References for Galaxy Clusters Database

M. Kalinkov, I. Valtchanov, I. Kuneva
Institute of Astronomy, Bulgarian Academy of Sciences, 72 Tsarigradsko Chaussee blvd, BG-1784 Sofia, Bulgaria

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ABSTRACT

A bibliographic database will be constructed with the purpose to be a general tool for searching references for galaxy clusters. The structure of the database will be completely different from the available now databases as NED, SIMBAD, LEDA. Search based on hierarchical keyword system will be performed through web interfaces from numerous bibliographic sources – journal articles, preprints, unpublished results and papers, theses, scientific reports. Data from the very beginning of the extragalactic research will be included as well.

References for galaxy clusters (RGC) is continuation of a previous project for collecting all published information for galaxy clusters. There are neither previous attempts nor projects for compiling such database for galaxy clusters and our effort will be to include into the database all of the available bibliography through our system of keywords until the end of 1999. Now over 3 000 entries are included into the preliminary version of the database.

1. Introduction

Clusters of galaxies are the largest gravitationally bound systems in the Universe. They are the most effective tracers of the large scale structure of the Universe, as well as of the formation history and evolution of the largest mass scales.

About 16 000 clusters of galaxies are known at present and there is a large amount of observational data for about 2–3 000.

It is true that some information on clusters (catalogs, lists, etc.) can be retrieved from any astronomical data center, but it is impossible more specific information to be obtained. The only exception is NASA/IPAC Extragalactic Database (NED). But despite of the tens of thousands references stored in NED, there is no easy way to find where, e.g. photometry is published for a given cluster.

The main aim of our project is to give the opportunity for queries where data for any observation or theoretical consideration is published or stored. It is reasonable to test the basic
concepts which will be incorporated in the database using A/ACO clusters of galaxies (Abell 1958, Abell et al. 1989). And this work concerns mainly the data for these clusters.

2. Catalogs of clusters of galaxies. Identifications

The first catalog of clusters of galaxies was published by Abell (1958) for $\delta \geq -27^\circ$ and extended by Abell, Corwin & Olowin (1989) for $\delta \leq -17^\circ$. Thus both catalogs are unique in their coverage of the entire sky. We denote the clusters from these catalogs with prefix “A” (which is not the same as in NED). There are A1 ÷ A4076 clusters, about 4050 different. Moreover, ACO contains about 1150 supplementary (S) southern clusters which are either not rich enough or at a great distance to be included in the main catalog.

Many clusters are found by Zwicky et al. (1961–68) but for $\delta \geq 0^\circ$. Their total number is 9133 (denoted with prefix “ZC”).

There are other lists of groups and clusters:

Various visual searching procedures for clusters result in a subjective catalogs. While the catalog of Sheetman is the first one where a “blind” computer search was performed among the famous Lick counts of galaxies (Shane & Wirtanen 1967, Seldner et al. 1977).

The Abell-like algorithm catalogs are entirely automated and so they are entirely objective.

Clusters of galaxies are found also by Jackson (1982), Gunn, Hoessel & Oke (1986), Willick (1991) and Postman et al. (1996).

Some designations of clusters are proposed and used before A/ACO catalog publication and some of them have clear correspondence to the objects in the A/ACO catalog. For example, A3266 = Ser040/6 = DN0431-616 = APM510 and references for all these objects must point to A3266. So it would be impossible to retrieve the information available for a given A/ACO cluster without making first a cross-identifications of clusters among all available catalogs or lists. Some identifications are presented in the original ACO catalog with some misprints or errors.

We present here a new cross-identifications (Appendix 1) between A/ACO clusters and the other clusters. Abell–Zwicky cross-identifications are taken from Kalinkov et al. (1997, 1998). Appendix 2 contains some essential notes about A-ZC identifications.

3. Two ways to retrieve references

The basic idea is to assign two lists to each reference – the first contains the A/ACO clusters and the second contains the keywords describing observational data or results.

Two ways for references retrieval for any cluster are possible – using a glossary of keywords
or using a thesaurus which is created for that particular need of clusters of galaxies.

The present version of this project operates with a glossary, given in Appendix 3 (where names and designations as Coma, Perseus, Virgo,... Shapley Scl, Ind Scl, Psc-Cet void, Hydra A, ...3C28, 3C40, NGC 1272, NGC 1275 ...are not included).

Using a thesaurus of the kind compiled by Shobbrook & Shobbrook (1993) would be convenient but it is very hard to create a new thesaurus for such a narrow field like clusters of galaxies. If a usual thesaurus is available then it would be quite simple to find any reference assigned with a narrower term. But it is not possible to use a narrower terms for clusters of galaxies, when there are hierarchical structures (double galaxies, groups, superclusters, substructures and so on). Two examples are given in Appendix 4 – for primary terms (PT) CLUSTERS OF GALAXIES and SUPERCLUSTERS OF GALAXIES. Evidently, the broader term (BT) is STRUCTURES. The corresponding narrower terms (NT) as well as related terms (RT) are presented. The main difficulty is that many NT denoted with “∗” – Catalogs, Crossing time, Searching radius, . . . , have meaning which is different for different PT. So the ∗ figures as a comment or a scope note (SN). As a conclusion, a general retrieval of references is possible for combinations of NT and PT.

