Bull. Spec. Astrophys. Obs., 2002, 53, 131–133

ODA–R — the Bank of observational data of the radiotelescope RATAN-600. The first version

V.K. Kononov, S.V. Pavlov, M.G. Mingaliev, O.V. Verkhodanov, E.K. Nizhelskaya, N.V. Khubieva

Special Astrophysical Observatory of the Russian AS, Nizhnij Arkhyz 369167, Russia

Received March 29, 2002; accepted April 22, 2002.

Abstract. Principal results of placing in service the first version of the Bank of observational data of the radio telescope RATAN-600 are discussed. The content of individual divisions of the integrated informational system is described and the fundamental statistical data on the local archives are presented.

Key words: telescopes: radio — methods: data analysis — methods: numerical

By the end of 2001, all the basic work on the fulfilment of the 3-year project of creation of an integrated informational system of the radio telescope had been completed. As a result, we developed, adopted and maintain the first version of the observational data Bank ODA–R (Observational Data Archive — RATAN–600) which is now involved in the round-the-clock observational cycle of the instrument (Kononov et al., 2001). In 1999–2001 the work on the project was supported by the RFBR (grant N99-07-90296), which made it possible to develop the suitable soft- and hard-ware adequate for the stated problems.

The created data Bank is a multibase distributed informational system, which enables "on-line" accumulation of the results of all the astrophysical experiments carried out at the RATAN–600, long-term storage of the unique material and automatic access to the archival data. The principles of creation of the Bank, its status as a standard component in the technological chain "data acquisition — data processing", interrelation with the acquisition and processing systems, the ability for dealing with a variety of observational data defined the ODA–R as an integrated informational system. At the same time, the data Bank is a multibase system for it incorporates a number of specialized databases containing both the digital arrays and the auxiliary reference information. The ODA–R operating in the OS Linux with extensive use of the local network of RATAN–600 and the whole observatory is realized as a distributed system that provides for a possibility of redistribution of its resources (software and data) between the computers for a more optimum processing of input and output data flows.

The basic method of designing is information integration of different-type systems (acquisition, archiving, processing) which take part in the technological cycle of the radio telescope RATAN–600, and also of various observational data, with simultaneous approaching the universally accepted international standards (Kononov, Mingaliev, 1998). Unified intersystem interface, FLEX-interface (FLexible EXchange), based on the common and local standards (Kononov, 1995) is used as the form of integration.

The system is intended for different types of standardized radio data and provides authorized access to the archival information. Each type of data corresponds to a specific detector-measuring complex, while the archive of a certain type of data is considered as a local archive, being a separate division of the Bank. All the local archives have the same organization and independent maintenance, but with the aid of the unified system of control. The number of local archives is not limited, which makes it possible to introduce new types of data, that is, development and introduction of new detector-measuring complexes at RATAN–600.

At the present time, the Bank ODA–R maintains the following types of data:

Rr (Continuum)	—	broad-band radiometers (feed cabins N 1, 5, 6);
Ry (Radiolines)	—	radiospectrometric complex (feed cabin N 2);
Rs (PAS)	—	panoramic spectrum analyser (the Sun feed cabin N 3).

The data Bank includes the main archival base (DB), that contains the parameterized digital experimental arrays, and is fragmented by the types of data (horizontal fragmentation), and the problem-orientated multi-level reference databases (RDB) as

