

CALÁN-TOLOLO SURVEY. VII. ONE HUNDRED SOUTHERN QUASARS

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RESUMEN

Se presenta la séptima lista de la Exploración Calán-Tololo. Contiene información acerca de 100 cuasares australes, cuyas magnitudes B están en el intervalo $16 \leq B < 19.5$, con sólo 20 objetos más brillantes que $B = 18$. Los corrimientos al rojo z son tales que 69 objetos cumplen con $1.8 \leq z < 2.4$, 11 objetos tienen z tal que $2.4 \leq z < 3.4$ y 20 cuasares tienen un $z < 1.8$. Estos cuasares fueron encontrados en Cerro Calán explorando placas de prisma objetivo tomadas en el Observatorio Inter-Americano de Cerro Tololo, utilizando la cámara Curtis-Schmidt con el prisma ultravioleta delgado y placas IIIaJ. Se presentan cartas de identificación, coordenadas ecuatoriales, una estimación de la magnitud azul, B , y un corrimiento preliminar del rojo. Todos los cuasares de esta lista han sido confirmados espectroscópicamente, información que será publicada posteriormente (Maza & Ortiz 1996). Sólo doce de los quasars aquí reportados eran conocidos con anterioridad.

ABSTRACT

The seventh list of the Calán-Tololo Survey is presented. It contains information for 100 southern quasars with a B magnitude in the range $16 \leq B < 19.5$; only 20 quasars are brighter than $B = 18$. The redshifts z of these quasars are such that for 69 objects $1.8 \leq z < 2.4$, for 11 objects $2.4 \leq z < 3.4$ and for 20 quasars $z < 1.8$. These quasars were found at Cerro Calán, searching objective prism plates obtained at Cerro Tololo Inter-American Observatory, using the Curtis-Schmidt telescope, the thin UV prism and IIIaJ plates. Identification charts, equatorial coordinates, an estimated blue magnitude, B , and a preliminary redshift for every object are presented. All quasars in this list have been confirmed using slit spectroscopy. The spectroscopic data shall be presented elsewhere (Maza & Ortiz 1996). Only twelve of these quasars were known before.

Key words: QUASARS—GENERAL

1. INTRODUCTION

The Calán-Tololo Survey (hereinafter CTS) is an objective prism survey conducted at Cerro Calán (Department of Astronomy, Universidad de Chile) in Santiago, using photographic plates obtained at Cerro Tololo Inter-American Observatory (CTIO). We have used the Curtis-Schmidt telescope, IIIaJ

plates and the thin UV prism. The CTS is a southern extension to the Tololo Survey (Smith 1975; Smith, Aguirre, & Zelman 1976) and to the Michigan Survey (MacAlpine, Lewis, & Smith 1977; MacAlpine, Smith, & Lewis 1977a, 1977b; MacAlpine & Lewis 1978; MacAlpine & Williams 1981). The main goal of the CTS is the discovery of new quasars and emission line galaxies. A description of the survey, the procedure and other details can be found in Maza et al. 1988a, 1988b, 1989, 1991 and 1992.

List No. 1 of the Calán-Tololo Survey containing 30 new Seyfert 1 galaxies was published in 1989 (Maza et al. 1989). List No. 3 presenting 42 H II

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galaxies was published in 1991 (Maza et al. 1991). List No. 2 containing data for 40 Seyfert 1 galaxies was published in 1992 (Maza et al. 1992). List No. 4 presenting data for 50 Seyfert 1 galaxies was published in 1994 (Maza et al. 1994). List No. 5 containing data for 200 quasars was published in 1993 (Maza et al. 1993). List No. 6 containing data for 100 southern quasars was published in 1995 (Maza et al. 1995). The present list contains information for 100 additional quasars discovered in the Calán-Tololo Survey and fully confirmed by slit spectroscopy at Las Campanas Observatory (Carnegie Southern Observatory).

