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Astronomical Data Centre

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1 Introduction

The Astronomical Data Centre (ADC) at IUCAA has a large collection of catalogues, data libraries and images, together with software for accessing these resources. The ADC was developed in response to the Indian astronomical community's need to access data from various sources in a simple and user friendly way, but it can be used by the astronomical community all over the world.

In manual searches of catalogues, a researcher requiring information about a subset of objects in a catalogue, has to work through a number of pages in the catalogue to get the required information. During this time no other person can access the information. After data collection, the researcher has the Herculean task of collating and studying the data statistically. The difficulties are compounded when the required information is spread across several catalogues, all using different conventions. An alternative, which has been available for a few years now, has been to access computer based data banks. However these data banks are all located outside India and can be accessed only through sophisticated computer networks of the kind which are not available in India at the present time except at a few locations. Access through the public telephone network is sometimes possible, but this is prohibitively expensive. Even when computer networks become available, accessing data from abroad will require the use of international telephone links or satellite channels which will remain expensive, especially for a user based in India, for a long time.

The situation improves dramatically when facilities created at the ADC are used. With the help of catalogues and software available at the ADC, many users can at the same time quickly filter information from a number of catalogues, carry out preliminary statistical analysis, and produce output in convenient machine readable or graphical form. The resources of the ADC can be accessed in a number of different ways ranging from queries sent through ordinary post, to remote connection to the ADC computers. The software can be tailored to the specific needs of the Indian astronomical community, and data which is not already available with the ADC can be easily obtained for the user. In the following pages we will describe the various facilities available at the ADC and the methods for accessing them.

2 Data with the ADC

The ADC has aquired data from a number of sources, including the Centre de Données Astronomiques de Strasbourg (CDS), France and the Astronomical Data Centre at the National Space Science Data Centre,Maryland,USA. This data was obtained on tapes , cartridges and CD-ROM and consists of a collection of more than 500 catalogues (see Appendix D). Data has also been obtained directly from individuals and the literature. The ADC has a number of stellar libraries like the Stellar Spectrophotometric Atlas (J.E. Gunn, L.L. Stryker), Library of Stellar Spectra (G.H. Jacoby et.al.), and image data at different wavelengths. The collection is augmented from time to time with new data.

It is not possible to include in this booklet details of the data presently with the ADC, but this information can be easily obtained by users in the manner described below. Data which may be needed by a user, but is not available with the ADC, can be easily and quickly obtained, as a service to the user, if sufficient information is provided about its location. A list of catalogues available with the ADC can be sent on a floppy to a user upon request.

3 Data retrieval

Data can be retrieved in two different ways :

- Object based search.
- Catalogue based search.

3.1 Object based search

In this case the data pertains to a given object such as a galaxy, quasar or star. The object is identified by a standard name or designation or position, and the system provides all the data available on it. It is also possible to search a chosen area of the sky around the given object, look for its nearest neighbours and so on. The databases SIMBAD and IPAC function in this manner. This method is very useful when data is required on a list of objects.

3.2 Catalogue based search

For some applications it is necessary to search for objects in one or more specified catalogues. Such searches involve finding objects with given properties, like those with redshift in a given range and visual magnitude brighter than a certain limit.

4 Searches at the ADC

The ADC software permits catalogue based as well as object based searches. A number of programs have been developed which allow the user to make convenient menu based searches. Catalogues like the *"Third Reference Catalogue of Bright Galaxies"* (de Vaucouleurs et.al.) contain thousands of objects, each with tens of measured parameters. It is difficult even to display the catalogue on a normal computer screen. The ADC software allows the user to select required parameters and obtain values for these for a subset of the catalogue. The results of the search can be viewed on the screen, printed or received at a remote location by E-mail. At the present time the ADC software allows only a subset of the available catalogues to be searched in this manner. In what follows, catalogues which can be accessed through the software will be called *processed catalogues.* When a catalogue is not processed, it can still be accessed in a simple manner, but the user has to write simple programs for selecting required objects and fields.

The ADC software also allows basic data on specific objects of different types to be obtained. Here the user selects the class of object (star, galaxy, quasar) and provides a list of objects. The software then retrieves data on these objects from certain pre-selected catalogues.

5 How to access the ADC

The data at the ADC can be accessed in a number of ways ranging from queries sent through the normal postal service, to remote access using the telnet facility. These methods are summarized below.

