EXAMPLES OF DIGITAL VERSIONS OF THE CRAO SPECTRAL PHOTOGRAPHIC ARCHIVES

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ABSTRACT. The glass library of Crimean Astrophysical Observatory (CrAO) comprises of about 15,000 photoplates and films with the spectra of planets, stellar, nebula and extragalactic objects. All spectra were obtained in period from 1929 to 1990 years and separated on different collections. Some results of the digitizing photoplates from these collections are presented in this paper.

Key words: database, virtual observatory, spectroscopy

1. Introduction

The CrAO has a long history of spectral observations. The first observations of astronomical objects in the Crimea (solar prominences with a spectroscope) were started in the southern branch of the Pulkovo Astronomical Observatory near Simeiz on the mount Koshka ("The Cat") in the first quarter of the XX century (Polosukhina et al., 2008). Later on the photographic spectral observations with the objective prism at the astrograph with the 117-mm objective "Unar" (Kurbasova, 2007) and since 1926 on a quartz spectrograph for the Newtonian focus and large prism spectrograph with a thermostat and two different cameras at the 40-inch reflector "Goward Grabb" firm (Kryuchkov et al., 2009) were followed. For example, a large program of observations to determine the radial velocities of stars (Shajn, Albitzky, 1932) was conducted with this telescope. Since 1950th the spectroscopic observations with 400-mm astrograph, 1200-mm and 2600- mm reflectors were carried out in the new Crimean Astrophysical Observatory, which was built near Bakhchisarai in the Crimean Mountains.

This article gives the examples of digital versions of the CrAO non-solar spectral photographic archives. Conventionally, all spectral observations have been divided into several collections obtained on the astrographs with objective prism and on the reflector telescopes. All old negatives were digitized on the EPSON Expression 10000XL scanner with a resolution 2400 dpi, the output files were saved in FITS formats. When creating a digital version of archives of spectral observations, a special attention can be paid to the data preparation in formats that are used in interactive applications recommended by IVOA: Aladin (Bonnarel et al., 2000), VOSpec (savo01.esac.esa.int/vospec), Specview (www.stsci.edu/ institute/software_hardware) etc.

Our work is carried out within the project of LADAN – Crimean Astronomical Virtual Observatory (Shlyapnikov, 2007) as a part of the Ukrainian Virtual Observatory – UkrVO (Vavilova et al., 2010, 2011).

2. Brief description of spectra collections

2.1. Objective prism spectroscopy

Collection of spectral observations conducted with an objective prism consists of three parts determined by three types of astrographs (table 1), on which the spectra were obtained.

Table 1: Basic parameters of astrographs and dispersion for digitized spectra.

Astrograph	Diameter of objective (mm)	Focal length (mm)	Dispersion at H_γ (Å/pix)
Unar	117	600	1.5
Dogmar	167	750	1.4
400-mm	400	1600	1.5

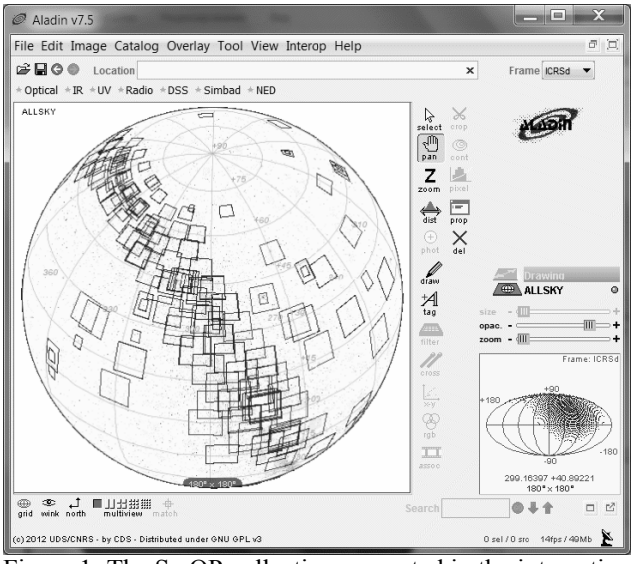

Figure 1: The SwOP collection presented in the interactive sky atlas Aladin

"Spectroscopy with Objective Prism" (SwOP) collection contains about 1000 spectral plates obtained with Unar, Dogmar, and 400-mm astrographs in 1929 – 1965 years. The largest number of negatives was obtained for studying the stellar and dust components of the Galaxy and for revealing the stars, which excite intergalactic medium. The Shajn's areas collection contains more 500 spectral plates obtained on 400-mm astrograph in 1950-1965 years with a goal to investigate a structure of the Milky Way. Figure 1 illustrates the sky coverage of the plates from SwOP collection.