2. OBSERVATIONS

Objective prism photographic plates have been obtained for 266 fields in the southern hemisphere at galactic latitude b such that $|b| \geq 20^\circ$, covering 5150 deg^2 . To the original 163 fields of the CTS — see Figure 1 in Maza et al. 1989 — additional strips at $\delta = -30^\circ$ (strip “F”), $\delta = -50^\circ$ (strip “G”), and $\delta = -55^\circ$ (strip “H”) have been added in the right ascension interval $19^h \leq \alpha \leq 6^h$.

We have used the Curtis-Schmidt telescope at CTIO equipped with the thin UV prism that yields a reciprocal dispersion of 1740 Å mm^{-1} at $H\beta$, 1340 Å mm^{-1} at $H\gamma$, and 1100 Å mm^{-1} at $\lambda 3727 \text{ Å}$ (Blanco 1974). We have used Eastman Kodak IIIaJ plates baked in 2% forming gas and exposed to the sky limit (90 min) with spectra oriented north-south, without trailing. Objects as faint as 19th mag in B are visible at the plate limit. The UV prism spectral resolution at the Curtis-Schmidt plate scale ($97'' \text{ mm}^{-1}$) is $\sim 30 \text{ Å}$ at $H\beta$ and $\sim 20 \text{ Å}$ at $\lambda 3727 \text{ Å}$ for a $2''$ seeing.

Our method of selecting a quasar candidate relies on the presence of emission lines in the spectrum. Strong emission lines present in the spectrum of a high redshift quasar ($L\alpha$, most of the time) are resolved on our objective prism spectra, allowing a clear separation between quasar candidates and high redshift starburst galaxies. The most favorable case to select a quasar candidate is when $L\alpha$ lies near $\lambda 4000 \text{ Å}$ and the C IV line ($\lambda 1549 \text{ Å}$) is at $\lambda 5000 \text{ Å}$, corresponding to a quasar at a redshift $z \sim 2.2$. The lines used for candidate selection on the objective prism plates are: $L\alpha$ ($\sim 75\%$ of the time), C IV and Mg II (at $\lambda 2798 \text{ Å}$). In a few cases, broad absorption lines quasars (BALs) have been found because their spectrum looks quite conspicuous on the objective prism plates; they look like unusual carbon stars.

3. LIST No. 7

Figure 1 presents identification charts and Table 1 contains the corresponding data for 100 additional quasars found and confirmed in our survey. Quasar candidates were selected from the objective

prism plates and they were confirmed using slit spectroscopy at the 2.5-m du Pont telescope at Las Campanas Observatory (Carnegie Institution of Washington Southern Observatory). Only twelve of the quasars presented here were known before, according to the sixth edition of the catalogue of quasars by Véron-Cetty & Véron (1993); they are identified in Table 1 by an asterisk after the CT number.

Table 1 contains, for quasars numbered from 501 to 600 a name, labeled “Object” obtained from a contraction of the letter designating the strip on the sky, the field number in the strip and the candidate number in that field. For example, object C1610 is the tenth candidate selected in area “C16” (sixteenth field in strip “C”) (see Figure 1 in Maza et al. 1989).

Equatorial coordinates (J2000.0) were obtained using the Digitized Sky Survey (DSS), the STSDAS software package and the corresponding tasks in the IRAF working environment on SUN workstations at Cerro Calán. A preliminary set of coordinate for each candidate was obtained by overlaying a grid on the objective prism plate. Then a $15' \times 15'$ image was extracted from the DSS. The object was identified in that image and coordinates were obtained using the plate solution in the header of each image. The astrometric accuracy of these coordinates is better than 1 arcsecond.

Column 5 in Table 1 presents a B magnitude estimated from the ESO Quick Blue Chart for every object south of -15° . The CCD sequence F342-10 from Stobie, Sagar, & Gilmore (1985) was used for our eye estimates made by one of us (RA). Then these B magnitudes were compared with the instrumental magnitudes from the DSS, yielding a fit for 97 objects with a scatter of $\pm 0.34 \text{ mag}$. Using that relationship and the DSS, we estimated B values for objects 515, 521, and 525, which are located north of -15° . As quasars in Table 1 could present photometric variability it is necessary to emphasize that the magnitudes quoted here correspond to an eye estimate made on direct plates taken at least 15 years ago; those magnitudes do not necessarily correspond to the apparent magnitudes of the quasars in the objective prism plates.

