PART A – ESSENTIAL INFORMATION

1. SUMMARY

It is important to keep track of the intellectual legacy that made possible the realization of astronomical discoveries, which are part of the general history of human science. The “historic” nature of astronomical research has become more evident, and the need for keeping observational data collected over the years to discover changes in astronomical objects is more and more important.

A unique astronomical survey was carried out by the Byurakan Astrophysical Observatory (BAO) from 1965-1980 by Beniamin Markarian and his colleagues called the First Byurakan Survey (FBS or Markarian survey). The FBS was the first systematic objective-prism survey, the largest objective-prism survey, a new method of search for active galaxies. The Markarian survey with its discoveries and new approach in study of the nearby Universe is considered as one of the most important achievements of 20th century’s astrophysics.

The astronomical plates that bear valuable information are made of glass covered by photographic emulsion that records and keeps the images and spectra of the celestial objects. Each image or spectrum is a few dozen microns large and there are risks of losing this information because the plates may be broken or scratched and the emulsion may be spoiled due to temperature and humidity effects. To preserve this unique database, we conducted in 2002 a project of digitization of Markarian plates and created its electronic version on DVDs and accessible through Internet (http://www aras.am/Dfbs/dfbs.html), the Digitized First Byurakan Survey (DFBS). It was the first digitization project in Armenia and one of the first in world astronomy.

2 DETAILS OF THE NOMINATOR

2.1 Name (person or organisation)

Byurakan Astrophysical Observatory (BAO), Armenian National Academy of Sciences (NAS)

2.2 Relationship to the documentary heritage nominated

BAO owns the FBS plates and the DFBS database. The FBS plates are being kept at BAO Plate Archive and the DFBS database is written on DVDs and is available through web.

2.3 Contact person (s)
Dr. Areg Mickaelian, Project Manager and Principal Investigator, Digitized First Byurakan Survey (DFBS)
Ms. Parandzem Sinanyan, Head of the Plate Archive at BAO.
Armenian National Commission for UNESCO.

2.4 Contact details (include address, phone, fax, email)

Byurakan Astrophysical Observatory:
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3 IDENTITY AND DESCRIPTION OF THE DOCUMENTARY HERITAGE

3.1 Name and identification details of the items being nominated

Digitized First Byurakan Survey (DFBS), the digitized copy of the First Byurakan Survey (FBS, known as “Markarian survey”, Markarian survey 2000 plates), URL: http://www.aras.am/Dfbs/dfbs.html
Owner: Byurakan Astrophysical Observatory (BAO), Byurakan 0213, Aragatzotn province, Armenia, located at the BAO Plate Archive

3.2 Description

The celestial bodies, namely stars, nebulae and galaxies are evolving objects: their physical conditions change with time, and consequently the radiation emitted by them which brings us information about their nature also changes. One of the most important achievements of modern astronomy was the understanding of the role of instability phenomena in the general evolution of the Universe. The “historic” nature of astronomical research has become therefore more evident, and the need for keeping observational data collected over the years to discover changes in astronomical objects is more and more important to the astronomical community. Furthermore, in a more general context, it is important to keep track of the intellectual legacy that made possible the realization of astronomical discoveries, which are part of the general history of human Science.

A unique astronomical survey (photographing a large area of the sky and search for new types of objects) was carried out in the Byurakan Astrophysical Observatory (BAO) from 1965-1980 by Beniamin Markarian and his colleagues; they used 1m Schmidt telescope (a telescope having large field of view) with a 1.5° objective prism to observe a significant portion (17,000 sq. deg) of the total sky at high galactic latitudes where most of the galaxies are located and obtained 2000 photographic plates with low-dispersion spectra of all objects in any field, totaling
40,000,000 spectra for 20,000,000 objects. Up to now, this is the largest spectroscopic survey by its coverage and the number of objects. This survey was called First Byurakan Survey (FBS or Markarian survey), as later the second one (deeper, but less in coverage) followed. The main purpose was the search for galaxies with ultraviolet (UV) excess, and the authors found 1500 such objects. However, the FBS allowed revealing thousand of other new interesting objects, including quasars, planetary nebulae, white dwarfs, cataclysmic variables, carbon stars, etc. and optical identification of infrared (IR) and X-ray sources. In addition, the FBS was the first systematic objective-prism survey, the largest objective-prism survey, a new method of search for active galaxies. It led to the classification of Seyfert galaxies, to the definition of Starburst galaxies, etc. Markarian survey with its discoveries and new approach in study of the nearby Universe is considered as one of the most important achievements of the 20th century's astrophysics. Perhaps all astronomers working in the field of active galaxies have dealt with Markarian galaxies that led to dramatic new knowledge in the field of active galaxies. These objects contain all types of active galaxies, radio, infrared, X-ray and Gamma-ray sources, interacting and merging objects, galaxies with double and multiple nuclei. The Markarian galaxies appear in all new studies where any new interesting result has been achieved. New large facilities are now available for astrophysical research giving hundreds times better results than in Markarian’s times. Space telescopes are being launched every year and thousands of new interesting objects are being listed in archives. And surprisingly, Markarian galaxies do not become mere “historical” objects: all recent interesting discoveries at different wavelengths come to prove again that Markarian galaxies are probably the most interesting objects in the Universe. They contain all wonders of the extragalactic Universe. It is possible to teach extragalactic astronomy, especially the course of active galaxies based only on the Markarian galaxies.