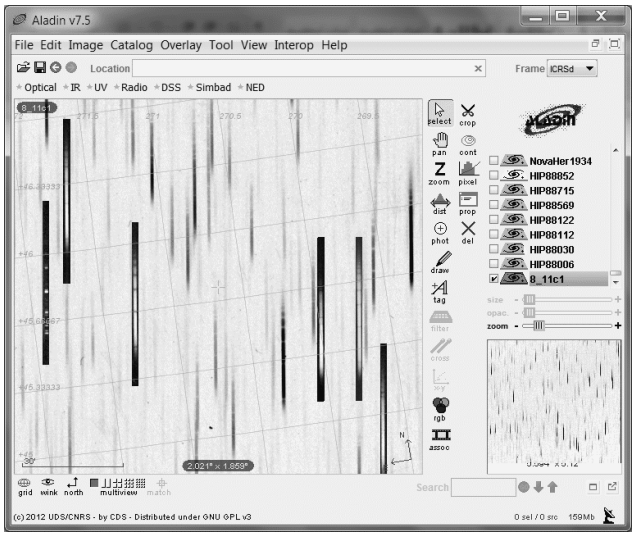

Figure 2: Fragment of full image photographic plate (negative) with the spectra of the extracting objects (positive)

The examples of spectra extracted from the photographic plate obtained on the Unar astrograph are shown in Figures 2 and 3.

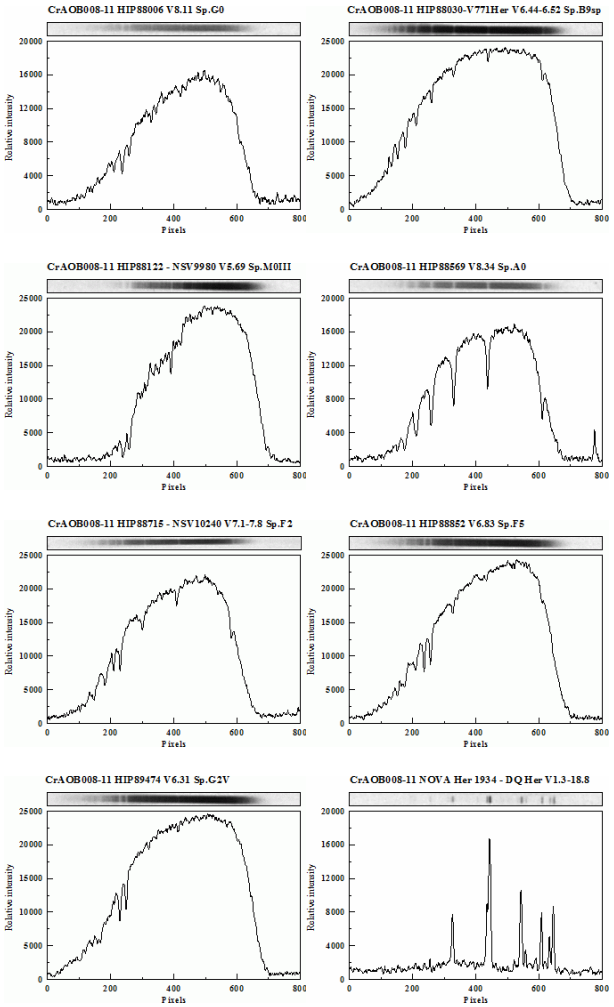

Figure 3: Examples of spectra extracted from the plate obtained with an objective prism on the Unar astrograph.

We conducted measurements for different A-stars to convert pixels scale in wavelength scale. Figure 4 illustrates the dispersion curves for Unar, Dogmar, and 400-mm astrographs.

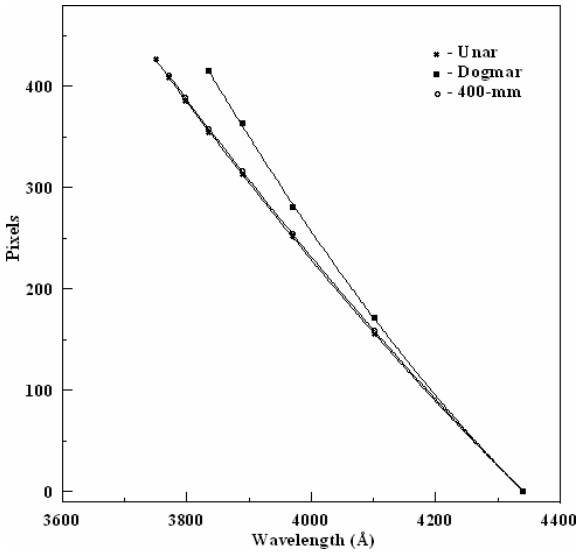

Figure 4: Dispersion curves for digitized plates obtained with different astrographs.