Column 6 in Table 1 presents preliminary values for the redshifts of these quasars. These figures were obtained at the telescope when the spectroscopic confirmation of the quasars was made; they should be accurate to ± 0.02 . (A comparison between the redshifts quoted here and those listed by Véron-Cetty & Véron (1993) for the twelve known quasars produces a fit with a rms of 0.020). The details of the spectrophotometry shall be presented elsewhere (Maza & Ortiz 1996). The final redshift value will be reported there.

Finally the last column of Table 1 presents the ESO Quick Blue chart number where these quasars can be found.

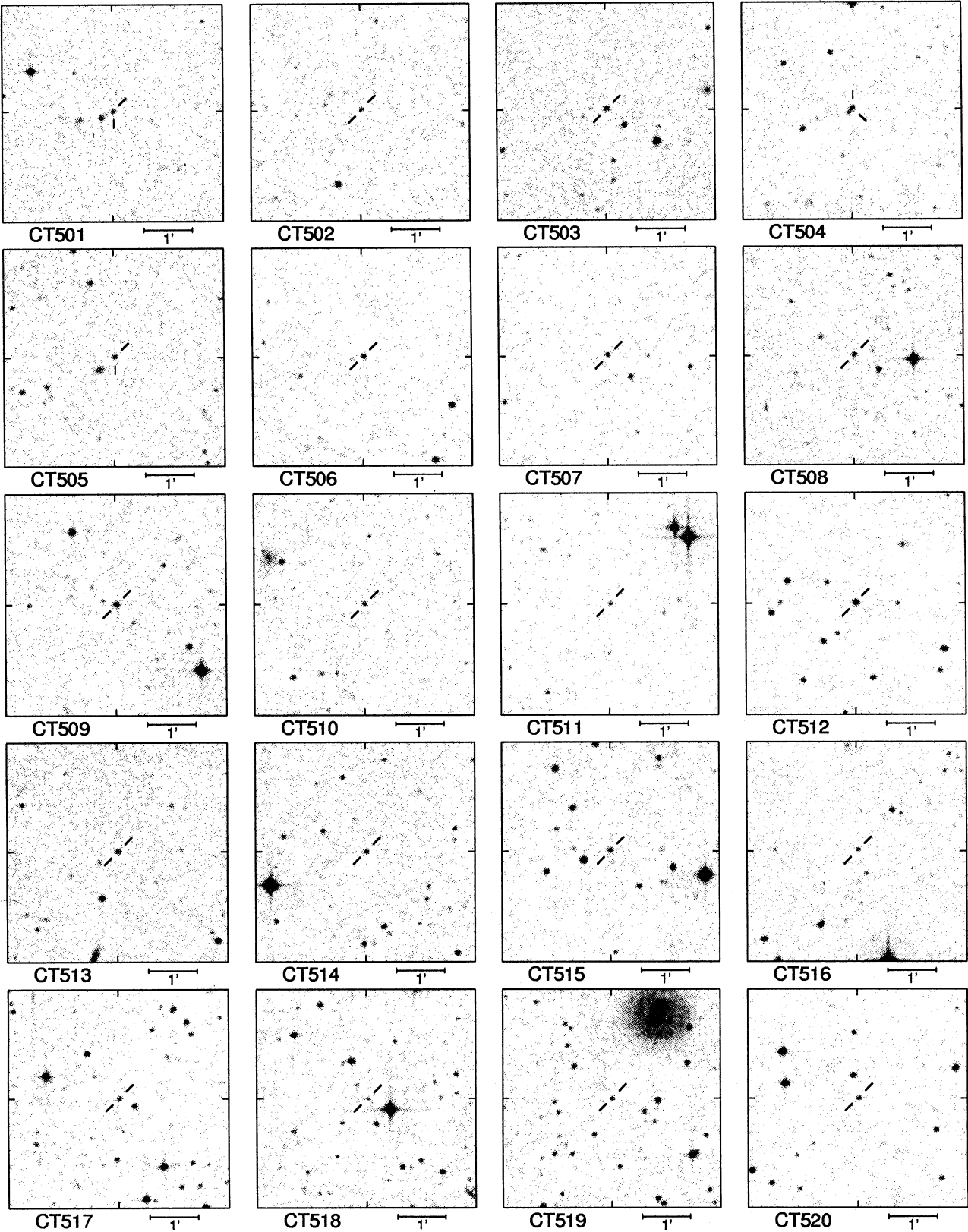


Fig. 1a. Objects 501–520. Finding charts for Calán-Tololo quasars from the Digitized Sky Survey (DSS). North is to the top and east to the left. Each chart covers $4' \times 4'$.

