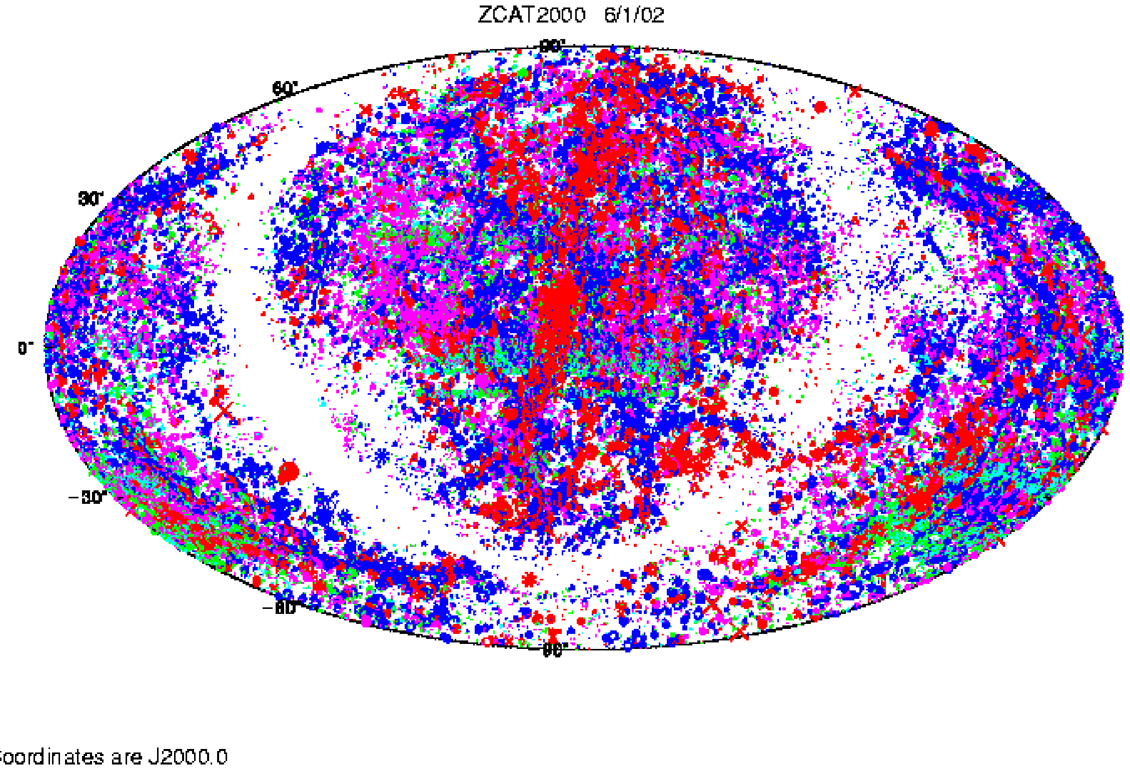
THE CENTER FOR ASTROPHYSICS REDSHIFT CATALOG

Sky Distribution of ZCAT2000 Entries



Plot of the distribution on the sky of all entries in ZCAT as of June 2002. Colors are red v < 3000, blue 3000< v < 7000, magenta 7000 < v < 12000, cyan 12000 < v < 25000, and green 25,000 < v < 100,000 km/s. Point size is a function of apparent magnitude. The green bands represent the well studied regions of the LCRS and 2dF surveys and the Century Survey (from a program by J. Mader).

I. Introduction

The **CFA REDSHIFT CATALOG** incorporates much of the latest velocity data from the Whipple Observatory and other sources as well as velocities from earlier compilations such as the *Second Reference Catalogue* of de Vaucouleurs, de Vaucouleurs and Corwin, the *Index of Galaxy Spectra* of Gisler and Friel, and the *Catalogue of Radial Velocities of Galaxies* of Palumbo, Tanzella-Nitti and Vettolani. It includes BT magnitudes, some UGC numbers and increased ‘‘accuracy’’ in the velocity source information.