Though the FBS was accomplished a few decades ago, many astronomers even from the Byurakan Observatory could not work with the plates, as they were unique, and no copies were available. The astronomical plates that bear valuable information are made of glass covered by photographic emulsion that records and keeps the images and spectra of the celestial objects. Each image or spectrum is a few dozen microns large and there are risks of losing this information because the plates may be broken or scratched and the emulsion may be spoiled due to temperature and humidity effects. To preserve this unique database, we conducted in 2002 a project of digitization of Markarian plates and creation of its electronic version on DVDs and accessible through the Internet, the Digitized First Byurakan Survey (DFBS, http://www aras.am/Dfbs/dfbs.html). It was the first digitization project in Armenia and one of the first ones in world astronomy. The project was carried out during 4 years in collaboration with the Italian, USA, and German scientists. It required a substantial effort, including the scanning of 2000 plates with a very high resolution to preserve the information, astrometric solution, wavelength and photometric calibration, developing classification principles, etc. Today the results are freely accessible to the world astronomical community through a dedicated web interface on ArmCluster (and for a fast access in Europe and elsewhere, on the DFBS server at the University of Rome, Italy at http://byurakan.phys.uniroma1.it/). To make the material more useful and efficient, it was necessary to make software to extract the spectra, calibrate the data to wavelengths and fluxes, and classification. A catalog and database of spectra were created. Moreover, the Armenian Virtual Observatory (ArVO, http://www aras.am/Arvo/arvo.htm) was created based on the DFBS. ArVO allows the Armenian astronomy to contribute and be integrated into the international databases. New projects are possible with efficient use of the DFBS.

Bibliography:

Referees:

**Prof. Elizabeth Griffin**, Chair of the International Astronomical Union Working Group on Preservation & Digitization of Photographic Plates, Herzberg Institute of Astrophysics, Victoria, Canada. E-mail: Elizabeth.Griffin@hia-iha.nrc-cnrc.gc.ca

**Prof. Francoise Genova**, Chair of the French Virtual Observatory (OV-France) and CDS, Observatoire de Strasbourg, France. E-mail: genova@newb6.u-strasbg.fr

**Prof. Milcho Tsvetkov**, Project Manager of the Wide-Field Plate Database (WFPDB), Institute of Astronomy, Sofia, Bulgaria. E-mail: milcho@skyarchive.org

4 **JUSTIFICATION FOR INCLUSION/ ASSESSMENT AGAINST CRITERIA**

4.1 Is authenticity established?

Yes. The FBS plates were obtained in Byurakan in 1965-1980 and have been kept there since the beginning. All observations have been recorded in journals and up to now are available. The DFBS project was carried out by our team and the scanned copies have been stored on DVDs by ourselves.

4.2 Is world significance, uniqueness and irreplaceability established?

Yes. The Markarian survey was the first systematic low-dispersion survey in the world and the first systematic search for active galaxies. Up to now, it is the largest spectroscopic survey having 40,000,000 spectra on 20,000,000 objects of the Northern extragalactic sky and part of the Southern one. The DFBS is a unique and irreplaceable database and its influence on the world science is **global**. There is no other equal database. Its loss will result in the loss of all valuable information accumulated during 15 years. In addition, such Schmidt type telescopes at present are not used and it is impossible to obtain similar data.

4.3 Is one or more of the criteria of (a) time (b) place (c) people (d) subject and theme (e) form and style satisfied?

(a) **Time.** The DFBS (1965-1980) was the first systematic spectroscopic survey for active galaxies and in addition serves as the only such large survey for any other research. Several other such surveys followed in 1980s-1990s, however none of them had such an impact in science.

