THE ESO ARCHIVE PROJECT

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ABSTRACT

Following the Archiving Policy recently defined, observations made at the ESO telescopes will be archived, starting with the large instruments. The FITS format is used extensively for the description of each stored observation, and a Catalogue is built up for retrieval purposes; this Catalogue will be accessible from ESO at Garching and via the existing networks. During the archiving process, special care is taken to homogenize the names of the targets observed.

1. INTRODUCTION

The main reasons to archive the data obtained at the ESO telescopes are: (a) to keep an historical record of the observed objects, for later analysis of possible long-term variabilities (b) to reuse the data for other purposes and therefore avoid the duplication of observations and (c) to allow researches based on the accumulated material, *e.g.* statistical studies, evolution of an object over several years, etc.

General Archiving will first start with the largest ESO telescopes (3.6, 2.2) and the new NTT. The amount of data to be archived is expected to be in the range 5 to 10 Gb/yr/telescope in the short term, but this amount will likely increase in the future.

The Archive is made of two parts shortly described in the following paragraphs: the bulk of the Archive is made of the observed *raw* data, including the information necessary to locate the observation in time and space; and the *catalogue* of the observations is organised as a data-base, allowing queries to locate the archived data and to judge whether they are suited to a new application.

2. ARCHIVED DATA

2.1 The Archive Format

Each archived data set includes the image stored as a two-dimensional image, together with a description or *header* specifying how the data were acquired. The FITS format (Wells *et al.*, 1981) allows to store binary data together with a complete description of these data. This format was chosen because it has the main advantages of being computer-independent (the Archive can be moved to a different computer without reformatting the data) and being widely known and used in the astronomical community (it was recommended by the IAU).

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Any observation is described in the header by means of FITS keywords followed by a numeric or character parameter. Basic FITS keywords defined in the original paper (Wells *et al.*, 1981) are used for very general descriptions: **BITPIX**, **NAXIS**, **NAXIS1**, **NAXIS2** provide the size of each image; **TELESCOP**, **INSTRUME**, **OBSERVER** designate the instrumentation and the observer's name; **DATE-OBS**, **EXPTIME** specify when the observation was performed, and the exposure duration; a **MJD-OBS** keyword (modified Julian date, *i.e.* $JD - 2400000.5$) is added to have a more accurate date and time stamp; **RA**, **DEC** provide the position of the telescope at the date of observation; **OBJECT** is the original designation of the target, and **TARGET** is a "standard" designation homogeneized over the whole Archive. Finally, the observer's comments are listed under the **COMMENT** keyword.

The original FITS scheme does not allow a complete description of all observing pecularities and instrument setup. A more complete description of the ESO–specific parameters is achieved via a 3–level hierarchy starting with a unique keyword **"ESO--OBS"**, followed by a second keyword that specifies one of the six categories detailed below, and a third keyword that designates the parameter. The categories are:

1. **GENERAL** is related to the observation run (project identification), and to the classification of the observation, as a *scientific*, a *calibration* observation or the observation of a *standard* object.
2. **TELESCOP** describes the telescope setting, *e.g.* the focus used.
3. **INSTRUME** describes the instrument setting, *e.g.* the filters used, the dispersive system with its orientation, etc
4. **DETECTOR** describes the parameters of the detector, *e.g.* its name, mode, status, the gain, the temperatures
5. **CHECKING** provides some key values for checking purposes, *e.g.* checksum numbers
6. **MIDAS** is only present for processed data, and lists the parameters used to transform raw data into calibrated data.

2.2 The Archive Medium

The large amount of data stored in the Archive requires large capacity storage media. Besides the classical 6250bpi tapes, new large capacity storage media recently became available and were tested at ESO: video cartridge tapes storing as much as 3 Gbytes, with a very attractive cost (about twenty times lower than classical tapes), and WORM (write once, read many times) optical disks with storage capabilities larger than 1 Gbyte. Optical disks are attractive for their direct access capability and the cost of the stored Gbyte comparable to the classical tape, but no standard has yet emerged.

The storage medium still remains an open choice for the ESO Archive. The final solution will likely be a combination of several media, for instance optical disks for frequently used data (*e.g.* fundamental calibrations), and cartridges for occasionally accessed data.