The format for the catalog is:

A20,I2,I2,F5.2,A1,I2,I2,F4.1,F5.2,I7,I3,A1,........

A more detailed description of the format can be found in Table 1. By definition, we are continually adding information and updates of the catalog will be made available at reasonable intervals.

The data presented here have primarily been assembled for the purpose of studying the large scale structure of the universe, and, as such, are nearly complete in redshift information, but are not necessarily complete in such categories as diameter, magnitude and cross-references to other catalogs. Additional information of that type will be added in later editions.

Much of the data in the northern hemisphere owe their origin to Zwicky's catalogues of galaxies (Zwicky *et al.* 1961-66; Zwicky 1971; Zwicky, Sargent and Kowal 1975). The authors of this catalog would like to express both their gratitute and reverence for Zwicky's monumental efforts.

The current public version of the CfA Redshift Catalog is available via anonymous ftp from:

fang-ftp.cfa.harvard.edu

in

/pub/catalogs

The main data file is velocity.dat.gz (in compressed format) or velocity.dat (not compressed). Other useful data and programs can also be found there. Please read the README file first.

II. Velocities

Please note that the velocities quoted are heliocentric and that redshifts (z's) have been converted to velocity via $v = zc$, where $c = 299{,}792.5\ km\ s^{-1}$. Redshift is defined as:

$$z = \frac{(\lambda - \lambda_o)}{\lambda_o} \quad .$$

The use of velocity as cz without any special relativistic correction is important in reminding astronomers (and other folks!) that in the formula for proper, comoving distance, it is z (and not v) combined with Ω that gives the distance:

$$D = [\frac{2c}{H_o \Omega_o^2 (1+z)}]\{\Omega_o z + (\Omega_o - 2)[\sqrt{\Omega_o z + 1} - 1]\}$$

from Mattig(1959) (c.f. Fairall 1992).

We quote heliocentric velocities to allow individual users to correct to their own favorite galactocentric or ''local groupocentric'' or ''Virgocentric'' or even the microwave background frame.

We have endeavored to properly remove such corrections before entering data into the catalog, but confusion still remains in those cases where the authors do not explicitly state what corrections were made. In those cases we assume $300 \sin(l) \cos(b)\ km\ s^{-1}$ to be the galactocentric correction. Note also that now that velocities of precisions less than 30 km/sec are commonplace, the correction to heliocentic is **mandatory**! We strongly urge all other authors to follow this convention.

Basic radial velocity sources are listed in Table 2. Velocities with negative source designations are still in the private domain and cannot be used without the appropriate owner's consent. The additional source information in columns 51 and 52 is the number of the paper under the broader source categorization. Initially this was alphabetic, but as more recent papers are added, the numbering scheme has become chronological. Again, beware of blanks, which may signify source zero, but most likely indicates that this information has not yet been updated. In any case, the zero/blank paper for each source is likely to represent the largest number of velocities available from that source (*e.g.* the Second Reference Catalogue).

The RFN column in the catalog contains the file number of the spectrum which we have obtained for that galaxy. If this column is blank, we have not observed the galaxy. We have tried to fill this column in for all entries in zcat, not just with velocity entries measured by us (see section VIII for details on nomenclature).

Objects listed in the catalog that have no velocity and no listed velocity source (in the northern hemisphere) will be observed as part of the CfA survey extension. Give us time! (in particular, telescope time....). In some cases, faint members of studied clusters are included to help users of this catalog determine which galaxies have been measured and which remain.