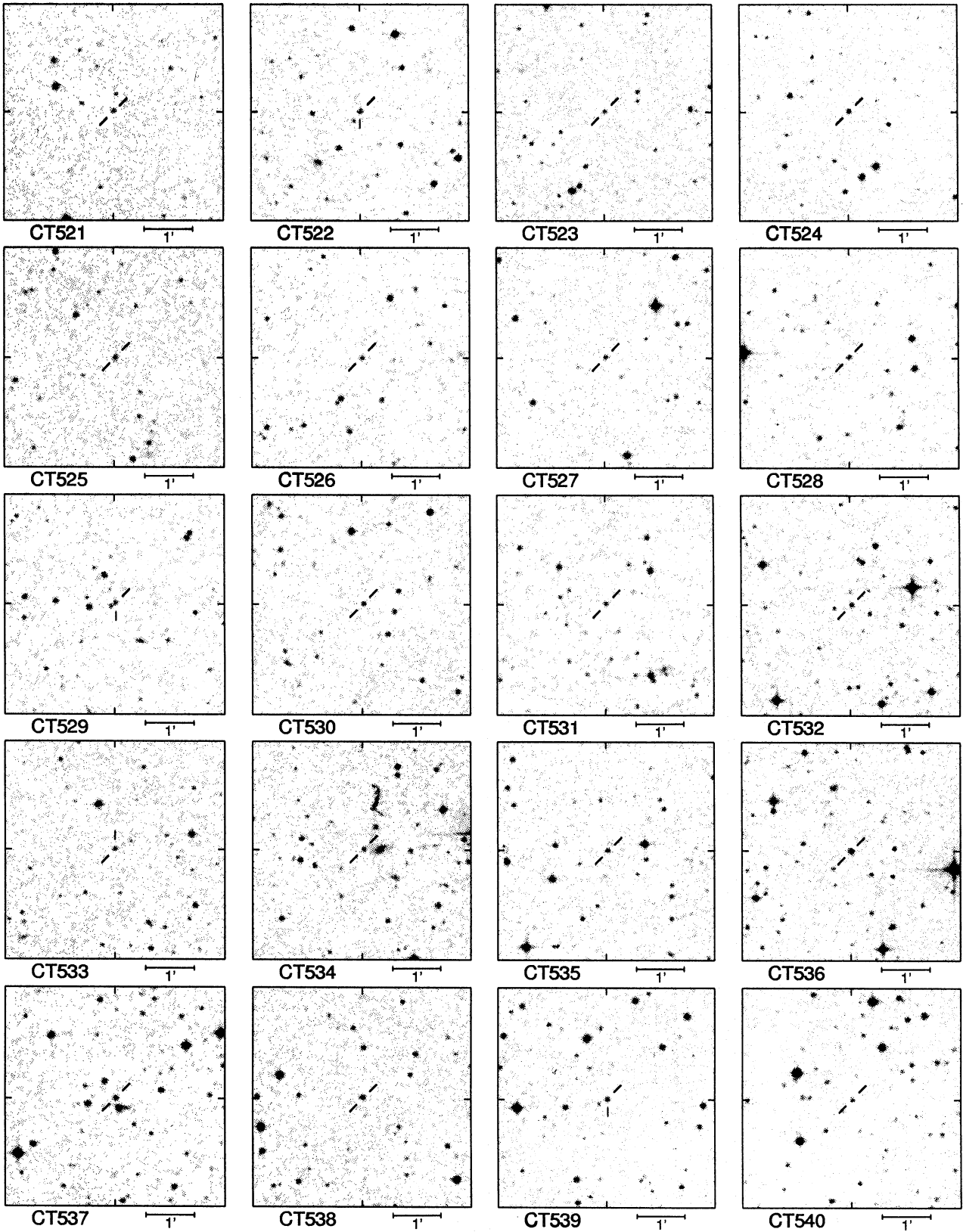


Fig. 1b. Same as Figure 1a for objects 521–540.

