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A catalogue of quasars and active nuclei: 10th edition*

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Abstract. The recent publication of the first release of the 2dF quasar catalogue (Croom et al. 2001) containing nearly 10 000 new QSOs, almost doubling the number of known such objects, led us to prepare an updated version of our catalogue of quasars and active nuclei which now contains 23 760 quasars, 608 BL Lac objects and 5751 active galaxies (of which 2765 are Seyfert 1s). Like the ninth edition, it includes position and redshift as well as photometry (U, B, V) and 6 and 11 cm flux densities when available. We also give a list of all known lensed and double quasars.

Key words. quasars: general – galaxies: Seyfert – BL Lacertae objects: general

1. Introduction

The first catalogue of quasars was published in 1971 by De Veny et al.; it contained 202 objects. The number of known quasars has since steadily increased, but the recent release of the "2dF QSO redshift survey" (Croom et al. 2001) has almost doubled this number (see Table 1), which is expected to increase again dramatically when the final 2dF catalogue will be published at the end of 2002 containing ∼15 000 new QSOs and when the "Sloan Digital Sky Survey", which should discover ∼100 000 QSOs, will be completed in about 2004 (Fan et al. 1999).

In the present edition, containing quasars with measured redshift known to us prior to May 1st, 2001, as in the preceding editions, we do not give any information about absorption lines or X-ray properties. But we give the absolute magnitude for each object and, when available, the 11 and 6 cm flux densities.

This catalogue should not be used for any statistical analysis as it is not complete in any sense, except that it is, hopefully, a complete survey of the literature.

2. Description of the catalogue

The quasars are listed in Table I. We have arbitrarily defined a quasar as a starlike object, or an object with a starlike nucleus with broad emission lines, brighter than absolute magnitude $M_B = -23$; the absolute magnitude is computed, by assuming $H_0 = 50\ \mathrm{km\,s^{-1}\ Mpc^{-1}}$, $q_0 = 0$, and an optical spectral index α equal to 0.3 (defined as $S \propto \nu^{-\alpha}$) (Francis et al. 1991), as follows:

Table 1. Increase with time of the number of known QSOs, BL Lacs and Seyfert 1s.

QSO	BL Lac	Seyfert 1	reference
202			De Veny et al. (1971)
2251		190	Véron-Cetty & Véron (1984)
2835	73	236	Véron-Cetty & Véron (1985)
3473	84	258	Véron-Cetty & Véron (1987)
4169	117	358	Véron-Cetty & Véron (1989)
6225	162	575	Véron-Cetty & Véron (1991)
7383	171	695	Véron-Cetty & Véron (1993)
8609	220	888	Véron-Cetty & Véron (1996)
11 358	357	1111	Véron-Cetty & Véron (1998)
13 214	462	1711	Véron-Cetty & Véron (2000a)
23 760	608	2765	present edition

$$M = m + 5 - 5 \times \log D - k + \Delta m(z)$$

where m is the B magnitude, $D = c/H_0 \times A$, with A the photometric distance (Terrell 1977):

$$A = z\left[1 + \frac{z(1-q_0)}{(1+2q_0 z)^{0.5} + 1 + q_0 z}\right]$$

z is the redshift; $k = -2.5\ \log(1+z)^{1-\alpha}$ is the k correction, $\Delta m(z)$ is a correction to k taking into account the fact that the spectrum of quasars is not strictly a power law of the form $S \propto \nu^{-\alpha}$, but is affected by emission lines and by the Ly α forest depleting the continuum to the blue of Ly α. Assuming that the spectrum is a power law with

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* The catalogue (Tables I to V) is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via
http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/374/92
or at the Observatoire de Haute Provence (http://www.obs-hp.fr).

$\alpha = 0.3$ may not give the best possible estimate of the k correction (Wisotzki 2000).

In Table II, we list all confirmed, probable or possible BL Lac objects with or without a measured redshift, without consideration of their absolute magnitude. As better spectra are becoming available, broad emission lines have been detected in a number of objects formerly classified as BL Lac; they have usually been moved to Table I (Véron-Cetty & Véron 2000b).