Velocity Errors

In general, the errors listed for velocities are the errors quoted by the original source. (*i.e.*, random errors are quoted and systematic ones are neglected.) The only exceptions are where multiple measurements have significantly improved the velocity precision. Many sources quote errors that are really the **internal** mean error - *e.g.* the variance in the velocities measured from multiple lines in a single spectrum of a galaxy. These often do not include errors in zero points, errors caused by mis-centering the galaxy in the slit, other instrumental offsets, etc., and are always underestimates of the true **external** error in the velocity estimate. Some sources are better than others; velocity errors from the CfA survey and most 21-cm sources are nearly within unity of the true external error (CfA errors are only about 10-20% low), while the uncertainties quoted in some older works, such as the RC2 and the RSA, are underestimates by more than a factor of two (see, for example, Sandage 1978). For several more detailed analyses of velocity uncertainties, see Lewis (1983), Rood (1982), Tifft (1990) and references therein.

A small number of our velocities are listed with the notation ''poor velocity.'' These are weak cross-correlation velocities or velocities from single emission lines that need to be checked. We will do that. In general, there is enough information in the spectra to suggest that they are nearly correct (but I wouldn't stake my first born child on them).

III. Magnitudes

Magnitudes for galaxies are a persistent and pesky problem. We have tried to do our best to adopt a more or less uniform system for the largest number of galaxies. That system is the B(0)-Zwicky system (Huchra 1976). Magnitude sources for quoted values are given in Table 3. B_T magnitudes, when available, are given in columns 66-71. These are generally about 0.4 magnitude brighter than magnitudes on the B(0)-Zw system. Some additional galaxy magnitudes, especially for objects in deeper surveys, come from digital scans of photographic plates - mostly in the photographic J and R bands. These magnitudes, by definition, are rarely easily converted into the more standard isophotal or total photographic B systems; each observer requires different zero point and color corrections. Some magnitudes have also been entered from the StScI Guide star scans (G) and from other such sources. Until proven otherwise and properly calibrated, **these magnitudes are not to be trusted.**

Temporarily, we have derived very approximate corrections from other systems to the B(0)-Zwicky system. These are given for sources 3-7 as:

Magnitude Source - 3 B(0) = M + 1.38
Magnitude Source - 4 B(0) = M + 0.34
Magnitude Source - 5 B(0) = M + 0.5
Magnitude Source - 6 B(0) = M + 0.4
Magnitude Source - 7 B(0) = M + 0.5
Magnitude Source - A B(0) = M + 0.4
Magnitude Source - R,r B(0) = M + 1.6 for T < 1
Magnitude Source - R,r B(0) = M + 1.2 for 0 < T < 6
Magnitude Source - R,r B(0) = M + 0.9 for 5 < T
Magnitude Source - V,v B(0) = M + 1.0 for T > 1
Magnitude Source - V,v B(0) = M + 0.7 for T > 1
Magnitude Source - J B(0) = M + 0.4 (approximately).
Magnitude Source - C B(0) = M + 0.5

Note that these corrections are **NOT** in ZCAT, but rather represent suggested corrections for future and further use. ‘‘T’’ is the deVaucouleurs’ T-type described below.

Magnitudes are taken preferentially from the 1st Reference Catalogue of de Vaucouleurs - B(0) (magnitude source 0), Harvard Corrected (magnitude source 2), and then from the Zwicky Catalogue (magnitude source 1). Magnitudes from other sources are used only when necessary and/or available. As mentioned above, this choice of system maximizes the number of galaxy magnitudes available and will allow for easy conversion to other systems given diameter and morphological type information (*e.g.* the BT system). Note that we have begun to include corrected Blue magnitudes from the RC3, as magnitude source ‘‘A’’; these should be nearly identical to BT magnitudes (source 6), but again may not be of high quality unless based on actual photoelectric or CCD photometry. Magnitudes for many faint sources have been derived from either CCD or photoelectic photometry (particularly for AGN, Hewett and Burbidge 1993).

There are several published systems of correction to the Zwicky catalogue magnitudes (Burakowskia and Rudnicki 1974; Bothun and Schommer 1982; Giovanelli and Haynes 1984; Bothun and Cornell 1992; Kron and Shane 1976), but generally these require full morphological type and diameter information for the transformation. User’s of this catalog should transform the magnitudes as they require. Surprisingly, almost all of those papers have shown that Zwicky magnitudes are generally robust at the ±0.35 magnitude level as was origially shown in Huchra (1976).