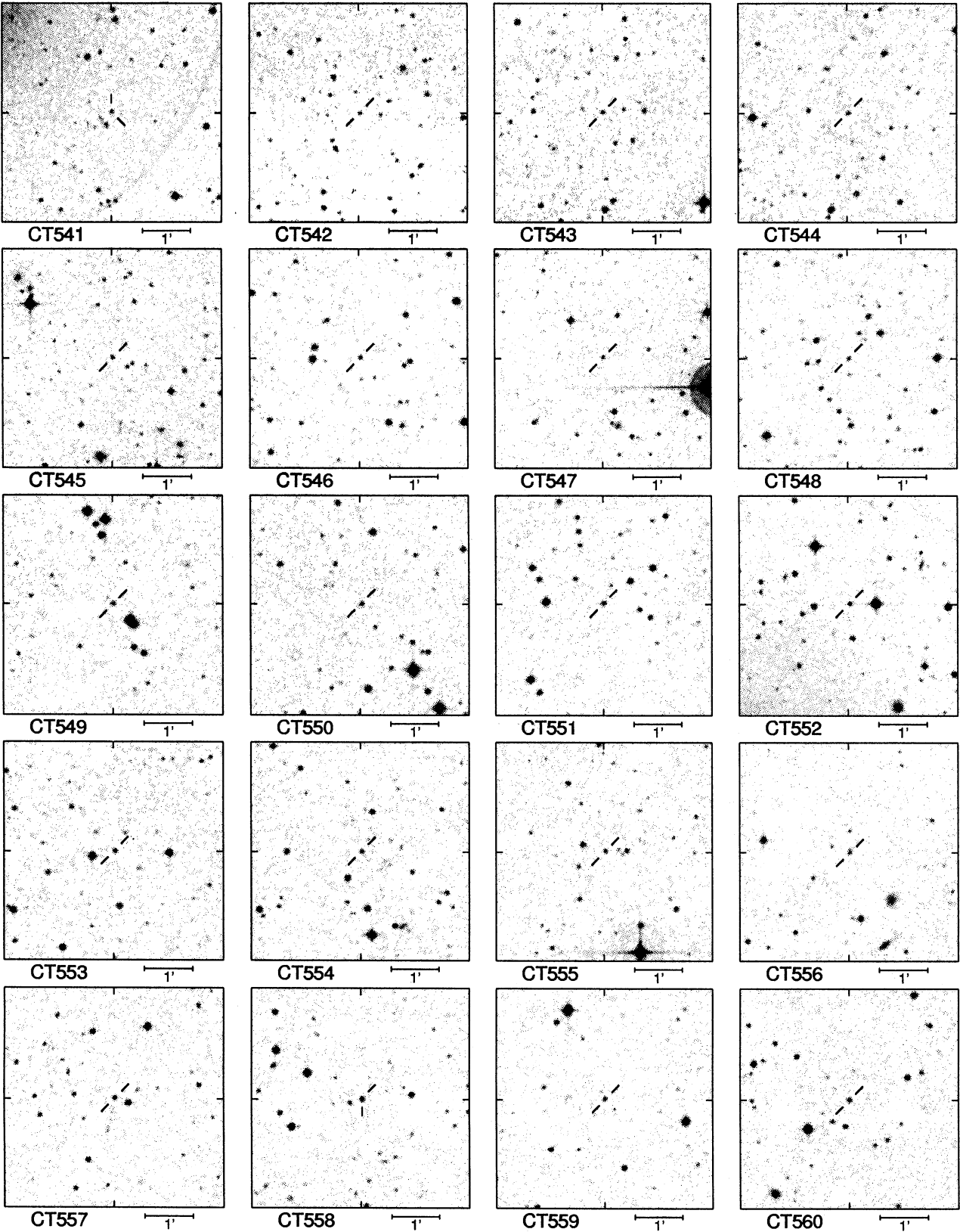


Fig. 1c. Same as Figure 1a for objects 541–560.

