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STATUS OF THE DIGITIZATION OF THE ARCHIVES OF PLATES OF THE ITALIAN ASTRONOMICAL OBSERVATORIES AND OF THE SPECOLA VATICANA

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Abstract. A large-scale national project to digitize the archive of plates of the Italian Astronomical Observatories and of the Specola Vaticana has started in 2002 following a pilot program funded by the University of Padova in 2001. Identical systems, composed of commercial scanners plus dedicated personal computers and acquisition software have been installed in all participating Institutes. Two more elements make up the total project: the provision of high quality photometric sequences with the Campo Imperatore telescopes, and the distribution of the digitized information to all interested researchers via the international Web. This paper presents some of the activities carried out and results obtained.

Key words: Astronomical Data Bases

1. INTRODUCTION

Highly valuable information is stored in the photographic archives of many Italian Observatories and in the Specola Vaticana. Several

plates date back to the end of the XIX Century. A proper digitization of this veritable treasury is of paramount importance, both for its preservation and for the fuller exploitation of its scientific content. Therefore we started a large national program (see Paper I and Paper II).

Among the many potential scientific uses of the digitized files, we intend to pursue the following: search for past transits of asteroids and comets, for a better reconstruction of their orbital and physical evolution; discovery and inventory of high proper motion stars; time history of variable stars in the Milky Way and in external galaxies, of AGNs and QSOs; inventory of novae and supernovae in external galaxies; spectral classification over wide fields.

2. THE PHOTOGRAPHIC ARCHIVES CENSUS

Table 1 gives an estimate of the number of plates of the Italian Institutes and of the Specola Vaticana archives. The total number is too large to be digitized in a reasonable amount of time. A visual inspection of the material is therefore in progress in order to select the best material according to the priorities set by our scientific interests.

Table 1. Inventory of the useful plates in the participating Italian Observatories and Specola Vaticana.

Type	Number of Plates	Dates
Images	57500	1897-1998
Spectra	26100	1951-1994
Objective Prism	3100	1958-1998
Type	**Number of Plates**	**Dates**
Images	8500	1894-1986
Objective Prism	1326	1957-1986
Polarimeter	30	1957-1986

The digital logbooks of direct imaging plates of all the Asiago telescopes, and of the objective prism spectra of the S67/92-cm and S40/50-cm telescopes are on-line (www.pd.astro.it/Asiago/). For the S67/92 telescope, an on-line query page is available (see http://dipastro.pd.astro.it/∼asiago/), yielding data from the main fields of the catalogue, and a jpeg preview of the already scanned plates. The query can be made by plate number, name or coordi-

nates of the object. Utilization of these services by the International community is already very active. The logbooks in digital form of the other Observatories are in advanced preparation, and should be completed before the end of 2003.

The Vatican archive is well preserved and ordered from the very first plate. The digitization of the logbooks is currently being done by the Bulgarian Academy of Sciences in Sofia.

3. THE HARDWARE

Several commercial scanners with retro-illumination, resolutions of 1600x3200 dpi, format A3 or A4, output at 14 or 16 bits, have been purchased for Asiago, Padova, Catania and Rome. The same scanners are used by several other European institutes. The scanners are connected via USB2 or FireWire to dedicated PCs. Typical dimensions of the digitized files at 1600 dpi range from 70 MB for the 9x12 cm plates of the Asiago 122 cm telescope to 260 MB for the 20x20 cm Schmidt plates.

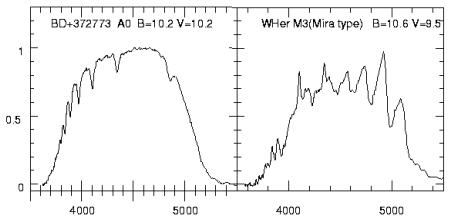

Fig. 1. Spectral types of 10th mag stars from an objective prism plate taken in 1972 with the Campo Imperatore S60.

To store and distribute this large amount of data a NAS unit (Network Attached Storage)with capability of 0.5 to 1 Terabyte, has been implemented in Campo Imperatore for NFS, FTP and Windows protocols. A second unit has been installed at Asiago Observatory.

The most serious limitation of the present hardware has been found for fine grained spectroscopic material. The resolution of 1600 dpi, coupled with the internally scattered light, is insufficient. However, for Schmidt objective prism material and low resolution spectra, useful work can still be done with the available equipment, as shown by Figure 1.

