The Spectroscopic Database of the Digitized First Byurakan Survey

Byurakan Astrophysical Observatory (BAO), Armenia

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## Objective prism surveys and the SDSS

<table>
<thead>
<tr>
<th>Survey</th>
<th>Years</th>
<th>Telescopes and equipment</th>
<th>Emulsions</th>
<th>D at Hα</th>
<th>Spectral range, A</th>
<th>Area covered</th>
<th>Vlim</th>
<th>Objects of interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBS</td>
<td>1965-1980</td>
<td>Byurakan 102/132 cm Schmidt, 1.5° prism</td>
<td>IIa-F</td>
<td>1800</td>
<td>3400-6900</td>
<td></td>
<td>17.5</td>
<td>UVX galaxies (Markarian galaxies) FBS BSOs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IIIa-J+GG495 IIIa-F+RG2 IV-N</td>
<td>1800 900 280</td>
<td>3400-5300 4950-5400 6300-6950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS</td>
<td>1978-1991</td>
<td>Byurakan 102/132 cm Schmidt, 1.5°/3°/4° prisms</td>
<td>IIIa-J</td>
<td>1800</td>
<td>3400-6900</td>
<td></td>
<td>19</td>
<td>UVX galaxies, QSO/Sy, BCDG, hot stars</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IIIa-J+GG495 IIIa-F+RG2 IV-N</td>
<td>1800 900 280</td>
<td>3400-5300 4950-5400 6300-6950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case</td>
<td>1983-1995</td>
<td>Kitt Peak 61/91 cm Burrell Schmidt, 1.8° prism</td>
<td>IIIa-J</td>
<td>1350</td>
<td>3400-5300</td>
<td></td>
<td>18</td>
<td>Blue stellar objects, UVX galaxies (CSO/CBS/CG)</td>
</tr>
<tr>
<td>HQS</td>
<td>1985-1997</td>
<td>Calar-Alto 80 cm Schmidt, 1.7° prism</td>
<td>IIIa-J</td>
<td>1390</td>
<td>3400-5300</td>
<td></td>
<td>19</td>
<td>QSOs, Hamburg/RASS</td>
</tr>
<tr>
<td>HES</td>
<td>1990-1996</td>
<td>ESO 1m Schmidt, 4° prism</td>
<td>IIIa-J</td>
<td>280</td>
<td>3400-5300</td>
<td></td>
<td>18</td>
<td>QSOs</td>
</tr>
<tr>
<td>SDSS</td>
<td>2000-</td>
<td>Apache Point 2.5m Ritchey-Chretien, Double MOS</td>
<td>CCD</td>
<td>res.: 2.5A</td>
<td>3800-9200</td>
<td></td>
<td>21</td>
<td>100 million objects; 1 million galaxies, 100,000 QSOs</td>
</tr>
</tbody>
</table>

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**Notes:**
- SDSS: Sloan Digital Sky Survey
- FBS: Byurakan Field Survey
- SBS: Surface Brightness Survey
- Case: Case Survey
- HQS: Hamburg/Quasar Survey
- HES: ESO Heterodyne Survey
- UVX: Ultraviolet X-ray
- QSO/Sy: Quasar/Seyfert
- BCDG: BCDG (Blue Compact Dwarf Galaxy)
- CSO/CBS/CG: Canada/UK Schmidt Telescope/Canada/Brown/Columbia

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**Additional Details:**
- **FBS BSOs:** Be visible through the prism.
- **SDSS:** Use CCD detectors to capture data.
- **Area covered:** Measured in degrees squared (deg²).
- **Vlim:** Maximum velocity limit in km/s.