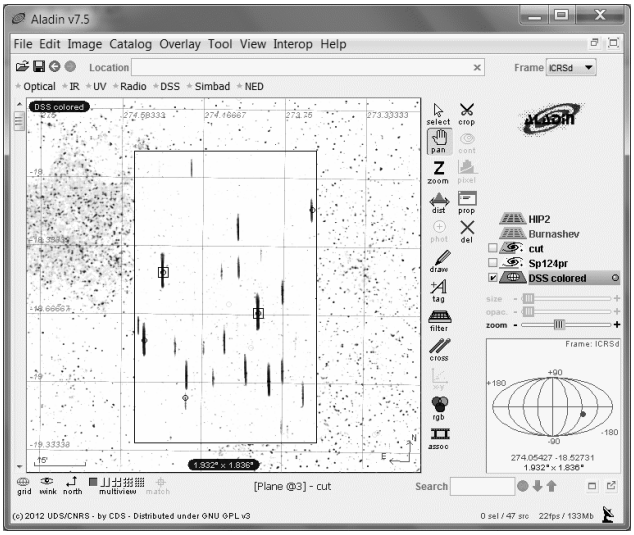

Figure 5: Fragment of a full-format image with spectrophotometric standards.

The figure 5 illustrates a fragment of a full-format image obtained with an objective prism on the 400-mm astrograph (circles – stars from the HIPPARCOS catalog, squares – spectrophotometric standards from the catalog by Burnashev (1985).

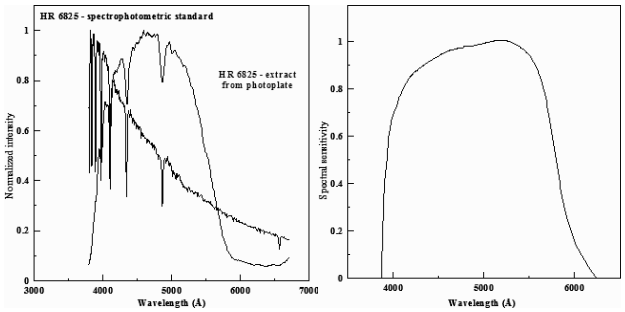

Figure 6: (see comments in the text)

We used SEDs to determine the spectral sensitivity of the negative in the SwOP collection. It is given in Fig. 6: left panel – a comparison of the normalized data of spectrophotometric standard with the data extracted from the digitized negative; right panel – a certain spectral sensitivity of the negative (from the data presented on the left panel) for the further reduction of the extracted spectra. More information about spectroscopy with objective prism and these astrographs see papers by Brodskaya (1953) and Pronik (1958).

2.2. 40-inch reflector "Goward Grabb" collection

About 3,200 spectra were obtained with 40-inch telescope (Shain, 1926) at the Simeiz observatory in 1929-1941 (distribution of the observed objects on the sky is given in Fig. 7).

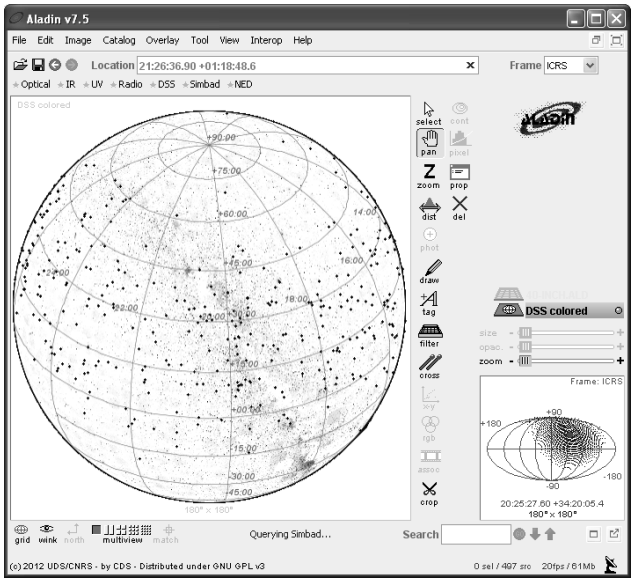

Figure 7: The sky of 40-inch reflector

Figure 8: The alfa And spectrogram obtained with 40-inch reflector on November, 13-14, 1929.