5.1 Access through the postal and related services

A user who needs a catalogue, or data on a list of objects, can send the query through ordinary post, courier service or FAX, specifying the medium on which the data is needed. The available media are paper, diskette, tape, cartridge and exabyte. Data can be provided on paper only if the length is manageable. When data is provided by any other means, the medium is to be returned to the ADC after the data is copied by the user, or the cost of the medium is to be reimbursed.

Queries received in this manner will normally be answered on the same (working) day, with the data being dispatched through a courier. When the data is not available with the ADC, all efforts will be made to obtain the data, if the location is known to the user or can be discovered by the ADC.

5.2 Access through E-mail

The ADC computer can answer queries received by E-mail, if these are sent in a fixed format. The advantage of this method is that the turnaround time is just a few minutes, and the presence of a human expert is not needed. The ADC computers will be available for queries at all hours on all days of the year, barring shutdown due to faults or maintenance. The details for using this facility are provided in Appendix C. When the queries are too complicated to be interpreted by the computer, i.e. when they cannot be put into the fixed format required, they can be sent to the ADC manager. The E-mail address for this is also in Appendix C. Queries received by E-mail will be answered in the same manner, except when the required data is very voluminous, in which case it will be dispatched on an appropriate medium.

5.3 Access through telnet

When the *telnet* facility is available to the user, it is possible to log into the ADC computer. In this case all the data and programs are accessible and the user can interactively prepare a file of the required data, and the file is automatically sent by E-mail to the user. If a single file is longer than 100KB, it can be copied to the user's site using the ftp facility. The ADC can be accessed through the World Wide Web (WWW), if the Xmosaic facility is available at the user's site. The details are provided in Appendix B.

5.4 Visits to the ADC

When a user needs to extensively access the ADC software to examine data, or to transfer large volumes of data, it will be convenient to actually visit the ADC. It will then be possible for the user to have direct access to the computers, as well as support from the ADC staff. Some funds are available for such visits.

6 How to use the ADC

6.1 Processed catalogues

This section provides a brief description on how the ADC programs may be used to access processed catalogues, provided the user has the facility to log into the ADC computers. Those who do not have this facility may use this section to structure their queries appropriately before sending them through post or E-mail.

A user logs into the ADC computers as *"data"* at the login prompt. Several options are then presented on the screen. Some of the menus are displayed in Appendix B, while a brief description of the options is given below.

1. **List of Catalogues** : This option allows the user to find out which catalogues are available with the ADC, the manner in which they are stored and accessed, their length and so on. By making the right menu selections, it is possible to browse through the list of catalogues or to obtain information about specific catalogues by selecting them using the author name, title, year of publication or keywords. This search will indicate which catalogues can be used through the ADC software(we call these *processed catalogues*).

2. **Catalogues** : This option allows the user to access *processed catalogues*. These have been grouped into categories by the type of objects they contain. The categories that are available at the present time are:

- Cobe
- Galaxies
- Nebulae
- Pulsars
- Quasars
- Radio Data
- Stars
- X-ray Data

When a category is chosen, the list of catalogues under it are displayed. When one of these is chosen, the data fields in the catalogue are displayed and those required can be selected. Various filters are then presented, so that a subset of the objects in the catalogue can be chosen. The selected data fields for the objects in the subset are then displayed and stored for later use. A *Help* option is available for every catalogue. This provides information about the data available in it. A sample session is provided in Appendix B.

3. **Utilities** : This option provides a number of programs which allow the user to search specified areas of the sky, obtain distribution of various quantities, graphical representations, statistical analysis and so on. Many programs here are still under development. At present the option provides for the following searches :

   - **Galaxies near galaxies** : Find galaxies within a given area of the sky around a specified galaxy.
   - **Stars near galaxies** : Find stars within a given area of the sky around a specified galaxy.

4. **Telnet** : This option allows the user to access other international databases while using the ADC. The databases that can be accessed at present are :

- EINLINE (Einstein On Line Service)
- NED (NASA/IPAC Extragalactic Database)
- SIMBAD (Centre de Données astronomiques de Strasbourg)
- IUE (International Ultraviolet Explorer)
- PINET (The Physics Information Network of The American Institute Of Physics)

5. **Help** : This option provides a short description of the various items in the main menu.

6. **Exit** : This option is used for terminating the program.

