

CATS – THE LARGEST RADIO ASTRONOMICAL DATABASE: EXTRAGALACTIC FACILITIES

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Abstract. The authors describe the largest existing publicly accessible radio source database CATS which contains more than 300 catalogues of objects detected in different (mostly radio) wavelength ranges. Both internal and external access to the CATS database is available.

Key words: databases – catalogs: extragalactic

1. INTRODUCTION

The CATS (this means “Astrophysical CATalogues Support System”) database (<http://cats.sao.ru>) operating at the Special Astrophysical Observatory for the last five years (Verkhodanov et al. 1997) unifies now more than 300 astrophysical catalogues of objects, their description and the corresponding software. The majority of these catalogues was obtained with radio telescope sky surveys at different wavelengths and in different sky regions. CATS includes galactic as well as extragalactic radio surveys. It also contains gamma, X-ray, optical and infrared data.

One of the main tasks for the authors was to organize this collection of catalogues and to give the possibility of using it in scientific investigations to the international astronomical community. The basis of CATS is described in Verkhodanov et al. (1997a,b). We constructed our database under the UNIX operating system without

Table 1. Some major radio extragalactic catalogues in CATS.

Freq. (MHz)	Name, publ., year	RA (deg)	DEC (deg)	S_{\min} (mJy)	Num. of src.	N per sq. deg
10-25	UTR-2, 78-95	0-24	>-13	10000	1754	0.2
38	8C, 90/95	0-24	>+60	1000	5859	1.7
80	CUL2, 75	0-24	-48,+35	2000	1748	0.06
151	6CII, 88	8.5-17.5	+30,+51	200	8278	4.1
151	6CIII, 90	5.5-18.3	+48,+68	200	8749	4.5
151	7CIII, 96	9-16	+20,+35	150	5526	4.0
178	4C, 65	0-24	-7,+80	2000	4844	0.2
325	WENSS, 98	0-24	+30,+90	18	229420	22
365	TXS, 96	0-24	-35.5,+71.5	250	66841	2.
408	MRC, 81/91	0-24	-85,+18.5	700	12141	0.5
408	B2, 70-73	0-24	+24,+40	250	9929	3.1
408	B3, 85	0-24	+37,+47	100	13354	5.2
1400	WB92, 92	0-24	-5,+82	150	31524	0.7
1400	NVSS39, 98	0-24	-40,+90	2.0	1814748	58.
1400	FIRST, 2000	7.3-17.4	-3,3+58.6	1.0	722354	73.
2700	PKS, (90)	0-24	-90,+27	50	8264	0.3
3900	Z, 89	0-24	0,+14	50	8503	1.7
3900	RC, 91/93	0-24	4.5,5.5	4	1189	3.2
4850	MG1-4, 86-91	var.	0,+39	50	24180	1.2
4850	87GB, 91	0-24	0,+75	25	54579	2.7
4850	BWE, 91	0-24	0,+75	25	53522	2.7
4850	GB6, 96	0-24	0,+75	18	75162	3.7
4850	PMNM, 94	0-24	-88,-37	25	15045	1.8
4850	PMN-S, 94	0-24	-87.5,-37	20	23277	2.8
4850	PMN-E, 95	0-24	-9.5,+10	42	11774	1.7

involving any standard database systems because of the three main reasons:

- (a) they are very expensive commercial products,
- (b) there are no human resources to develop them in the observatory now,
- (c) it is simpler to solve our task without complex systems.

We designed our database using UNIX simple organization principles, which permitted us to easily include new information in our database system:

Table 2. Some non-radio extragalactic catalogues in CATS.

λ range	Name, year	RA (h)	DEC (deg)	N	N/deg^2
	PGC, 89	0–24	–90,+90	73197	3.6
opt	MCG, 75	0–24	–33.5,+90	31886	
ir	IRASPSC, 87	0–24	–90,+90	245889	11.9
ir	IRASFSC, 89	0–24	$ b >10$	235935	13.8
ir	IRASSC, 89	0–24	–90,+90	43886	
X-ray	ROSAT, 95	0–24	–90,+90	74301	3.6

(a) every new catalogue of objects has to be contained in the corresponding UNIX directory,

(b) the catalogue description must also be in that directory,

(c) the programs for local operations with the catalogue of objects are also in the same directory,

(d) brief characteristics, program names and “readme”-file are stored in the special reference file,

(e) there are scripts operating with every low level program and documentation of each catalog, and accessible from the UNIX standard shells, graphics and WWW system.

To simplify the design of CATS operating programs, two utilities of ‘*select*’ and ‘*match*’ type have been worked out. These utilities operate with the pattern string, describing a format of the ASCII table with astrophysical data and permitting administrators to easily include new catalogues to the database.

On the basis of these principles we created a low level software in C-language, organized shell scripts and e-mail and HTTP access to CATS commands. All the large catalogues are indexed to accelerate data search. The CATS database operates now under OS Linux RedHat 5.2 (<http://cats.sao.ru>) and under OS Solaris for the local use at RATAN-600.

2. MAJOR CATALOGUES AND SOME TOOLS

Short information of some extragalactic catalogues stored in the CATS database is given in Table 1. Some non-radio extragalactic catalogues of CATS are presented in Table 2.

CATS users have access to all catalogues simultaneously or to selected ones in selected areas; for the search it is sufficient to fill in a form via the navigator or in an e-mail message.

The standard access to the CATS database is provided in three different ways: (1) <http://cats.sao.ru>; (2) e-mail: cats@sao.ru (an empty e-mail delivers a help file); (3) <ftp://cats.sao.ru> (anonymous FTP). HTTP and e-mail access permits users to obtain information from cross-identifications of entries in CATS with user-specified input lists. Examples of e-mail requests, which are very convenient for a slow network transfer, and corresponding detailed instructions can be obtained from the homepage or by sending an empty e-mail message to cats@sao.ru.

Another system developed to operate with the CATS output tables is the SPG (SPectra Graphics) package designed in C-codes. It processes continuum spectra of radio sources recorded as FITS tables and allows users to fit a spectrum with a standard set of curves:

$$\begin{aligned} (1) \quad y &= A + Bx, & (3) \quad y &= A + Bx + C \times \exp(x), \\ (2) \quad y &= A + Bx + Cx^2, & (4) \quad y &= A + Bx + C \times \exp(-x), \end{aligned}$$

where $x = \log \nu$, $y = \log S$, ν is the frequency (MHz), S is the flux density (Jy). The SPG program acting in the X Window system allows users to choose via a menu among these curves either automatically (by a least-squares fit), or by manual selection of the fitting function, or by manual fitting using the mouse (when the curve follows a cursor). Data points may be weighted in different manners: setting equal weight, setting weights by flux density errors or filling a form with a table of frequencies, flux densities and weights. For a given set of cosmological parameters, a user can calculate radio power and luminosity of extragalactic sources.

In conclusion, we would like to note that the CATS database including astrophysical catalogues and processing software is continually developed according to users' wishes and astrophysical interests.

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