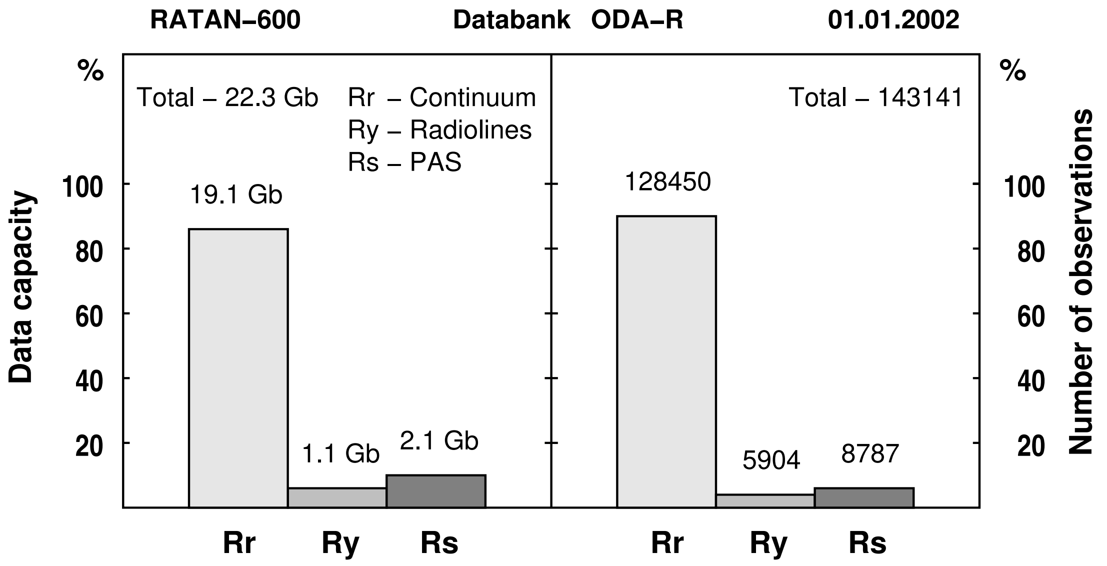

Figure 1: *Comparison of the divisions of the Bank ODA–R according to volumes of the main archival bases and number of observations.*

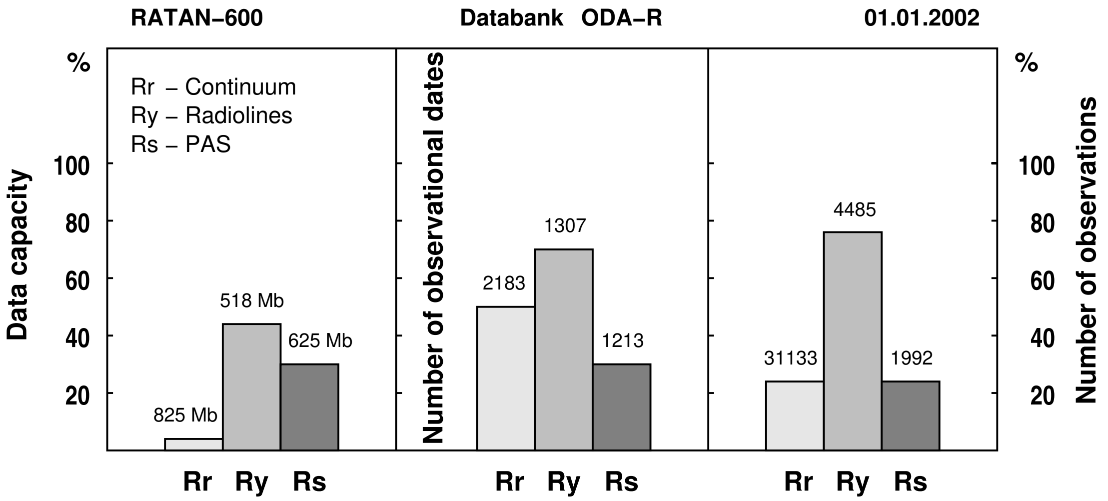

Figure 2: *Relation proportion of the reconstructed data included in the divisions of the Bank ODA–R.*

superstructure of the main DB (vertical fragmentation). The permanently extending main DB is located on the volumes of optical disks CD-R 650–700 Mb in capacity, while its resident part — on hard magnetic disks organized in the form of the RAID array. The RDB of any levels are always resident. The main DB is filled with both current (new) observational data and as a result of gradual reconstruction, reduction to the local standards and inclusion of the "old" experimental data in the respective divisions of the Bank ODA–R. The content of the RDB of individual divisions represents any changes inside the appropriate parts of the main DB.

The ODA–R, being one of the technological components, maintains automatic round-the-clock observations at RATAN–600 by organizing connection with the acquisition systems with the aid of a two-level net buffering system controlled by the central archive server of the radio telescope — *oda.ratan.sao.ru*. The net buffering system is part of the data Bank — its input interface environment, which executes the "on-line" reception and control of 100% of output information of the acquisition system.