6.2 Unprocessed catalogues on disk

These are catalogues in ASCII format which are available on disk, but not in a processed form. They cannot be accessed through the ADC software, and it is the user's responsibility to develop the simple programs for reading their contents. The ADC can provide help in developing such programs.

To reach such a catalogue, the access code of the catalogue should first be determined from the list of catalogues. Typing the access code in the account called *data* changes the directory to the location of the catalogues. A list of files available is then displayed on the screen, and can be used as any other ASCII file. As an example, typing "rc3" takes you to the directory where the rc3 catalogue is stored on disk(note that a processed version of this is available).

6.3 Catalogues on tape

These are catalogues which are not expected to be used often. Personnel of the ADC can load these catalogues on disk, and provide access to them, when a request is received.

7 Appendix A : Addresses

Postal Address :	Astronomical Data Centre IUCAA Post Bag 4, Ganeshkhind Pune - 411007 India	
Fax :	0212 335760	
E-mail Address :	astrodat@iucaa.ernet.in	
IP Address :	144.16.31.6	telnet login:data ftp login:anonymous
WWW URL :	http://www.iucaa.ernet.in/	(Xmosaic)

8 Appendix B : Telnet and ftp

- **Telnet** : The use of *telnet* to access the ADC will be explained through an example.
  To begin a session, the user executes the following command :

  telnet 144.16.31.6

  At the login prompt the user logs in as **data**. (See **Figure 1**.)

  Depending on the type of the terminal, the user types **sun** or **vt100**. Now he sees the main menu of the ADC. (See **Figure 2**.)

  An example of a session is shown in the following figures.

- **ftp** : ftp is a program that allows a user to transfer files from one host to another over the network. The transfer begins with the user executing the following command on his computer :

  ftp 144.16.31.6

  At the username prompt the user should enter either **"ftp"** or **"anonymous"**. The program will then ask for the password. The user should type in his e-mail address in place of the password. Now the user has logged into the computer as an anonymous user and can navigate the directory structure using the cd command. It is not possible to execute programs in this mode. To retrieve a file the user executes the following command :

  get ⟨file name⟩

  In the context of the ADC, *ftp* is used to obtain long files created by the user as a result of a search.

```
shelltool - /bin/csh

jupiter {43}: telnet 144.16.31.6
Trying 144.16.31.6 ...
Connected to 144.16.31.6.
Escape character is '^]'.

SunOS UNIX (jupiter)
login: data
Last login: Thu Jul 14 10:37:34 from io
SunOS Release 4.1.3 (jupiter) #1:Fri Dec 24 12:44:21 GMT+0500 1993
You have mail.
Thu Jul 14 11:18:40 GMT+0500 1994
/jusr3/anonymous
Choose terminal type : sun or vt100?
sun
```

Figure 1: Login

```
cmdtool - /bin/csh

ADC

Opening Menu

1. List of Catalogues
2. Catalogues 1
3. Catalogues 2
4. Telnet
5. Utilities
6. Help
7. Quit

Enter your choice: 2

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Application : ADC2          Menu : ADC2     V^   <OSC> <DBG>     <Rep>
```

Figure 2: Opening Menu, Choice 2

cmdtool-/bin/csh

Astronomical Data Centre

MISC

1. Cobe
2. Galaxies
3. Globular Clusters
4. Nebulae
5. Pulsar
6. Prev Menu
7. Exit

Enter your choice: 2

Inter University Centre for Astronomy and Astrophysics

Application: ADC2 Menu: TRY2 v^ <OSC> < DBG> < Rep>

Figure 3: Categories Menu

shelltool-/bin/csh

Astronomical Data Centre

Galaxies Catalogues

1. Galaxies 1
2. Galaxies 2
3. Previous Menu
4. Exit

Enter your choice: 1

Inter University Centre for Astronomy and Astrophysics

Application: ADC2 Menu: GALAXIES v <OSC DBG > <Rep>

Figure 4: Galaxy Submenus, Choice 1

```
cmdtool - /bin/csh

Astronomical Data Centre

Galaxies Catalogues

1.  Abell & Zwicky
2.  Basic Data (de Vau. 3rd ed)
3.  CFA
4.  CGCG
5.  de Vaucouleurs 2nd ed.
6.  De Vaucouleurs 3rd ed
7.  Previous Menu
8.  Exit

Enter your choice: 1

Inter-University Centre for Astronomy and Astrophysics

Application:ADC2    Menu: ADC2    v^    <OSC> < DBG>  <Rep>
```