2MASS magnitudes are listed as "khj=" in the comment field when available, same thing with SDSS magnitude, noted as "ugriz=".

IV. Morphological Types

The format for the morphological type designations is: I2, A1, I1, A1, where the first two digits are the numerically coded T type, the next letter is the Bar type, the next digit is the numericaly coded luminosity class, and the final letter denotes morphological perculiarities. The types are explained in more detail in Table 4.

Moderately detailed descriptions of morphological types have been given by Sandage (1966) and de Vaucouleurs *et al.* (1959; 1963; 1976). For this catalog we have chosen to used the numerically coded types, ‘‘T types,’’ devised by de Vaucouleurs and collaborators. Morphological types are de Vaucouleurs’ T types from the RC2, Uppsala Catalogue and the Revised Shapley-Ames Catalog. Some additional types have been defined for peculiar and un-typed objects and for objects that are in catalogs of extragalactic objects but are really galactic in nature:

24 = Open Star Cluster

25 = Plate Flaw, Star, etc. misclassified as a galaxy.
26 = TTauri Star
27 = Globular Cluster, Galactic
28 = Globular Cluster, Extragalactic
29 = Multiple Stars (Doubles/triples/...)
30 = Planetary Nebula, misclassified as a galaxy.
31 = HII Region, part of a galaxy.
32 = HII Region, misclassified as a galaxy.
33 = Reflection Nebula, misclassified elsewhere as a galaxy.
35 = High Velocity Cloud (usually from HI survey)
40 = Part of a galaxy
50 = Unclassified artifact (i.e. look into it more)
51 = No object at coordinates
52 = Artifact due to bright star (diff. spike)
53 = Meteor streak

Many of these later classifications have been added to aid in classifying "extended sources" in the 2MASS Extended Source Catalog. And some additional generic types have been defined for objects that cannot or have not been classified fully in the de Vaucouleurs revised Hubble sequence:

-9 = QSO/AGN, stellar, usually at high redshift
-6 = Compact Elliptical (same designation as DV)
-7 = Elliptical (generic)
11 = Compact Magellanic Irr (Extragalactic HII Region)
15 = Peculiar or untyped galaxy
16 = Irr II (a.k.a. "trainwreck")
20 = Sprial galaxy (generic)

Note that these would ordinarily be lumped into broader morphological bins, so 20's might be spread over types 1-6, -7's over -5 to -2, -6 would be lumped into -5, etc. if you want to use these types as part of the generic sequence.

We have decided to retain information on galactic objects misclassified as galaxies, on HII regions that are parts of other galaxies, and other such objects to prevent their inclusion in future lists of galaxies. Users should remove objects of type greater than 20 before using this catalog as a simple galaxy catalog --- otherwise you'll get all the HII regions in M101 listed separately as well a few plate flaws, stars and other assorted junk! We have also started (Fall of 1991) to include moderate redshift objects ($z < \sim 1.0$) identified in AGN and Quasar searches since these *are* legitimately large extragalactic objects that can play an important part in mapping large scale structure. Such objects are included in the catalog with the type designation ''-9.''

Additional types for galaxies in the first CfA Redshift Survey region have been estimated by J. Huchra from glass copies of the Palomar Sky Survey at Kitt Peak National Observatory. Types for southern galaxies come from both the ESO catalog and the Vorontsov-Velyaminov Catalogues. More detailed types for the second CfA survey have been estimated by Harold Corwin.

!!! BEWARE Remember that types as well as source designations should be read in alphanumeric format to not confuse blanks with zeros.