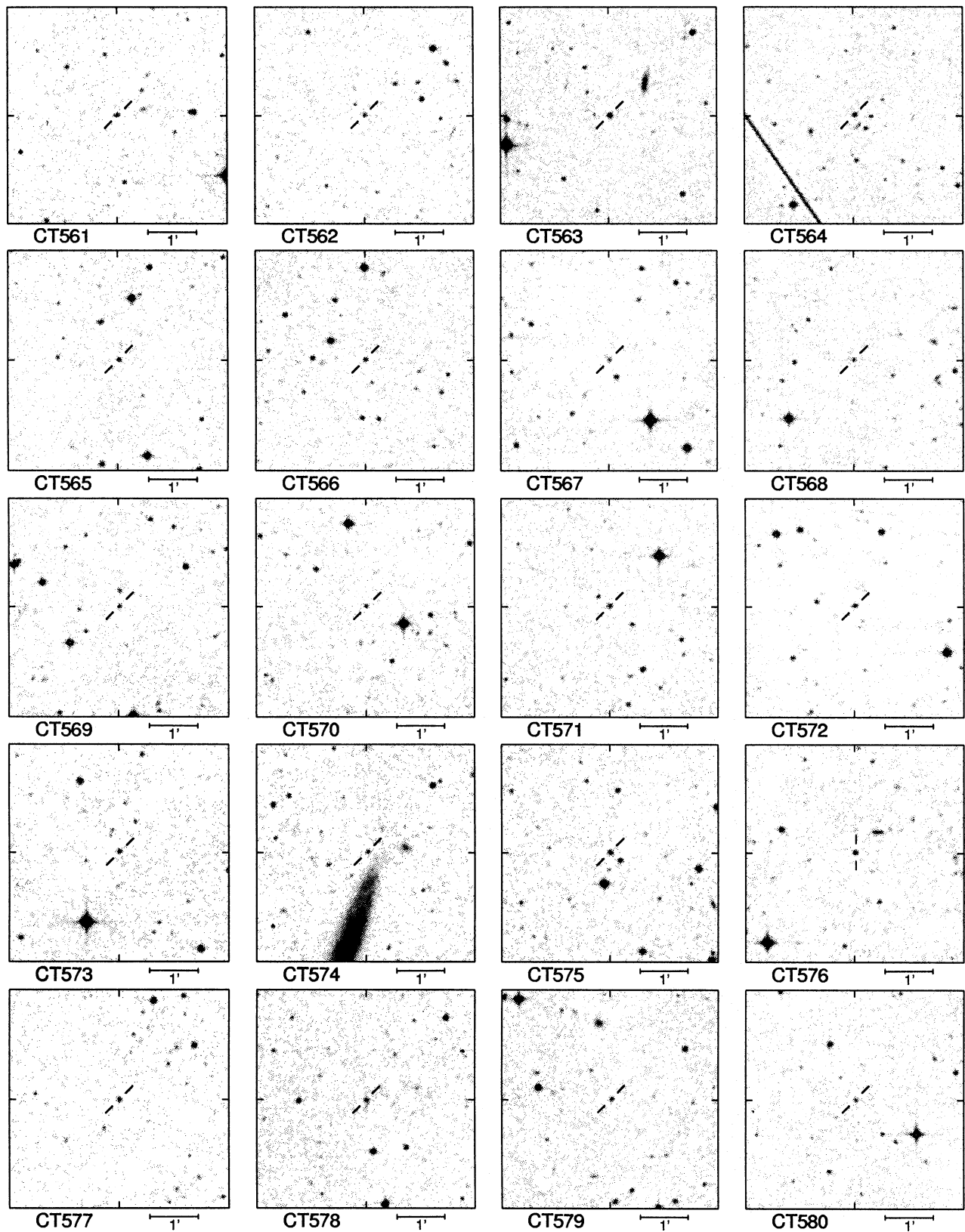


Fig. 1d. Same as Figure 1a for objects 561–580.

