



Spectral photographic archives of observatories of Ukraine: digital versions

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Abstract. Photographic archives of Ukrainian observatories contain a large number of plates in collections of spectral observations. First attempts to digitize them and to make them available via VO formats and protocols of data transfer and processing were undertaken during last years. The involved observatories are Crimean Astrophysical Observatory (CrAO) and Main Astronomical observatory NAS of Ukraine (MAO NASU). The project of spectral archive digitizing is carried out within the framework of Ukrainian Virtual Observatory - UkrVO. The core of UkrVO is a Joint Digital Archive (JDA) of photographic and CCD observations. On-line databases of spectral photographic collections and their fitting for VO tools set are the further enhancement of the idea of JDA.

Keywords : virtual observatory – digital archive – spectral library

1. Photographic spectral archives of CrAO

CrAO has a long history of spectral observations. The glass library of CrAO contains over 15,000 photographic spectral observations of different astronomical objects made since 1920th. Firstly they were the spectroscopic observations of solar prominences and later the photographic spectral observations began on the astrograph with 12 cm Unar objective and an objective prism. Since 1926, the spectral observations were carried out in the framework of radial velocities program on the 1 m reflector "Goward Grabb", equipped with quartz spectrograph in the Newtonian focus and large single-prism spectrograph with a thermostat and two cameras of different characteristics.

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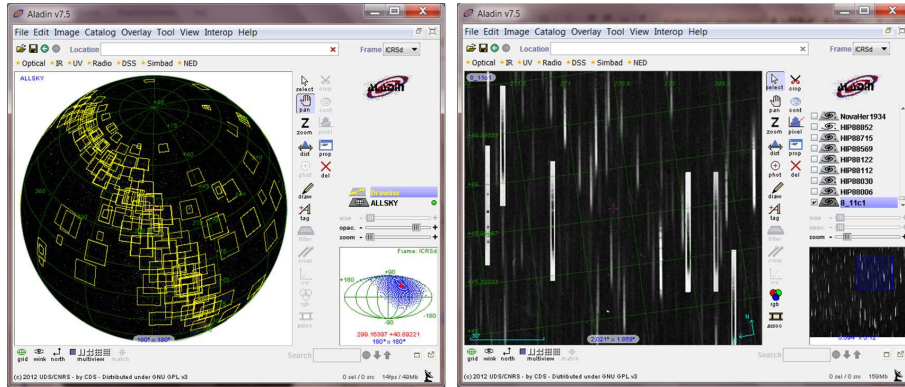


Figure 1. Left - distribution of astrograph spectral plates over the sky. Right - positive fullsize plate image with spectra of extracted objects

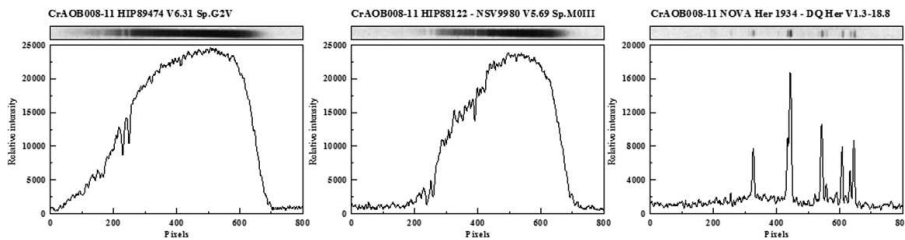


Figure 2. Spectra of extracted objects. The right one - Nova Her 1934

About 3200 spectra were obtained using the 40-inch telescope and a 117-mm astrograph with an objective prism in Simeiz observatory (CrAO - since 1945) during 1929-1941. The Shain's areas collection contains about 500 spectral plates. They were obtained during 1950-1965 using 16-inch astrograph with an objective prism in order to investigate the structure of the Milky Way.

Collection of the 50-inch telescope contains more than 5,500 direct images and 1,000 spectra got with the image converter FKT-1A obtained using 1.25-m telescope during 1953-1990. Collection of the the 2.6-m telescope (ZTSh) consists of more than 3,000 spectra of different objects obtained in 1964-1990. About 3,000 images of active galactic nuclei and comparison stars were made with the image converter.

Main attention is paid to the data preparation in the formats compatible with those used in VO tools and their presentation in the IVOA interactive applications (Aladin, VOSpec, Specview). The work is carried out within the framework of LADAN project in CrAO.