V. Diameters

Diameters are in arc minutes from the blue Palomar Sky Survey or the ESO quick blue survey à la Nilson, ESO, VV or the RC2. The input format is given below as F4.1, but be forewarned that several galaxies have diameters that exceed 99.9 arc-minutes (e.g. M31 and M33) and are stored as F4.0, and many, especially faint, compact galaxies have diameters smaller than 1 arc-minute that have been measured with precisions of two decimal places (*e.g.* 0.35'). As it stands, an input format of F4.n is sufficient to handle all the diameters in the catalog, but an output format of F6.2 is required to reproduce the catalog entries properly (without either overflow or truncation). Reading and writing diameters as A4 also works; the variable can then be translated into a number.

VI. Complete Subset Catalogs

There are several subset catalogs that represent ''complete'' samples of galaxies. One, published in the Ap. J. Supplements in June of 1983 is called ''North Zwicky Forty'' or NZ40.DAT for short (fans of bad Burt Reynolds movies take note). It contains all galaxies in the merged Zwicky-Nilson catalog with the following properties:

$$B \leq 14.5 \qquad \text{and}$$

$$b^{II} \geq 40^\circ, \ \text{and} \ \delta \geq 0.0^\circ \qquad \text{or}$$

$$b^{II} \leq -30^\circ, \ \text{and} \ \delta \geq -2.5^\circ$$

The velocities for this sample are complete - it contains one star III ZW 92 (Zwicky wasn't perfect, but awfully close!) and ~ 2400 galaxies.

The other, large area, complete, magnitude-limited catalog is called the ''Bright Galaxy Redshift Catalogue'' or BGRC.DAT for short and contains all known galaxies brighter than B(0) = 13.21 in our adopted magnitude system. It is a whole sky catalog and the velocities are 99% complete. It contains ~ 1350 galaxies. This sub-catalog has only been circulated as a private communication. This catalog is also extremely close to the Revised Shapley-Ames Catalogue of Sandage and Tammann.

ZCAT contains the data from the Southern Galaxy Redshift Survey (da Costa *et al.* 1987), which is an almost complete diameter limited sample of ~1900 galaxies, and the Second Southern Sky Redshift Survey or SSRS2 of da Costa *et al.* 1998, with ~5500 galaxies brighter than approximately 15.5 ESO blue magnitude. ZCAT also contains the data from the two IRAS galaxy surveys of M. Davis, J. Huchra, M. Strauss, J. Tonry and A. Yahil --- all objects above an absolute galactic latitude of 10 degrees with IR colors like galaxies and with $F_{60} > 1.95$ Jy (Strauss *et al.* 1992) and above 1.2 Jy (Fisher *et al.* 1995). ZCAT also contains all the data from the Nearby Galaxy Catalogue of Tully and Fisher (1987), and is being continually updated with the data for the UGC catalog survey of Bothun *et al.* (1986).

The 2dF Galaxy Redshift Survey 100k Data Release, 30 June 2001 is now included. Less than 3000 galaxies of this survey were dropped because the velocities were not good enough. You will find in the comment field the 2dFGRS assigned names of each galaxy starting with "TGS" or "TGN". The names of the galaxies are as noted below (see section VII). The 2dF Galaxy Redshift Survey Final Data Release (June 2003) redshifts not in the previous release were added May 2005 (125,349 redshifts). Please note that there are over 4000 redshiftless entries, those had z=-9.000 in the data file from the 2dF webpage (in the file best.observations.idz from http://msowww.anu.edu.au/2dFGRS/). Review of about 100 charts from that sample showed galaxies, pairs or galaxy+star pair. They will need further observations to acquire redshifts.

The 6dF Galaxy Redshift Survey Data Release 1 issued March 2004 is now included. Of their original 52,048 spectra, the spectra with redshift measurement quality of 3 and 4 were chosen. There are 45,945 spectras meeting this criteria. From this sample, 31,083 galaxies from this survery were taken to put into ZCAT, the remaining were already in the catalog. The 6dF Galaxy Redshift Survey Data Release 2 issued May 2005 is now included with 23,390 new redshifts not include in DR1.