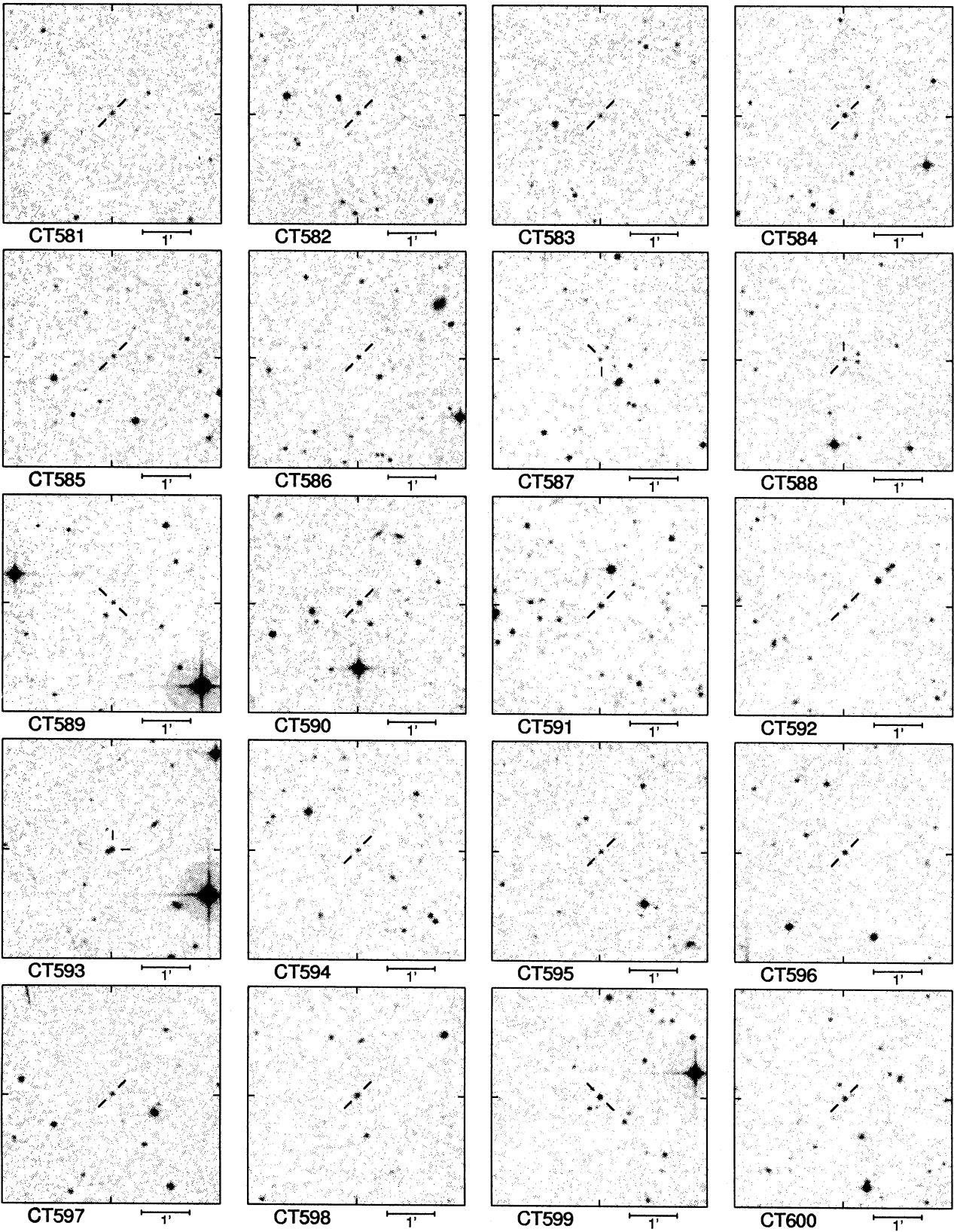


Fig. 1e. Same as Figure 1a for objects 581–600.

