±196 |
|            | 23 39 37.2 | -46 02 25.4 | 17.70 | 19155±293 |
|            | 23 39 21.5 | -46 02 35.9 | 17.80 | 21298±261 |
|            | 23 39 30.2 | -46 00 56.4 | 17.80 | 19629±226 |
|            | 23 39 54.5 | -46 00 48.6 | 17.80 | 21222±138 |
|            | 23 39 53.3 | -46 00 11.9 | 17.80 | 33921±380 |

Table 4. New velocity dispersions in APM clusters. (†) Velocity data from Las Campanas Redshift Survey

| Cl. Id.       | \(<z_{\text{new}}\) | \(\sigma\) | N |
|---------------|----------------------|------------|---|
| APMCC 050     | 0.064                | 693±251    | 7 |
| APMCC 073     | 0.112                | 867±260    | 7 |
| APMCC 132     | 0.067                | 1123±233   | 12|
| APMCC 160     | 0.076                | 573±285    | 7 |
| APMCC 352(†)  | 0.083                | 795±120    | 18|
| APMCC 359     | 0.067                | 399±180    | 9 |
| APM 031451.8-510556 | 0.076 | 748±144 | 10 |
| APMCC 369     | 0.075                | 700±98     | 29|
| APMCC 400     | 0.071                | 528±232    | 8 |
| APM 221539.0-390817(†) | 0.142 | 729±142 | 22 |
| APMCC 815     | 0.090                | 425±158    | 8 |
| APMCC 824     | 0.098                | 780±127    | 11|
| APMCC 915     | 0.068                | 751±179    | 10|

Table 5. Comparison of Velocity dispersions with Fadda et al. (1996). (†) Velocity data from Las Campanas Redshift Survey

| Cl. Id.       | \(<z_{\text{new}}\) | \(\sigma\) | \(\sigma(\text{lit})\) | N |
|---------------|----------------------|------------|---------------------|---|
| APMCC 015     | 0.061                | 652±248    | 628±61              | 80|
| APMCC 042(†)  | 0.098                | 790±167    | 768±139             | 20|
| APMCC 173(†)  | 0.080                | 416±87     | 547±159             | 30|
| APMCC 746(†)  | 0.072                | 509±127    | 677±141             | 29|