The exact copy of the Bank ODA–R is maintained by archival server II of RATAN–600 — *rain.sao.ru*, which is located in the Headquarters building (Lower site) of SAO and is accessible in Internet.

The archiving of experimental data is a rigorously co-ordinated multistage strictly documented process, which takes account of all the specific features of operation of the radio telescope and the need of astronomers for having prompt access to the latest observational data. The automatic control of the flow of information at each stage ensures a reliable and correct filling of all the archival bases of the Bank ODA–R. Access to the archival data is provided by the key parameters (lists of dates and names of objects) with the aid of the authorization system on the basis of the catalogue of aliases of observers and net facilities of the OS Linux Red Hat 6.2 with extensive use of the RDB and the apparatus of regular expressions.

As of 1.01.2002, the state of the Bank is characterized by the following parameters:

Archival time interval	—	24 years
Number of observations	—	143141
Content of the main archival DB	—	22.3 Gb
Content of the RDB	—	0.6 Gb
Number of records in the RDB	—	$\sim$ 45 mln

Fig. 1 presents a comparison of 3 divisions of the Bank ODA–R in terms of capacity of the main archival bases and number of observations.

In the course of creation of the Bank ODA–R, special attention was given to the reconstruction of the previously accumulated "old" experimental data, which had long been stored in a digital form outside any sufficiently systematized and maintained archival base and therefore inaccessible for astronomers. As a result of the work done by the ODA–R project participants and also by the staff of the Radio Spectroscopy Laboratory and the Group of Solar Investigation, the data of $\sim$ 38000 radio observations made during the years 1978–1995 (18 years), which made about 2 Gb in volume, were reconstructed, reorganized and included in appropriate divisions of the system (Kononov et al., 1998; Kononov, Pavlov, 1999). Fig. 2 illustrates a relative proportion of the reconstructed data (as of 1.01.2002) for different divisions of the Bank in such parameters as the body of data, the number of observing dates and the number of observations.

A complex approach to the problem of storage of experimental data at RATAN–600 and having access to them made it possible to form (on the basis of the Bank ODA–R) different topical working archives related to individual observing programmes and also personal archives of radio astronomers.

The principles of creation of the Bank ODA–R, its ideology and the approaches realized are being adopted in new promising projects such as ODA–B/SS — the Bank of observational data of the stellar spectrographs of the 6 m telescope (Kononov, Panchuk, 2001) and a project of creation of a virtual miniobservatory on the basis of the informational systems of RATAN–600 (Verkhodanov et al., 2001a,b).

Acknowledgements. Kononov V.K. express his gratitude to the RFBR for partial support of the work through grant N 02-07-90247 within the frames of the project of creation of USS — a complex of automation of preparation and execution of observations at RATAN–600. Verkhodanov O.V. thanks RFBR for partial support through grant N 02-07-90038.

References

Kononov V.K., 1995, Preprint SAO, **110T**, 13

Kononov V.K., Mingaliev M.G., 1998, Preprint SAO, **129T**

Kononov V.K., Pavlov S.V., Mingaliev M.G., Verkhodanov O.V., 1998, Preprint SAO, **128T**

Kononov V.K., Pavlov S.V., 1999, Preprint SAO, **130T**

Kononov V.K., Panchuk V.E., 2001, Preprint SAO, **163**

Kononov V.K., Pavlov S.V., Mingaliev M.G., Verkhodanov O.V., Nizhelskaya E.K., Khubieva N.V., 2001, Preprint SAO, **164**

Verkhodanov O.V., Trushkin S.A., Kononov V.K., Kopylov A.I., Verkhodanova N.V., Gubanov A.G., Chernenkov V.N., Zhelenkova O.P., 2001a, in: Proceed. of All-Russia Conf., 6–12 August, 2001, St.-Petersburg, 32

Verkhodanov O.V., Kononov V.K., Trushkin S.A., Kopylov A.I., Verkhodanova N.V., Zhelenkova O.P., Chernenkov V.N., 2001b, Astronomische Gesellschaft Abstract Series No. **18**, JENAM'2001, Munich, Sept. 10–15, 254