Table III lists "active galaxies": Seyfert 1s, Seyfert 2s and Liners fainter than $M_B = -23$. A number of galaxies with a nuclear HII region are also included, the reason being that they have been called Seyfert in the past and later reclassified; we consider it useful to keep track of these reclassifications to avoid further confusion.

Seyfert 1s have broad Balmer and other permitted lines; Seyfert 2s have Balmer and forbidden lines of the same width. Osterbrock (1977, 1981) has divided the Seyfert 1s into five subgroups: Seyfert 1.0, 1.2, 1.5, 1.8 and 1.9 on the basis of the appearance of the Balmer lines. Seyfert 1.0s are "typical" members of the class, as described by Khachikian & Weedman (1971, 1974), while Seyfert 1.5s are objects intermediate between typical Seyfert 1s and Seyfert 2s, with an easily apparent narrow Hβ profile superimposed on broad wings. The classes Seyfert 1.2 and 1.8 are used to describe objects with relatively weaker and stronger narrow Hβ components, intermediate between Seyfert 1.0 and 1.5 and Seyfert 1.5 and 2 respectively. In Seyfert 1.9, although the broad Hα emission is clearly evident, broad Hβ cannot be detected with certainty by mere visual inspection of the spectra.

We have adopted the more quantitative classification introduced by Winkler (1992):

S1.0	$5.0 < R$	
S1.2	$2.0 < R < 5.0$	
S1.5	$0.333 < R < 2.0$	
S1.8	$R < 0.333$	broad component visible in Hα and Hβ
S1.9		broad component visible in Hα but not in Hβ
S2		no broad component visible

where R is the ratio of the total Hβ to the [OIII]λ5007 fluxes.

Several objects have been found to show extreme spectral variability, changing from Seyfert 1.8 or 1.9 to Seyfert 1.0. In some cases these changes are consistent with changes in the reddening to the BLR while, in others, they are probably due to real changes in ionizing flux (Goodrich 1989a, 1995; Tran et al. 1992b). In some Seyfert 2s, a broad Pa β line has been detected, indicating the presence of a highly reddened broad line region (Goodrich et al. 1994); we call these objects S1i. A number of Seyfert 2s have, in polarized light, the spectra of Seyfert 1s (Antonucci & Miller 1985; Miller & Goodrich 1990; Tran et al. 1992a); we call them S1h. Typical full widths at half-maximum of the Balmer lines in Seyfert 1s lie in the range 2 000–6 000 km s^{-1}; however, there is a group of active galactic nuclei with all the properties of Seyfert 1s, but with unusually narrow Balmer lines (Osterbrock & Pogge 1985; Goodrich 1989b); they are defined as having the broad component of the Balmer lines narrower than 2 000 km s^{-1} $FWHM$ (Osterbrock 1987); we call them S1n.

Liners (as defined by Heckman 1980) are called S3. If broad Balmer lines are observed, they are called S3b; if these broad Balmer lines are only seen in polarized light, they are called S3h.

Only objects brighter than $M_B = -23$ appear in Table I, but, clearly, some objects would move from Tables I to III and vice versa if other values for q_0 and the spectral index were used or if an accurate B apparent magnitude was available for all objects. The variability may have a similar effect, as well as the size of the diaphragm used for the measurement as the contribution of the underlying galaxy for weak quasars may not be negligible.

Table IV lists the objects which once were believed to be quasars or BL lac objects and are now known to be either stars or normal galaxies.

Table I contains 23 760 objects, Table II, 608, Table III, 5 751 and Table IV, 71.

The catalogue is believed to contain all known quasars, BL Lac objects and Seyfert 1s.

Since the discovery in 1979 by Walsh et al. of the first gravitationally lensed quasar, Q 0957+561, a number of such objects (44) and of physical pairs with separation less than $10''$ (11) have been found. They are listed in Table V. Mortlock et al. (1999) have stressed the difficulty sometimes encountered in distinguishing lensed quasars from physical pairs.

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