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**Spectral Ranges:**
- Hα: Hydrogen α line
- l: Latitudinal range
- δ: Longitudinal range
# The Digitized First Byurakan Survey (DFBS)

**Teams:** Byurakan Obs., Univ. Roma, Cornell Univ.

**Years:** 2002-2005

**Instrument:** Epson Expression 1680 Pro scanner

**Scanning options:** 1600 dpi (15.875 \( \mu \) pix size), 16 bit, transparency (positive) mode, "scanfits"

**Plate size:** 9601\( \times \)9601 pix, 176 MB file

**Spectra:** 107\( \times \)5 pix (1700\( \mu \) in length)

**Dispersion:** 33 Å/pix average (22-60 Å/pix), 28.5 at H\( \gamma \)

**Spectral resolution:** 50Å

**Astrometric solution:** 1" rms accuracy

**Scale:** 1.542 "/pix

**Photometry:** 0.3\( ^{m} \) accuracy

**Number of objs:** \( \sim \)20,000,000 (\( \sim \)40,000,000 spectra)
scanning
astrometric solution
extraction
wavelength calibration
density and flux calibration
multiband (UBVR) photometry
making up template spectra
numerical classification
DFBS catalog and database
web page and user interface
DFBS extraction software

Software “bSpec”: automated extraction and classification of the spectral data in a DFBS plate. Coded under Linux using the Borland Kylix compiler

Performs all the operations necessary to build the DFBS database

Developed by Giuseppe Cirimele and the MIGG s.r.l. team.

A catalogue driven approach: an object list from the USNO-A2 catalogue.

Starting from the USNO coordinates, each spectrum was re-centered with a combination of two parameters a) peak position, b) baricenter.

The local background around each object was estimated using the median value of the pixel distribution in two parallel strips to the spectrum direction.

Automatic transformation from DN to I (in arbitrary units) for each plate, finding the “red head” and extraction of the spectrum subtracting the local background.

A preliminary mag calibration is made using 300 objects in the central part of each plate: instrumental B & R mags are evaluated integrating the spectrum between pixels 20-40 (R) and 55-90 (B). A polynomial fit of these mags against their USNO-A2 mags provides a calibration curve

> Computing DFBS mag for all objs.

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For each object, the database contains: USNO-A2 ID, RA and DEC, position of the red head in pix, B and R mags (USNO-A2 & DFBS), the local background value, a quality flag, the spectrum length, and the extracted spectrum.
The Digitized First Byurakan Survey
A cooperation among

Byurakan Astrophysical Observatory

Universita` di Roma "La Sapienza"

With the contribution of Migg s.r.l., REGIONE CALABRIA and U.E. (FESR).

Mirror WEB site at the Department of Physics, SCAE Group
Surface address: Department of Physics, P.le Aldo Moro 2 - 00185 Roma ITALY
Fax:+39-06-4463158
Sky coverage

Filter: observer. All, emulsion. All, with Spectra.

fbs1030 relevant parameters

- Plate center (J2000): 16:23:11, +82:02:10
- Observer: Lipovetsky
- Observation date: 1974-05-25
- Plate emulsion: IIaF
- Image size: 9601 x 9602
- Image pixelsize: 15.87500 x 15.87500 asec^2
- Prism: 1.5 degrees
- rms: 0.94 arcsec
- Spectral & phot. data: Available

Get image, explore, get data
Sky coverage

In a RA, DEC rectangular sky map shows the position on the sky of each plate; plates already processed are color-coded. Basic data about each plate are available by clicking on the corresponding plate.


Plate List

All the data on each plate selected by any parameter: RA or DEC, observation date, emulsions, observers.
Image found in plate fbs1053
centered at (21:31:43.208, -12:45:22.17)

Byurakan field

DSS1

Spectra selection
Image found in plate fbs1053
centered at (21:31:43.208, -12:45:22.17)
Explore

Allows the display of a portion of plate around a given central RA, DEC position, comparison with the same portion of the DSS1 or DSS2 (blue, red, or IR), interactive selection of one or more spectra present in the database, their collection (saving in a list) and downloading (ASCII files) to the guest computer.

http://astrot1.phys.uniroma1.it/byurakan/explore.php
Get image

Allows users to select a portion (presently up to 1024x1024 pixels, i.e. about 26.5 arcmin x 26.5 arcmin) of a plate in FITS format and all the spectra of this portion present in the database for downloading (spectra are ASCII files), as well as downloading of the whole selected field.

http://astrot1.phys.uniroma1.it/byurakan/getimage.php
Get spectra

Allows **downloading the spectra** in the database within a given distance from a selected central position; the query may be either interactive, with the RA, DEC, or made by uploading an ASCII file containing one or more RA, DEC positions (one per line). Objects may be selected by B, R or B-R values. This option displays also an interactive (clickable) table of the selected objects, which allows looking at each object individually (both 1D and 2D spectra) for a quick evaluation of the data.