4. Current status

(i) 3000 references are included – journal articles, workshops, symposia, colloquia papers, thesis works.

(ii) References for all A/ACO clusters of galaxies, together with their cross-identification (Appendix 1) may be retrieved at present. There are about 5200 clusters.

(iii) The glossary is given in Appendix 3.

5. Future developments

(i) Actualizing the references. At the end of 1999 we expect to entry about 12 000 titles.

(ii) Including non A/ACO clusters – about 16 000 objects.

(iii) Extending the glossary.

(iv) Creation of thesaurus oriented to the field of clusters of galaxies.

(v) Free web access to the database
Acknowledgements

This project was initiated ten years ago as a part of a project “Reference Catalog of Clusters of Galaxies”. The creation of the database for clusters of galaxies is a complex and time consuming work, having in mind all the recent developments and the pouring observations of clusters of galaxies. Many colleagues have helped us and it is impossible to mention all of them. But we would like to thank particularly H. Andernach, H. Corwin, G. Dalton, G. de Vaucouleurs, J. Huchra, W. Keel, R. Nichol, F. Ochsenbein, A. Omont, G. Paturel, M. Postman, M. Ramella, H. van der Laan, R. Williams.

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Table 1.

| Reference                          | Prefix | Number of Objects |
|------------------------------------|--------|-------------------|
| **Visual procedure**               |        |                   |
| Klemola (1969)                     | Kl     | 44                |
| Sersic (1974)                      | Ser    | several tens      |
| Rose (1976)                        | Ro     | 124               |
| Duus & Newell (1977)               | DN     | 710               |
| Snow (1978)                        | Sn     | 29                |
| Braid & MacGillivray (1978)        | BMc    | ~ 400             |
| Quintana & White (1990)            | QW     | 267               |
| **Semi-automatic algorithm**       |        |                   |
| Shectman (1985)                    | Sh     | 646               |
| **Abell-like automatic algorithm** |        |                   |
| Lumsden et al. (1992)              | ED     | 737               |
| Dalton et al. (1997)               | APM    | 957               |
## APPENDIX 1

| A/AC0 | z   | nz | Cross-identifications |
|------|-----|----|-----------------------|
| A0001 | 0.1249 | 1   | ZC0022                |
| A0003 | 0.1012 | 1   | ZC0029                |
| A0005 |    |     | ZC0037                |
| A0006 |    |     | ZC0039                |
| A0007 | 0.1073 | 1   | ZC0048                |
| A0008 | 0.0949 | 1   | ZC0052                |
| A0013 | 0.0943 | 37  | APM021 Sh500          |
| A014  | 0.0667 | 8   | APM023 ED418 Sn01-05  |
| A0015 | 0.1211 | 2   | APM030 ED419          |
| A0016 | 0.0838 | 1   | Sh502 ZC0071          |
| A0017 | 0.0862 | 1   | ZC0069                |
| A0021 | 0.0946 | 11  | ZC0104                |
| A0022 | 0.0646 | 5   | APM050 ED437          |
| A0023 | 0.1052 | 1   | Sh508 ZC0105*         |
| A0024 | 0.1332 | 1   | ZC0106*               |
| A0025 |    |     | ZC0108                |
| A0026 | 0.1462 | 2   | ZC0109                |
| A0027 | 0.0640 | 2   | APM062 Sh511          |
| A0028 | 0.1945 | 2   | ZC0121                |
| A0029 |    |     | ZC0131                |
| S0002 | 0.0647 | 1   | ED393 BM433           |
| S0003 |    |     | ED395                 |
| S0004 |    |     | DN0001-702            |
| S0008 |    |     | DN0004-681            |
| S0012 | 0.0513 | 3   | APM012 ED407 BM279    |
| S0017 |    |     | APM022 ED414 BM282 DN0011-380 |
| S0019 |    |     | DN0013-681            |
| S0020 |    |     | DN0013-700            |
| S0021 | 0.0383 | 2   | QW001                 |
| S0027 |    |     | QW002 DN0016-697     |
| S0028 | 0.0535 | 1   | Sh506                 |
| S0034 |    |     | BM052                 |
| S0035 | 0.1232 | 5   | DN0020-394            |
| S0037 | 0.0528 | 18  | DN0021-425            |
| S0041 | 0.0498 | 1   | ED443                 |
| S0043 |    |     | APM066                |
| S0045 | 0.0248 | 1   | DN0022-571 Ro025      |