The FLAIR Shapley-Hydra (FLASH) redshift survey catalogue has been added to ZCAT. It contains 4613 galaxies.

A sample of 155,811 galaxies from the SDSS Data Release 1 is now included. More than 6200 galaxies of this survey were found in ZCAT and the SDSS magnitudes were added and/or velocities with errors were replaced; ugriz (or combination) in the comment field means they are the SDSS u, g, r, i, z magnitudes. As of March 2005, 271,942 galaxies from SDSS Data Release 3 are also included.

Véron-Cetty and Véron's "A Catalogue of Quasars and Active Nuclei" 9th edition (source 4402) is included in ZCAT. **Please note**: magnitudes in ZCAT for these entries are noted as "V." However, they are not all V, please refer to the original publication for the correct magnitude source.

Finally, ZCAT also contains all of the published data for the galaxies in the CfA Redshift survey extension to $m_{Zw} = 15.5$.

A variant of the whole CfA survey has been published by Falco *et al.* 1999. In addition, ZCAT contains (but without complete velocity information) all the Zwicky catalogue galaxies with $m_B <$ 15.5 in the CfA survey extensions.

Some of the small catalogs can be downloaded directly from the web. These are:

- nz40
- CfA2
- Updated Zwicky Catalogue
- LCRS
- 2dF
- SDSS (to get to the Space Telescope Science Institute's SDSS query web page, click here)

VII. Nomenclature, Comments, and Identifications

In this catalog, we rely as much as possible on good positions for proper identifcation of the galaxies listed. In clusters we also rely on published finding charts. In many cases, several authors have published velocities for the same galaxy with different ID's and discrepant positions. We are trying to ''standardize'' cluster id's by using Dressler's (1980) numbers in the comment field. We have done our best to remove such degeneracies, but know that some such duplicates still exist in the catalog. For good examples, one can look at the recent ''deconfusing'' of part of the NGC catalog and Zwicky catalogue by Thomson (1991, 1992). Other errors exist in catalogs and several other groups, Paturel *et al.* (1991) and the RC3 group (de Vaucouleurs *et al.* 1991) are working hard on correcting and documenting these. Harold Corwin has also produced a revised version of the NGC/IC catalog without many of the errors propagated through the RNGC (Sulentic and Tifft 1973) and NGC2000.0 (Sinnott 1988). We are incorporating these changes and corrections as rapidly as possible.

We have adopted the following priorities for nomenclature. (1) If a galaxy has an NGC or IC designation (Dreyer 1898, 1905), then that is its primary ZCAT name in A17 format with the *first* character ''N'' or ''I.'' (2) If a galaxy is in the Zwicky *et al.* catalog and not in the NGC or IC, then its designation is ''hhmmt±ddmm'' where hh = hours, mm = minutes, t = tenths of minutes of time, and dd = degrees. These coordinate names are taken directly from the Zwicky *et al.* catalog; they are the coordinates minus the decimal point. Better coordinates from other sources may exist and may be found in the coordinate columns. Occasionally these improved coordinates contradict Zwicky's. The Zwicky name is a 10 character designation starting in the first character. (3) All other *anonymous* galaxies have names of the form ''hhmm±ddmm'' or ''Ahhmm±ddmm'' where ss = seconds and .s = tenths of seconds of time. Multiple components or multiple galaxies at nearly the same coordinates are designated by trailing letters such as ''hhmm±ddmmB'' where the ''B'' indicates the second object at that location. These addtional letter designations are usually added in order of right ascension. All coordinate names are made with the B1950.0 coordinates.

As of April 2004, ZCAT format names also include the 2MASS format names: hhmmssss±ddmmsss or 2Mhhmmssss±ddmmsss where ssss (in right ascension) are the ss.ss without the decimal point and sss (declination) are ss.s without the decimal point. This name has the J2000 coordinates, as opposed to the ZCAT standard B1950 coordinates.