Photometric agreement between the two DFBS plates of the same field in B band ($\lambda=4500\text{A}$). Both DFBS plates contain objects up to $17.5^m$; rms is 0.12 for the B and 0.09 for the R instrumental mags.
DFBS: classification of spectra

- **Template spectra** for different types of objects and search among the low-dispersion spectra: QSO, BLL, Sy, CV, WD, sd, M, C, etc. A few dozens of objects for each type and each $0.5^m$ magnitude.

- **Numerical classification** scheme. Criteria worked out at FBS BSOs & IRAS programs. Based on the relation of magnitudes and widths of spectra (stellar/diffuse objects), SED (color), presence of broad lines. Link to general classification schemes by standard objects.

- **Modeling of spectra** for known types of objects. SED, emulsion response curve, calibration, other effects?
DFBS low dispersion spectra
DFBS low dispersion spectra
DFBS low dispersion spectra
**DFBS: catalog and database**

- **DFBS catalog:** list of all FBS objects with positional, photometric and spectral information (some 40,000,000 spectra corresponding to 20,000,000 objects)

- **DFBS database:** all FBS plates, 2D and 1D spectra, and the DFBS catalog

- **Available:** at the end of 2007 on 100 DVDs and through Internet (DFBS web page, CDS, etc.)
Search for high proper motion stars and variable objects

- High PM stars: blue stellar objects (WDs, sds); late-type stars (M, C)
- Variable objects: CVs, Novae, Miras, BLL, etc.

**FBS Blue Stellar Objects: variability**

- Brightness differences between DFBS, DSS1 and DSS2, as well as using data from MAPS, USNO-B1, etc.
- 16 objects with MAPS-FBS >2.5m, all candidate CVs.
- FBS 882 and FBS 218: extremely variable objects: 7.5-8 amplitudes.

FBS 0250+167: M7-M8 dwarf, $13.5^m$-$14.0^m$ (DFBS), $M_{abs} = 17.89$. Distance: 2.8 pc, $v_t = 68.1$ km/s. The 12th known high PM star, the faintest in m and M.

DFBS 1D spectrum of FBS 0250+167
Search for Asteroids in the DFBS

Aladin and SKYBOTE

- the brightest asteroids (<15-16), which may be visible in the DFBS plates
- fast & slow asteroids with a division parameter, estimated as the motion of 3" during 20 minutes (the typical exposure time of a DFBS plate)
- extraction of all spectra of asteroids found in DFBS by SkyBote; group them into extended (fast asteroids) and star-like (slow asteroids)
- modelling of a template spectra of asteroids by means of the star-like spectra
- search for new candidate asteroids by similar spectra & comparison with DSS1/DSS2 fields for elimination of the stars
- spectral analysis of the asteroid spectra to get some physical parameters
Identification of the spectrum of 288 Glauke

Apparent velocity

USNO stars (in red)

288 Glauke
Identification of the spectrum of 104 Klymene

Apparent velocity

USNO stars (in red)
Spectra of asteroids in the DFBS

104 Klymene
Mv ~ 14.5

288 Glauke
Mv ~ 14

627 Charis
Mv ~ 15.5

1323 Tugela
Mv ~ 15

4713 Steel
Mv ~ 16
Optical identification of X-ray, IR and radio sources

ROSAT FSC, IRAS PSC & FSC, NVSS, FIRST sources
Results on the SST Boötes

1 known QSO
22 known galaxies
28 known stars
4 X-ray sources
68 NIR sources
28 FIR sources
28 radio sources

22 new objects:
5 QSO candidates (2 radio sources)
10 galaxies (2 AGN:, 2 other blue galaxies, 6 int. systems; 8 are radio sources)
7 stars (1 R, 1 K, 2 G, 3 FG-type)

8 other known stars did not have spectral classification, we classify into: 1 A, 1 AF, 1 F, 1 FG, 3 G, 1 K-type
An R-type carbon star and two early type (A-F) stars are above the main sequence of objects.