Figure 5: Galaxy Catalogue 1 Menu, Choice 1

```
shelltool - /bin/csh

Astronomical Data Centre

CFA Catalogue

1.  Select
2.  Browse
3.  Help
4.  Previous menu
5.  Main Menu

Enter your choice: 1

Inter-University Centre for Astronomy and Astrophysics

Application:ADC2    Menu: CFRAMENU    v    <OSC> < DBG>  <Rep>
```

Figure 6: CFA Catalogue Menu, Choice 1

```
cmdtool - /bin/csh

0.    Name
1.    rahr
3.    decdeg
5.    Photo-Mag
6.    Redshift
7.    nt
8.    T_Type
9.    Dia_Maj_Axis
10.   Dia_Min_Axis
11.   Notes
98.   All fields
100.  Quit Select

Select fields for display.
Choose fields separated by blanks & end with RETURN:
0 1 3 5 6
```

Figure 7: Field Selection Menu for the CFA redshift cataloge.
Fields 0,1,3,5,6, chosen for display

```
cmdtool - /bin/csh

0.    Name
1.    rahr
3.    decdeg
5.    Phto-Mag
6.    Redshift
7.    nt
8.    T_Type
9.    Dia_Maj_Axis
10.   Dia_Min_Axis
11.   Notes

Choose fields for filtering. One field is to be selected
at a time.Only objects in selected ranges will appear in
the output.
Choose a field number or type 99 to PROCEED: 1
```

Figure 8: Range Selection Menu, selection of range for item 1 (RA) begins

```
LOW Right Asc Range :
        HR      MIN     SEC
        11 0 0
HIGH Right Asc Range:
        HR      MIN     SEC
        11 15 0
```

Figure 9: Minimum and Maximum values for RA chosen

```
cmdtool - /bin/csh

LOW Declination Range :
        DEG     MIN     SEC
        10  30  0

HIGH Declination Range :
        DEG     MIN     SEC
        13  30  0
```

Figure 10: Range for declination chosen

```
cmdtool - /bin/csh

For field Photo_Mag
Enter Range low :0

Enter Range High :14
```

Figure 11: Range for Photographic Magnitude chosen

```
cmdtool - /bin/csh

0.      Name
1.      rahr
3.      decdeg
5.      Photo-Mag
6.      Redshift
7.      nt
8.      T_Type
9.      Dia_Maj_Axis
10.     Dia_Min_Axis
11.     Notes

Choose fields for filtering. One field is to be selected
at a time. Only objects in selected ranges will appear in
the output.

Choose a field number or type 99 to PROCEED :99
```

Figure 12 : Choice of ranges terminated

```
                    DISPLAY  OPTIONS

            1.  Display data on screen
            2.  Display data on screen & store
                in file to be selected
            3.  Redirect output to file only
            4.  Mail
            5.  Exit

            Enter your choice: 1
```

Figure 13: Output Option Selection Menu, Option 1 selected

```
                    DISPLAY  OPTIONS

            1.  Display data on screen
            2.  Display data on screen & store
                 in a file to be selected
            3.  Redirect output to file only
            4.  Mail
            5.  Exit

Enter your choice : 1
Press Return To Continue, Ctrl D to exit

Name          rahr ramin decdeg decmin Photo-Mag Redshift rasec decsec
-------------------------------------------------------------------------

I 677         11   11.3   012    035    00014    003272
N3593         11   12.0   013    005    00012    000693
N3524         11   03.9   011    040    00013    001369
N3547         11   07.3   011    000    00013    001543
N3559         11   08.1   012    017    00014    003311
N3506         11   00.6   011    021    00014    006498

6 rows selected

Input truncated to 4 characters
```

Figure 14: Output

9 Appendix C : E-mail query

This facility allows you to query the database at iucaa through E-mail. When you send your queries by e-mail to the address

astrodat@iucaa.ernet.in,

a shell script automatically processes the queries and sends you the required information by e-mail. Presently the program allows only a few types of queries but will be enhanced in the future.