4. PLATE DIGITIZATION

Data acquisition is performed via a dedicated software that greatly enhances the ease of operations, working in the Windows op-

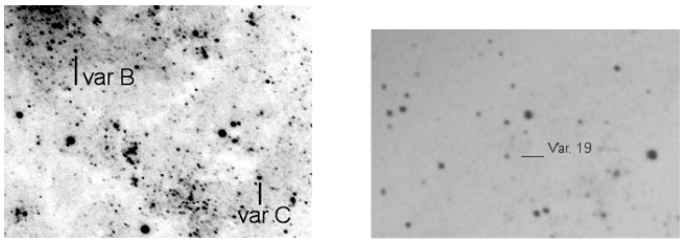

Fig. 2. Variables in M33 (Hubble-Sandage, left) and in M31

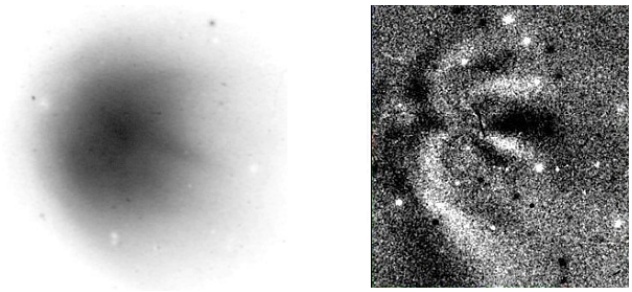

Fig. 3. Comet Halley in 1910. Left: from a Vatican Astrograph plate. Right: from a Catania Astrograph plate, after a Sekanina-type filtering (courtesy G. Cremonese and R. Ligustri)

erating system and providing as output a positive or negative FITS image, including a header. Typical digitization time for a S67 plate of 20x20cm is 7 minutes.

More recently, at Catania Observatory a new tool (AstroPlates) has been developed by P. Massimino in Visual Basic 6. AstroPlates requires IDL 5.4 or later versions. It simultaneously generates FITS and jpeg files.

Tests have been performed on many different types of plates, both with images and spectra, to determine the spatial resolution of the scanners as well as their astrometric and photometric precision. The effective spatial resolution is 16 micron/px, sufficient for the great part of the imaging plates in our archives, as shown in Fig. 1. The present activity of digitization is concentrated on images and on objective prism plates, well distributed among the several telescopes in order to gain experience with the different problems. More than 1000 plates have already been scanned. Figures 2 and 3 give some

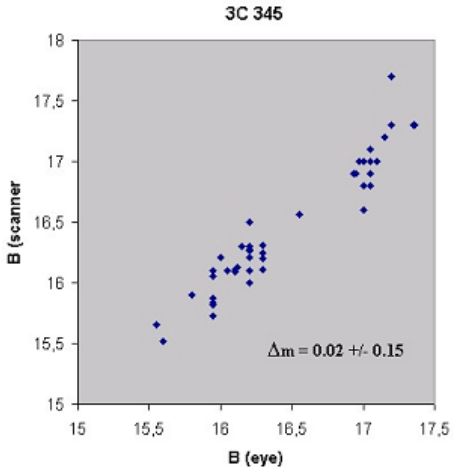

Fig. 4. Comparison of digital vs. eye magnitudes for 3C345

examples of digitized images. Figure 4 gives an indication of the attainable photometric accuracy for 3C345.

As is well known (Barbieri et al.,1977) the Asiago Observatory carried out since 1967 a large scale survey of Quasar Variability. In the past many plates were acquired and reduced with traditional methods (essentially by eye). Now we intend to repeat this work on the digitized material using modern photometric techniques. Figure 4 shows that the digital data are in very good agreement with the traditional ones, whose intrinsic error is ± 0.07 mag.

4.1. The CCD Photometric Program

The overall national program comprises as crucial element the acquisition of BVRI sequences in selected fields, by means of the CCD camera of the Campo Imperatore Schmidt telescope, which covers a field of approximately 1x1 sq. deg. Figure 5 gives an example in the Orion Nebula complex.

5. FUTURE PLANS

The project aims to complete the informatization of the logbooks by the end of Y2003; proceed with the digitization of selected fields of interest; define a common storage and retrieval system, in order to make the FITS and jpeg files accessible to the general user

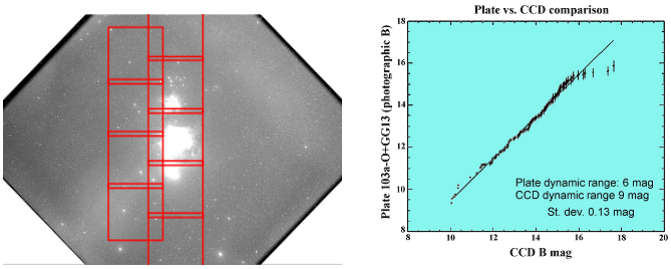

Fig. 5. Left: the CCD frames acquired in the M42 field. Right: CCD vs scanner B-photometry.

through the web; start a call for proposals to the International community, in order to selectively digitize those plates that give a maximum scientific return.

This project calls for its harmonisation with the concept of Virtual Observatory. We plan to coordinate our work with the Italian activities for the Datagrid and national Virtual Observatory (DRACO). As such, the use of the standards defined within the working groups of the International VO Alliance (IVOA) is envisaged, and data are planned to be eventually accessible to the community at large through the VO.

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