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3. THE CATALOGUE

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                    ESO Archive - Astronomical observations
+--------Setting----------+ +-------------Position--------------+ +--Pixels--+
|Tel.     3.6m  La Silla  | |          R.A.     Dec.    Air.M/Ep| | x     337|
|Instrum.       EFOSC     | +-----------------------------------| | y     520|
|Aperture FREE            | |Tel.     219.712   -26.4825    1.02| |min    167|
|Filter   V BESSEL   # 420| |Target   219.5500  -26.4667 1986.27| |Max  16383|
|Grism    FREE            | |Target   219.7500  -26.5333  J2000 | |mean   704|
+-------------------------+ +-----------------------------------+ +----------+
+---When, Who, Where------+ +--------Target Designation & Classification------+
|date 1986/04/10 05:14:27 | |Original   NGC5496 V 2MIN   Type                |
|Release date:            | |Names  NGC 5694                                 |
|Exposure time         120| |       C 1436 -263                              |
|Obs. Fusi Pecci          | |                                                |
|Tape AD033.030  seq# 4401| |                                                |
+-------------------------+ +------------------------------------------------+
 Comments

+--------------The Program: Identification, Authors, Title---------------------+
| 037.05-020  by Fusi Pecci/Buonanno/Corsi/Renzini/ at Bologna/Roma/Berkeley    |
| White dwarfs and lower main sequence stars in nearby globular clusters.       |
|                                                                               |
+-------------------------------------------------------------------------------+
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Figure 1: Example of a Display from ESO Archive

The Catalogue is built from the headers of each observation. The layout of the resulting Archive Catalogue, as seen by the astronomer for querying, is shown in Fig. 1; any combination of the fields displayed in Fig. 1 may be used for queries, *e.g.* a combination of requirements on position, filter and exposure time. This figure incidentally shows typical clerical errors (inversion of digits) that are easily corrected with the procedure used for Archiving Process described in section 5. The title of the accepted proposal is also listed in this figure; this piece of information can be useful to decide whether an observation is suited for a new study.

The Catalogue may be queried via STARCAT, a piece of software developed in collaboration with the STScI; STARCAT is mainly a user interface on top of the data-base. The same STARCAT interface also provides access to some fundamental astronomical catalogues (presently about 35), to preprints and periodicals received at the ESO Libraries, and also allows remote queries sent to the SIMBAD data-base (Dubois, 1988) and to the IUE Vilspa station.

4. ACESS TO ARCHIVED DATA

The Archiving Policy (van der Laan, 1988) recently defined at ESO grants a proprietary period of one year to the observing team; this proprieraty period may be extended on request in special cases. The contents of the Catalogue, *i.e.* the list of the observed targets as well as the title of the observing run, will however normally become public immediately after the end of the observations.

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The catalogue will be accessible for queries at the ESO computer facilities in Garching and over computer networks (presently SPAN and X25). Access to non-proprietary data will be possible at ESO Garching; shipment of data from the ESO Archive are subject to a scientific evaluation.

5. ARCHIVING PROCESS

The data acquired at La Silla are sent to Garching at regular intervals for Archiving. The archiving process includes conversion to FITS, checking, and updating the catalogue. The checking consists in classifying the observations (as scientific, calibration, standard object) and some verifications: correct date and time, but also the correctness of the object designation compared to the telescope position. The SIMBAD data-base (Dubois 1988) is used for this purpose: the designation of the objects which are close to the telescope position are compared to the observer's object designation, and the result is stored as the "standard" target designation.

A test over one year of EFOSC (ESO Faint Object Spectrograph and Camera) observations on the $3.6m$ telescope was performed to ensure the feasibility of the project. The reliabiity of some key parameters (telescope position, timing parameters, target names) was checked, and some improvements in the acquisition systems will be implemented to ensure a maximal reliability of the archived material.

REFERENCES

Dubois, P., 1988: *SIMBAD, an astronomical database* (this conference) [40]

Van der Laan, H., 1988: *The Messenger* **52**, 3

Wells, D.C., Greisen, E.W., Harten, R.H, 1981: *Astron. Astrophys., Suppl. Ser.* **44**, 363

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