Many galaxies are listed in more than one catalog - it is not unusual for a galaxy to be in Zwicky, Nilson, the MCG, Markaryan's lists, etc. We have tried to include complete identifications from the UGC, ESO and Markaryan lists, but other identifcations are given for only a small fraction of the galaxies in the catalog. (Usually they have been entered when the measurers provide machine readable catalogs of their data with all the other names listed). When they exist, MCG designations will be found in the comment field and will generally look like ''Mnn-mm-ppp,'' where nn is the declination zone (negative zones are preceeded by ''-''), mm is the sky survey field in the zone running from 0h, and ppp is the galaxy number. ESO designations like ''ESOnnn-(I)Gmmm,'' where nnn is the ESO field number and mmm is the galaxy number on the plate, appear as nnnmmm in the same column as the UGC galaxies. We have not preserved the distinction between isolated (-G) and interacting (-IG) galaxies in ESO.

Even though all coordinates in this list are quoted to $0.^{s}1$ and 1", the actual precision of positions for galaxies varies considerably. In general, coordinates from the Zwicky or Nilson catalogs are quoted to 1' and are precise to a little better than that. Coordinates from the MCG are often off by more than 2'. Galaxies from the above catalogs have coordinates quoted to only the nearest 1' and 6^{s}. Coordinates precise to 5"-6" have been taken from the RC2, from Spellman, Madore and Helou (1989), Dressler (1980), the ESO Catalog, the PGC, the RC3 and similar lists. We have endeavored to update and upgrade the coordinates in our lists as we can and also to remove confusion in crowded fields whenever we run across one. In some small number of cases, usually in the inner regions of clusters of galaxies, coordinates to this precision have been measured by us or our collaborators. A growing subset of galaxies in this catalog have coordinates measured to arc-second precision via measuring engine or plate scanner. This is particularly true for Seyfert galaxies, Markaryan galaxies, radio sources and other AGN, and also for data sets that come from multiple-fiber observations or new, deep small area surveys. Coordinates for IRAS sources extracted from the PSC are accurate to 20"-30", while strong sources that have been add-scanned will have more precise coordinates.

VIII. Spectra

Many of the galaxies in the catalog (notably the ones in our own surveys) have spectra on line at CfA. These are indexed by either their Reduce File Number (RFN) from the early Reticon days, or by the date of observation (DDMMYY) with the new CCD spectrograph (FAST, built by Dan Fabricant) on the 1.5-m at Mt. Hopkins. For Reticon spectra, T designates those taken with the Tillinghast, M with the MMT, L refers to spectra reduced by us but taken by Steve Shectman at Las Capanas with their reticon system, and S refers to the SAAO Radcliffe 1.9-m telescope in South Africa.

Spetra on-line at CfA and available to the public (including all those in the CfA1 and CfA2 surveys and the UZC catalog) can be accessed at the CfA Telescope Data Center: Spectral Archive

IX. Other Notes

In a very few instances we have listed discrepant velocities (where two velocity measures disagree by more than double their combined external errors) found by other sources in the comment field - *e.g.* 1234(9) indicates a velocity of 1234 from source 9. Effort is being made to clear these up by remeasuring the galaxies.

In general, the velocities listed are the best available in terms of the quoted measurement errors and the reliablity of the source (some people persist in quoting errors considerably smaller than their true external errors). In only a few cases have we attempted to average high quality data to produce slightly better values. For almost all objects only one velocity is available. We do not think it appropriate to average low quality data with the newer, significantly better velocities available from 21-cm work and relatively high dispersion optical work. The purpose of this catalog is to be a complete list of galaxies with radial velocities for mapping and statistical studies. (Observers who feel that their velocities have been slighted for poorer velocities should contact J.P.H.) In several cases, we have omitted velocities derived from detailed HI maps of galaxies - primarily because a single dish measurement of sufficient quality is usually extant. The best quality optical and HI observations have velocity errors < 10 km sec^{-1}, which are well below the internal velocity dispersions of the galaxies. By definition, there is some question as to what such high ''precision'' velocities really mean relative to the centers of ''mass'' of galaxies.