* - comment in Appendix 2 for A-ZC correspondence
## APPENDIX 2

### A/ACD Comments

| Comment | Description |
|---------|-------------|
| A0023  | hfZC012   |
| A0024  | fZC0076   |
| A0055  | hfZC0173  |
| A0064  | +A0065+A0067=ZC0194? |
| A0065  | +A0064+A0067=ZC0194? |
| A0067  | +A0064+A0065=ZC0194? |
| A0071  | heA0077=heZC0213,hbZC0181 |
| A0075  | heZC0217 |
| A0077  | heA0071=eZC0205 |
| A0095  | +A0101=ZC0254 |
| A0101  | +A0095=ZC0254 |
| A0102  | hbZC0265 |
| A0132  | fZC0322 |
| A0142  | fZC0368 |

- **hb** - half background
- **hf** - half foreground
- **he** - half equidistant
- **f** - foreground
APPENDIX 3

GLOSSARY

1st, 2nd... - First, second... rank
gamma rays
gas

21 cm gas
GINGA
global cls

absorption lines
gravitational lensing

AGN - active galactic nuclei
H0

alignment
HI

angular momentum
HII

arc

arcllet

associations
HALPHA

background photometry
HR - Hertzsprung-Russell diagram

Bar
Hubble Space Telescope

BCG - bright cluster g
Hubble diagram

binary model
I(s) - irregular(s) g(s)

black holes
ICG - intracluster gas

blue arcs
ICM - intracluster medium

blue gs
identification

blue objects
IGG - intergalactic gas

BM - Bautz-Morgan classification
IGM - intergalactic medium

BO - Butcher-Oemler effect
image

CCD infall

CCD photometry
IR - infrared

catalog
IRAS

cD, cD2
isophote photometry

CD LF - LF of cD gs
isopleth map

cl(s) - cluster(s)
IUE

c1 detection
jet

classification
KARA - Karachentsev

cO - CO observations
kinematics

colors
Lick - Lick observatory counts

compact gs
luminosity

cD LF - luminosity function

complex
luminosity segregation

cooling flow
LALPHA

core
Malmquist bias

correlation
map

correlation function
mass

cOSMOS
mass/energy

crossing time
M/L

cusp
mass segregation

d25 - 25 mag. diameter
member

db - dumb-bell
model

density
morphology

disk gs
m-z - magnitude-redshift relation

distance
NELGs - narrow emission line gs

DM - dark matter
[OIII]

double gs
0 - optical

dust
0 identification

dynamics
0 position

dwarfs
orbits

dEs - dwarf ellipticals
PA - positional angle

e(s) - elliptical(s)
peculiar

e&S0
photometry

E+cD
polarization

elongation
polar-ring gs

emission line gs
pole

emission lines
profile

equidensities
PUMA observations

EXOSAT
QSO

evolution
R - radio

Faraday rotation
radius
[FeX] ring gs
FIR - far infrared radiation RLF
formation ROSAT
rotation

g(s) - galaxy(-ies) S(s) - spiral(s)
g content Scl(s) - supercluster(s)
g mass Tifft effect
rotation

Scott effect TF - Tully-Fisher relation

g segregation UBV
shell gs

shape UV

simulations velocity
size velocity dispersion
SN - supernova velocity distribution
spectra velocity flow
spectroscopy velocity segregation

star formation velocity
statistics void
stellar population wavelet

Stroemgren wedge
structure X - X-ray radiation
X core

subclustering XLF - X-ray and radio LF
superposition X models

Sy - Seyfert X Scl
SZ - Sunyaev-Zeldovich effect X subclustering
tail z - redshift
tidal effect
APPENDIX 4a

PRIMARY TERM: CLUSTERS OF GALAXIES
BROADER TERM: STRUCTURES

NARROWER TERMS:

1st, 2nd, ..., 10th galaxy *Luminosity
Abell clusters *Luminosity function
*Alignments *Mass
APM clusters *M/L
BM classification *Membership
*cD galaxies *Morphology
*Catalogs Orbits of galaxies
*Content *Radio data
*Correlation functions *Relaxation time
*Counts *Richness
*Crossing time *Rotation
D galaxies *Searching procedures
Density cusps *Shape
*Distances *Simulations
*Dynamics *Size
ED clusters *Subclusters
*Evolution *Substructures
*Formation *Types
*Gas *Velocity dispersion
Intracluster matter *Velocity distribution
*Kinematics *X-ray data
Lick clusters Zwicky clusters

RELATED TERMS:
Galaxies
Great Attractor
Mergers
Missing mass
Peculiar velocities
Scott effect
Selections
Sunyaev-Zeldovich effect
Superclusters
Velocity field
Virial theorem
APPENDIX 4b

PRIMARY TERM: SUPERCLUSTERS OF GALAXIES
BROADER TERM: STRUCTURES

NARROWER TERMS:

* Catalogs
* Crossing time
* Correlation functions
* Counts
* Dynamics
* Evolution
* Formation
* Great Attractor
* Kinematics
  Local Supercluster
* M/L
* Maps
* Mass
* Membership
* Multiplicity
* Radio data
* Searching procedures
* Shape
* X-ray data

RELATED TERMS:

Clusters
Selections
Virial theorem