(b) **Place.** There are only a few large Schmidt telescopes in the world and the 1m Schmidt installed in Byurakan is probably the most efficient telescope of this kind.

(c) **People.** The FBS survey was created by Markarian and his colleagues and reflects the impact of these great observers. Astronomical observations (and their quality!) depend on the individuals who are able to obtain the needed results.
(d) **Subject and theme.** The FBS survey was a new method for discovery of active galaxies and led to a new knowledge on activity phenomenon in the Universe. It was a new development using a combination of the telescope, objective prism, and photographic emulsions.

(e) **Form and style.** The DFBS provides a convenient medium for further research work based on the FBS using its 40,000,000 low-dispersion spectra. It is available through a new environment called Virtual Observatory.

4.4 Are there issues of rarity, integrity, threat and management that relate to this nomination?

- **Rarity.** FBS and DFBS both are rare surviving examples (in fact, unique) of their types and time.
- **Integrity.** The plates are complete and all have been digitized. Moreover, in some fields there are 2 and more plates to obtain at least 1 good one.
- **Threat.** Physically the FBS plates are secure; however necessary conditions to keep the emulsion safe are required (temperature, humidity). The DFBS is secure as copies are available.
- **Management plan.** The plans are to preserve the FBS plates as historic value and use for further research only the digitized copies.

5 **LEGAL INFORMATION**

5.1 Owner of the documentary heritage (name and contact details)

Byurakan Astrophysical Observatory (BAO), Byurakan 0213, Aragatzotn province, Armenia.

5.2 Custodian of the documentary heritage (name and contact details, if different to owner)

Byurakan Astrophysical Observatory (BAO), Byurakan 0213, Aragatzotn province, Armenia.

5.3 Legal status:

(a) Category of ownership

It is owned by **BAO, a public institution.**

(b) Accessibility

The public access to the original FBS plates is not encouraged as the plates may be deteriorated. However, the digital copies available on DVDs and through Internet are freely accessible.

(c) Copyright status

The authors of the FBS project were Markarian, Lipovetski and Stepanian. However, the plates with the resulting observations belong to BAO. The authors of the DFBS project were Mickaelian et al. But the product is freely available and there is no any limitation of its use (scientific, educational, public, etc.) beside the commercial one.

(d) Responsible administration
BAO administration is responsible. It appoints the Head of the Photographic Archive who is responsible for the current operation of the archive and services offered to users and visitors.

(c) Other factors

None.

6 MANAGEMENT PLAN

6.1 Is there a management plan in existence for this documentary heritage? YES/NO

Yes. The FBS plates are stored at BAO Plate Archive where necessary conditions are not well followed. We plan to prepare a project for its preservation according to the international standards. The physical environment (air quality, temperature and humidity) of the FBS plates is not satisfactory and we need to move it to a separate room or provide necessary conditions. The quality of packaging also needs an improvement. Therefore, an estimate of USD 6000 will be needed in frame of our project, including expenses on the preparation of the room, air conditioner, devices to measure air conditions, and payments to manpower. The FBS may be displayed at BAO museum as its most valuable observational material and one that played a significant role in the world astronomy.

7 CONSULTATION

7.1 Provide details of consultation about this nomination with (a) the owner of the heritage (b) the custodian (c) your national or regional Memory of the World committee

We have consulted with the Director of BAO (Dr. Haik Harutyunian), the custodian (Ms. Parandzem Sinamyan), National Academy of Sciences and Armenian National Commission for UNESCO.

PART B – SUBSIDIARY INFORMATION

8 ASSESSMENT OF RISK

8.1 Detail the nature and scope of threats to this documentary heritage

The political situation allows a safe preservation of the FBS/DFBS documentary heritage; however necessary conditions (temperature, humidity, cleanliness, etc.) should be maintained. The quality of packaging also needs an improvement. The insufficient preservation budget does not allow keeping all standards required for the preservation of astronomical plates. After the digitization, the original FBS plates are kept as unique observations material and only the scanned copies are being accessed.

9 ASSESSMENT OF PRESERVATION
9. Detail the preservation context of the documentary heritage

The FBS plates are stored at BAO Plate Archive in envelopes. At the beginning they were at the observers (Markarian, Lipovetski, and Stepanian) who studied them and discovered the famous Markarian galaxies. In 1987, they were passed to our group for further studies and search for UV-excess stellar objects (the second part of the FBS). We delivered the plates to BAO Plate Archive after the digitization project in 2005. As mentioned above, BAO administration is responsible for the preservation and the Head of the Plate Archive is its representative.