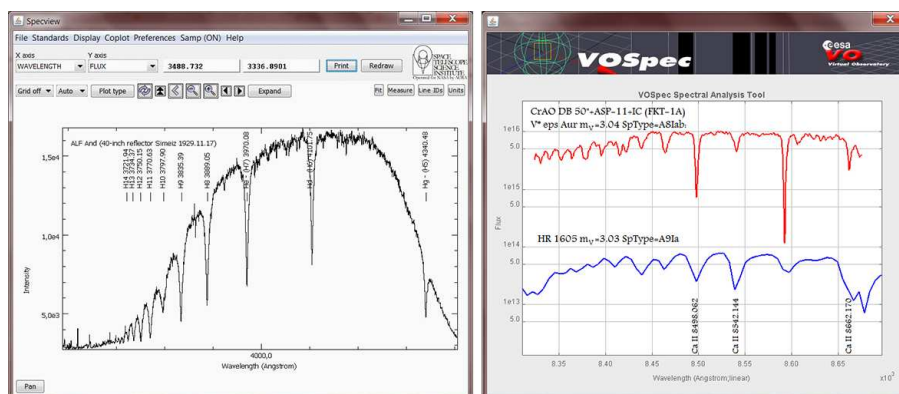


Figure 3. Specview (left) and VOSpec (right) visualization of spectra, obtained by 40-inch telescope in 1929 and 50-inch telescope in 1977 with the image converter.

2. MAO NASU spectral collection

Observations. MAO NASU spectral photographic material was obtained mostly by the 70-cm reflector AZT-2 (Kiev), in addition to the 60-cm Zeiss telescope at Mount Terskol, North Caucasus, Russia and 1-m telescope at Mount Sanglok (Institute of Astrophysics, Tajikistan), equipped with spectrographs UAGS with a set of gratings to obtain dispersions in the range of 29 Å/mm to 167 Å/mm in the range of wavelength 3500 - 6800 Å. There was also the experience of using DSA refractor (Double Short Astrograph) with a pre-objective prism to monitor Nova Cygni 1975 in the initial stage of outburst. Almost all spectra are calibrated with the 9-step attenuator and a comparison spectra for the wavelength scale.

Objects of observation: variable stars of R CrB type and stars with other types of variability having some similar characteristics, the low variable stars with similar characteristics of the chemical composition, pulsating variable AC Her in different phases of pulsations, carbon star HD 182040, HD 26, etc. Figure 4 shows an example of a unique variable R CrB in the active phase of the variability (scanned photographic plate and a portion of the spectrum). Any image carries a lot of the information, which can not be used at the time of its receipt due to the limited current interest. The main purpose of obtaining digital copies of photographic spectra is to create an on-line database with open access in order to detect and monitor the possible effects of star evolution. For example, objects with variables of type R CrB are rapidly evolving objects: a few members of the group have ceased or raised a similar variability during the XX century. The possibility exists that this may occur in the spectrum of the similar star, with a deficiency of hydrogen and the presence of strong fringes of carbon molecules (non-typical for stars of the appropriate temperature range).

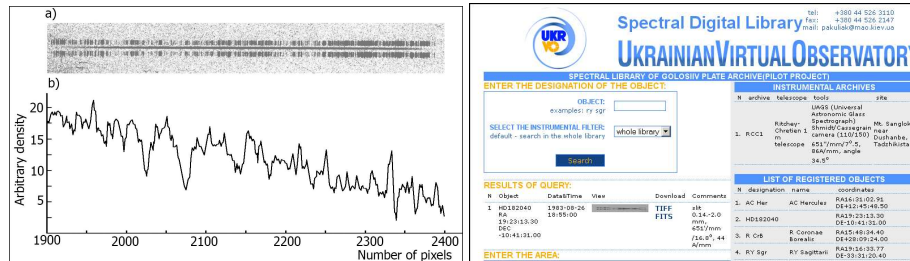


Figure 4. Left - a) Spectrum R CrB in JD 2445582.1 in the initial stage of 1983 minimum, 1-m Zeiss telescope; b) portion of the spectrum in the area H and K Ca II. Right - search interfaces of UkrVO Spectral digital library

3. UkrVO Spectral Digital Library

Photographic archive of MAO NASU contains about 50,000 of photographic plates with spectra. This archive was obtained in the frames of a great number of observational projects and has not systematized until now because of absence of observational logging.

The most interesting collections of spectral archive are observations of variable stars, conducted during 50–70th years. Instruments used were 1220-mm (Zeiss 50") reflector with ASP-11 diffraction spectrograph and ZTSh (both - Crimea AO), ACU-5 with ASP-20 spectrograph, 2-m reflector of Shemakha astrophysical observatory (Azerbaijan) with a spectrograph in Coude and Cassegrain, and instruments of Abastumani observatory (Georgia). Those observations are partly documented and can be included into UkrVO on-line spectral digital library.

We started the process of digitizing some collections of spectra, which can be systematized. It aims at creation a database of free access (UkrVO SDL) using modern image digitizing technologies. Plate digitizing is carried out using a flatbed scanner EpsonExpression 10000XL with 16-bit gray levels, resolution of 4800 dpi. Digitized images are stored in TIFF and FITS formats. FITS headers contain all the necessary meta-data for VO spectral tools and for treating them in other astronomical software. UkrVO SDL is available at the search web-page on the UkrVO site <http://ukr-vo.org/spectra/>

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