The spectrogram number 1, which is preserved in the collection of the CrAO spectral observations with 40-inch reflector, is presented in Figure 8.

All the data from this collection were extracted from the negatives and converted to formats supported by the IVOA applications. Figure 9 illustrates an example of the spectra of alfa And by Specview program.

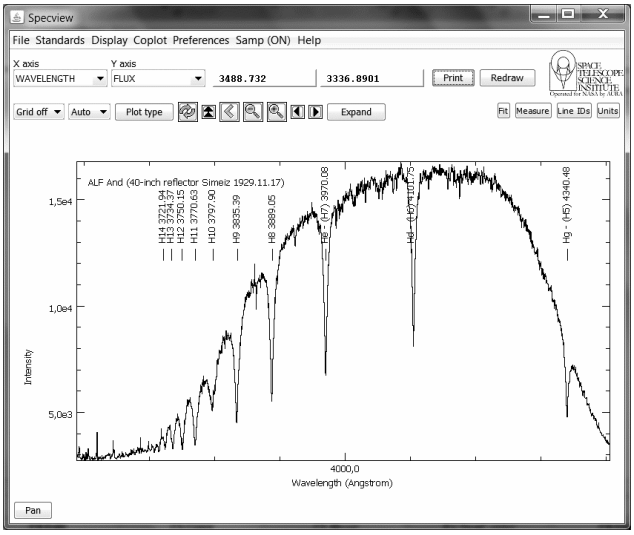

Figure 9: The alf And spectrum in Specview

2.3. The 1200-mm reflector of collection spectra

More than 5,500 direct spectra and 1,000 spectra with FKT-1A image convertor were obtained using 1200-mm telescope (Kopylov, 1954) in 1953-1990 (distribution of the observed objects on the sky is given in Fig. 10).

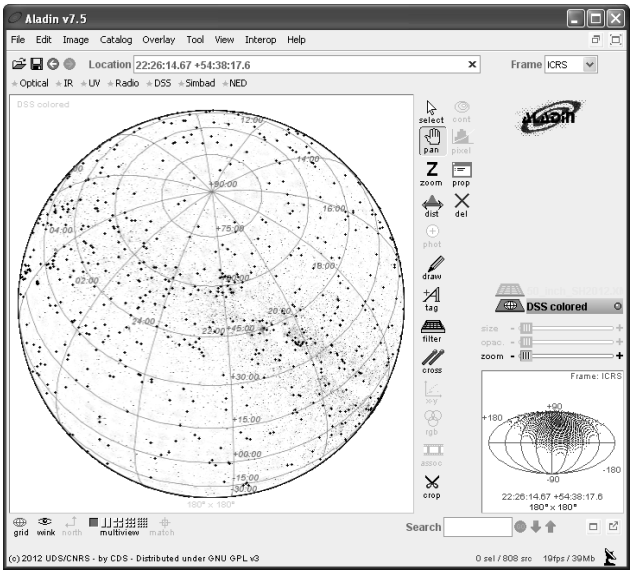

Figure 10: The sky of 1200-mm reflector

Full version of the database of observations conducted on the 1200-mm telescope with the image convertor FKT-1A, presented in the form of HTML-pages is illustrated in Fig. 11. Example of the VOSpec presentation of infrared spectroscopic observations eps Aur, obtained with these instruments as compared with the data for the object taken from the IVOA database, is illustrated in Fig. 12.