Radial velocities greater than 100,000 km/sec are now included in ZCAT (previously located in ZBIG.DAT). Please note that the velocities are noted as redshifts in F7.4 format. Averaged radial velocities for Abell clusters will also be found in another catalog ABELL.DAT.

Some galaxies from zsource= 4559 (Cohen *et al.* 2000) have T type. These values were taken from a follow-up paper: van den Bergh, Sidney *et al.* 2001, AJ, 122, 611.

The cataloguers make no claim that this issue is complete or free from errors. All galaxies brighter than B(0)=13.2 have been included, even when no velocity is available, but otherwise there is no homogeneous magnitude limit to the catalog. Some galaxies are listed despite their lack of velocity. These are objects in complete samples that we are currently trying to observe, DDO dwarves without velocities, ''DOUBLE'' galaxies that have been split up for the production of North Zwicky Forty or galaxies from other interesting catalogs (*e.g.* Binggeli *et al.*'s work on the Virgo Cluster dwarves - Ref 0109). Magnitudes on systems 0, 1 and 2 are more or less equivalent but other systems have not been well calibrated and are meant only to serve as a guide to the galaxy's brightness. Some of this data is unpublished, so authors are warned against making reference until this list is formally published.

X. Software

Several frotran programs are available to make data cuts, searches and maps from our catalog data. Chief among them are

- msample.for
- circle.for
- map.for

Msample is a program for taking coordinate, type and magnitude cuts in zcat format files. Circle is a program for doing cone searches. Map is a program for making Aitoff or Linear surface maps of data in zcat format.

We are constantly updating this list as new velocities, particularly better velocities, become available. We do not guarantee that what you see one day will be there the next!

A fairly large number of FORTRAN based utility programs now exists for sorting and searching in ZCAT including routines to do circle searches around annuli, cuts in galactic or equatorial coordinates, etc. See John Huchra for a more detailed description of these.

If errors are found, as some are sure to be in a compilation this large, please report them to the author (J.P.H.). If you wish to make additions, these will be gratefully accepted --- even more so if listings include accurate J2000 coordinates and heliocentric velocities and are transmitted electronically.

In this day and age, there is no need to present data in unusable formats, so we humbly request that all authors henceforth quote heliocentric velocities (or redshifts = (delta-lambda)/lambda), with their errors *if available*, and reasonably accurate J2000 coordinates in publications of data and that journal editors not accept papers presenting velocities in unusable forms. Presentation of velocities in undefined or poorly defined inertial reference frames (*e.g.* Local Groupocentric or the microwave background frame) should be avoided at all costs. Editors please take note!

Special thanks are in order for all the people who have worked on this catalog over the years - Cathy Clemens, Dinah Danby, Bob Davis, Marc Davis, Ed Horine, Dave Latham, Jon Morse, Jim Peters, Suzanne Rapp, Michael Strauss, Susan Tokarz, John Tonry and Jeff Mader. Several other fearless catalogers of galaxies and galaxy properties, most notably Harold Corwin and Dave Burstein, deserve thanks if only for being the last of a dying breed, as well as for comments, corrections, classifications and data. Thanks are also extended to those other observers who have sent in redshifts (particularly those who send heliocentric z's and good coordinates!) and corrections like Tony Fairall, Ed Groth, Riccardo Giovanelli, Martha Haynes, George Helou, Lyle Hoffman, Nathan Krumm, Otto Richter, Ed Salpeter and Wayne Warren. Lastly, we would like to thank all those people who have been willing to send us electronic copies of extended catalogs; these have certainly made our jobs significantly easier as well as reducing the probability of error on entry. This work has been supported by the Smithsonian Institution and by NASA grant NAGW-201. Some computer support has also been provided by the Digital Equipment Corporation.

Thank you.

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