Each query has the following format :
⟨**action**⟩⟨ **action modifiers** ⟩⟨ **arguments** ⟩

The **actions** that are available are :
1. Help : This action sends you the help file, which tells you how to use the ADC.
2. Search : This action allows you to search the catalogues depending upon the following four **action modifiers** :

- **Catlist**
- **Catalogue**
- **Stars_Near_Galaxy**
- **Galaxies_Near_Galaxy**

Catlist : This action modifier should be followed by one or more of the keywords **"Author"**, **"Keyword"**, **"Title"**, **"Year"**. This action searches the list of catalogues available at ADC by the author name, year of publication, title or keyword. For example, to search for catalogues published in year 1989, the query should be :

search catlist year 1989

To search for catalogues by author Zwicky, the query should be :

search catlist author Zwicky

Each line is treated as a seperate action. Therefore, if you want to search for catalogues published in the years 1989 and 1990 then you have to give two actions on seperate lines as follows :

search catlist year 1989
search catlist year 1990
The queries are not case-sensitive.

Catalogues :
This action searches a catalogue for the objects with the given limits for the various parameters. This option is still under development.

Stars_Near_Galaxy : This option searches a fixed catalogue (HD catalogue in this case) to find stars around a galaxy within a given radius. The coordinates of the galaxy are found out by the system from the RC3 catalogue. A typical query has the form :

search stars_near_galaxy
⟨galaxy name⟩⟨radius⟩
⟨galaxy name⟩⟨radius⟩
.....
end

Example :

search stars_near_galaxy
n 1234 60
n 2903 45.4
end

In the above example, the system will output two lists of stars. The first list will contain stars that are within 60 arc minutes (or one degree) of the galaxy NGC 1234. The second list will contain stars that are within 45.4 arc minutes of the galaxy NGC 2903.

Galaxies_Near_Galaxy :
This option searches a fixed catalogue (RC3 catalogue in this case) to find galaxies around a given galaxy within a given radius. The coordinates of a galaxy are found out by the system from the RC3 catalogue. A typical query has the form :

search galaxies_near_galaxy
⟨galaxy name⟩⟨radius⟩
⟨galaxy name⟩⟨radius⟩
.....
end

Example :

search galaxies_near_galaxy
n 1 48
n 2903 70
end

In the above example, the system will output two lists of galaxies. The first list will contain galaxies that are within 48 arc minutes of the galaxy NGC 1. The second list will contain stars that are within 70 arc minutes of the galaxy NGC 2903.

These actions should be included in the text portion of your e-mail. The subject of your e-mail should be *"query"*. The program uses the subject of your e-mail to distinguish queries from other e-mails. The following page has a complete example of an E-mail message sent to the *astrodat* account and the resulting reply from the computer.

```
Jupiter{41}: mail astrodat@iucaa.ernet.in
Subject: query
search catlist author zwicky
search galaxies_near_galaxy
n 1234  48.5
end
.
EOT
jupiter{42}:
```

Figure 1: E-mail query sent by the user

Mail Tool V3: View Message 21

From astrodat Wed Jul 7 10:08:59 1994
Date: Wed, 27 Jul 94 10:08:59 +050
From astrodat (Astro. Data Centre)
To: lhs
Content-length: 1081
**********QUERY : search catlist author zwicky **********

TITLE	AUTHOR	A	REFERENCE	SOURCE	SOURCE NUMBER	C_DATE	YEAR	STORE	access
CATALOGUE OF ABELL & ZWICKY CLUSTERS OF GALAXIES	ABELL G.O. CORWIN ZWICKY F., HERZOG E.	T	ASTROPHYS. J. SUPPL. 3. 211	ADC CDROM(CDS)	7/4		%	ORACLE	ABZWCLUS

Figure 2: Response received by the user through E-mail

10 Appendix D : Number of catalogues

The number of catalogues available in the various media formats are given below. The number increases continuously as new catalogues are added.

- Number of *processed* catalogues : 42
- Number of catalogues on Disk : 136
- Number of catalogues on Tape : 408

11 Appendix E : Data on CD-ROM

- The Guide Star Catalogue Version 1.1
- The Einstein Observatory SLEW Survey.
- A collection of data for stellar and nonstellar sources, including astrometry, spectroscopy and photometry.
- The Einstein Observatory Database of HRI X-ray Images. 1 June 1990 (Vol 1 & 2).
- The Einstein Observatory catalogue of IPC X-ray sources. 1 January 1990 (Vol 1, 2 & 3).
- Digitized All Sky Survey
- Compton Observatory EGRET All-Sky Survey. 1 June 1994 (Volume 1)