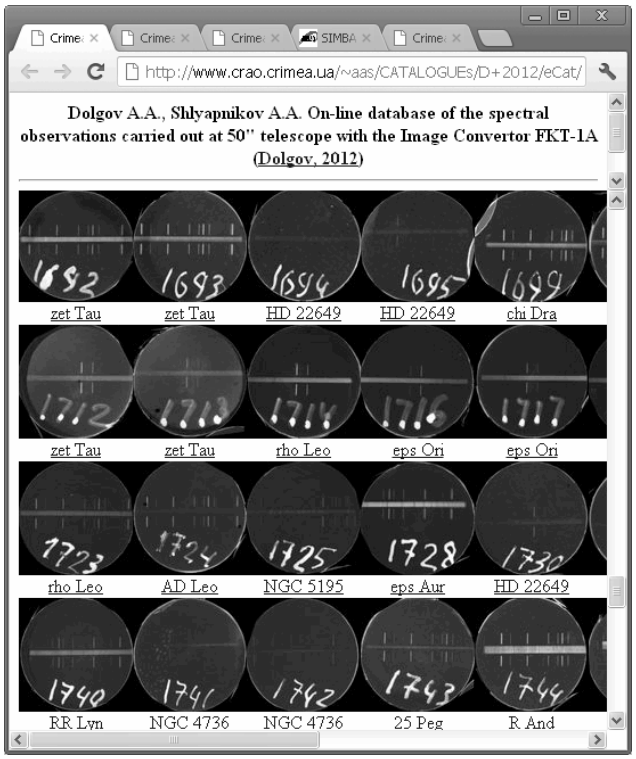

Figure 11: (see comments in the text)

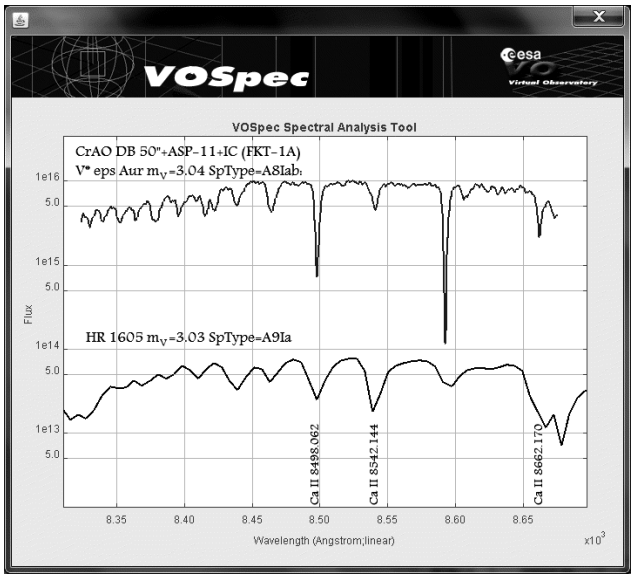

Figure 12: The alf And infrared spectrum in VOSpec

2.4. Collection of the ZTSh

More than 3,000 spectra of different objects and 3,000 spectra with image convertor for active galactic nuclei and the comparison stars were obtained using the 2600-mm telescope ZTSh (Ionnisiani et al., 1976) in 1964-1990. The examples of digitized spectra of extragalactic objects obtained by Chuvaev (1985) is illustrated in Figure 13.

3. Conclusion

This worked out technology of the conversion of photographic spectral observations of various astronomical objects in a digital format is the first step in creating a database of the CrAO collection for on-line use. It is also a part of the UkrVO Joint Digitized Archive of astronomical observations conducted at the observatories of Ukraine since 1880th (Vavilova et al., 2012a, 2012b).

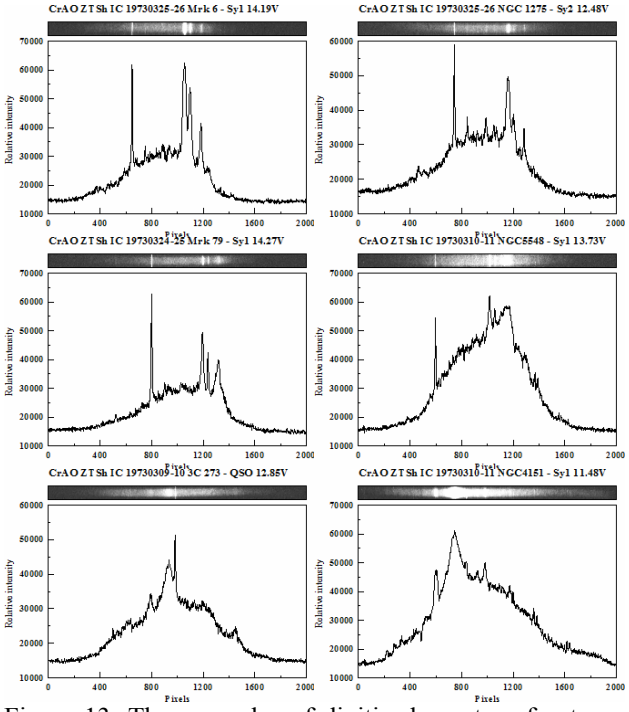

Figure 13: The examples of digitized spectra of extragalactic objects

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