CURRENT STATUS OF THE ACO CLUSTER REDSHIFT COMPILATION

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We present an update of our compilation of measured redshifts of galaxy clusters in the all-sky Abell catalog. In the last 7 years the number of ACO clusters with measured $z$ has doubled to now $\sim$2100, but still $\sim$56% of these are based on only 1 or 2 measured member galaxies. Our October 1997 version gives 2247 redshifts (including components or line-of-sight superpositions) for 2114 distinct A- and S-clusters. Velocity dispersions are listed for 536 different ACO clusters (613 subclusters) and the median is 695 km/s. We mention some applications of our compilation for determining the large-scale structure of the nearby Universe.

1 Introduction and Scope of this Work

Since the publication of ACO’s all-sky cluster catalog (with 822 redshifts) no redshift compilation of the full sample appeared in print. We present an update of our catalog of measured redshifts for both A- and S-clusters we maintain since 1989. Different from most previous compilations, we systematically scan the literature for any galaxy redshifts in the direction of ACO clusters. Apart from compilations like ZCAT and SRC (cf.), recent redshift surveys (e.g. LCRS or APMBG) proved to be rich in ACO cluster redshifts, though these galaxy–cluster associations have not been reported in literature. We include redshifts within a factor of 4 of the currently best photometric estimate $z_{\text{est}}$. We attach a special flag to those with $|\log(z_{\text{obs}}/z_{\text{est}})| > 0.3$ and we include these entries only if the galaxies are within $\sim$0.6 Abell radii (at the galaxy redshift). Otherwise we include galaxies out to about 1 Abell radius. The format of our compilation has been described previously. The bibliography has now 351 references and grows by about 25 papers per year.

2 Current Status and Exploratory Analysis

Since three years ago the number of clusters with measured redshifts has increased by $\sim$30%, and the number of known velocity dispersions by $\sim$60%. The latter is largely due to our efforts to collect literature data on individual galaxies and calculate velocity dispersions by ourselves. Our Oct. 1997 version gives redshifts for 2114 distinct (1706 A- and 408 S-) clusters, or 2247 entries.
including subclusters or line-of-sight superpositions. Of these, \( \sim 2150 \) entries (for \( \sim 2050 \) different ACO names) are within a factor of 2 from \( z_{\text{est}} \). In Fig. 1 the number of clusters \( (N_{cl}) \) with redshifts for at least \( N_z \) member galaxies is plotted vs. \( N_z \), for the “SR91” redshift compilation of northern ACO clusters, as well as for our previous and present full-sky compilations. We give comments (e.g. on additional or alternative redshifts or velocity dispersions) for 865 or 38% of all entries.

Since SR91 the fraction of clusters with “reliable” redshifts (i.e. \( N_z \geq 3 \)) has risen from \( \sim 32\% \) to \( \sim 44\% \) now, partly due to our efforts to merge data from different sources, especially for low \( N_z \). Such “reliable” redshifts now exist for 860 (670 A- and 190 S-) clusters. There are now 100 clusters with \( N_z \geq 50 \), the typical minimum for studies of individual cluster dynamics. The total number of galaxies involved (i.e. the sum of all \( N_z \)) is 22,200 (11,700 for A-, 7020 for ACO-, and 3480 for S-clusters), neglecting some overlap for a few clusters.

Whenever individual redshifts are available for \( N_z \geq 5 \) galaxies, we combine various sources and calculate a velocity dispersion \( \sigma_V \). We quote \( \sigma_V \) for 536 different ACO clusters (400 A- and 136 S-clusters) for a total of 613 subclusters. A rather non-Gaussian (top-hat) main peak (FWHM \( \sim 650 \) km/s) is followed by a long tail out to 2000 km/s. Experience shows that some clusters in this tail will turn out to be line-of-sight superpositions or cluster mergers.

The median \( \sigma_V \) for all 613 (451 A- and 162 S-) clusters and subclusters is 695 km/s (Fig. 2), close to the median of 428 values based on clusters with \( N_z \geq 10 \) (705 km/s). For the A-clusters alone the median \( \sigma_V \) is somewhat higher (700 km/s) than for the S-clusters (657 km/s). We suppose the reason for these values being smaller than previously reported is a more careful clipping of outliers and separation of subclusters.

There is a noticeable increase of the velocity dispersion \( \sigma_V \) with cluster redshift, probably due to both a higher fraction of richer clusters and a higher line-of-sight contamination with interloping galaxies at higher \( z \). There is also a trend for \( \sigma_V \) to increase with cluster richness \( R \). We find a median \( \sigma_V \) of 641, 842, and 1200 km/s for \( R=0–1 \), 2–3, and 4–5, respectively. We do not see any dependence of \( \sigma_V \) on Bautz-Morgan type.

In the course of our work we came across a new pair of identical clusters (A1664=A3541) and another five probably identical pairs or at least tightly connected clusters (A1681/A1683, A2122/A2124, A3389/S585, A3896/S1051, S622/S624).
With the increasing number of redshift surveys there are more and more cases where galaxy data from different sources for the same cluster need to be merged. In numerous cases this was impossible since no individual galaxy redshift data were published. As a result there are 15 clusters in our compilation with \( N_z \geq 10 \) and no \( \sigma_V \) available. For clusters with large \( N_z \) and more than two papers to merge, we often chose the paper with the largest \( N_z \) but quoted the additional references in the notes. It would be very helpful if authors of cluster redshifts included both, positions and velocities of individual galaxies, and clearly state whether velocities are geo-, helio- or galactocentric. Ideally, these data should always and immediately be integrated in a complete galaxy redshift compilation. If possible we incorporate data from most recent preprints (e.g. from the LANL/SISSA servers).

For the rich ACO clusters (A-names) we use the redshift estimate in \cite{ACO}. For the supplementary clusters we use the function proposed for the rich southern clusters by ACO \cite{ACO}, but scaled down by 30% (as found by one of us \cite{us}). We confirm the latter scaling with twice the number of S-clusters with measured \( z \) available now. We also find that the S-clusters do suffer from line-of-sight superpositions more than the A-clusters: 7.6% of the distinct S-cluster names appear with more than one entry, versus 5.6% for the distinct A-clusters.

In Fig. 3 we plot the distribution of estimated redshifts of all ACO- and S-clusters on top of that of the measured redshifts. Measured redshifts \((N_z >0)\) are now available for all northern clusters with \( z_{\text{est}} <0.076 \), for all southern A-clusters with \( z_{\text{est}} <0.057 \) and for all S-clusters with \( z_{\text{est}} <0.035 \).
Fig. 3. Redshift distribution of measured clusters ($z_{\text{obs}}$) and all (A+S) clusters

3 Applications

We used our compilation to establish the currently most complete catalog of superclusters of galaxies. Studying the 3-dimensional distribution of these superclusters we found that the richest superclusters occupy a more or less regular lattice of $\sim 120$ Mpc spacing. We see about five periods of this lattice. The observed regularity is in conflict with current models of structure formation. Most recently the data have been used to derive the cluster correlation function and the power spectrum. At present we are studying the shapes of rich superclusters (Jaaniste et al., in prep.).

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