TABLE 1

CALÁN-TOLOLO SURVEY LIST NO. 7: QUASARS

CT#	Object	α			(J2000.0)			δ			B	z	ESO
		h	m	s	°	'	"	°	'	"			
501*	C1610	0	04	29.80	-42	38	29.4	18.3	2.04	241			
502	H1601	0	07	53.21	-52	21	11.7	18.7	2.18	149			
503	H1704	0	11	17.70	-57	04	50.3	18.4	2.15	149			
504	H1701	0	35	18.33	-52	49	08.2	17.8	2.70	150			
505	H1801	0	39	05.23	-55	49	02.9	18.2	2.02	150			
506*	A1717	0	42	43.89	-36	47	41.1	19.0	2.72	351			
507	H1904	0	54	40.91	-53	32	18.9	18.1	2.28	151			
508*	B1611	0	59	25.04	-41	10	44.8	17.4	2.05	295			
509*	A1801	1	11	43.51	-35	03	01.4	16.6	2.41	352			
510	C2003	1	14	25.08	-46	38	05.4	18.7	2.18	244			
511*	H2009	1	23	04.89	-54	53	05.3	18.3	2.31	151			
512	G3001	4	30	37.24	-48	55	23.9	16.2	1.94	202			
513	G3006	4	41	10.95	-49	48	40.5	18.2	2.25	202			
514	G3003	4	41	31.18	-47	54	25.4	18.7	2.37	202			
515	R0530	10	48	59.97	-16	50	44.8	17.8	1.95	639			
516	J0713	11	36	08.14	-21	27	44.5	19.0	2.10	571			
517	M0711	11	36	56.13	-26	58	01.1	18.7	2.35	504			
518	M0712	11	52	03.09	-26	37	25.3	19.0	2.04	504			
519	M0811	11	54	58.38	-27	16	31.2	18.4	1.96	504			
520	M0801	11	55	10.33	-22	32	47.8	17.6	2.23	572			
521	R0939	11	59	06.08	-13	25	34.4	18.6	2.29	643			
522	M0815	12	01	10.83	-22	33	49.8	18.2	1.92	572			
523	M0816	12	02	01.89	-26	07	41.5	18.7	1.95	505			
524	M0912	12	12	46.65	-23	45	20.6	17.7	1.9	505			
525	R1037	12	21	08.74	-14	20	31.0	18.3	2.22	644			
526	M0911	12	21	09.55	-23	15	38.9	19.0	2.32	506			
527	M1009	12	32	18.06	-24	35	35.2	18.4	2.72	506			
528	M1019	12	39	31.60	-25	21	30.8	18.2	0.35	506			
529	M1011	12	43	36.89	-27	13	26.8	18.6	2.05	507			
530	M1021	12	49	30.38	-24	43	14.8	18.4	1.43	507			
531	M1237	13	06	42.49	-26	10	37.6	18.4	1.32	508			
532	M1528	13	53	35.25	-24	21	08.7	18.2	1.88	510			
533	M1529	13	56	00.23	-26	47	56.2	18.6	2.29	510			
534	M1530	13	58	52.24	-26	55	43.3	18.4	2.10	510			
535	M1521	14	01	33.53	-24	08	59.0	18.2	2.00	510			
536	M1527	14	01	49.25	-24	55	30.4	16.5	0.50	510			
537	M1615	14	11	51.51	-26	46	43.3	18.1	1.93	511			
538	M1656	14	21	01.61	-23	07	31.3	18.3	2.71	511			
539	M1655	14	22	36.62	-22	58	44.5	18.1	1.89	511			
540	M1657	14	30	08.42	-25	44	14.9	18.7	1.96	511			
541	M1730	14	47	29.18	-26	08	04.9	18.9	1.55	512			
542	A0408	20	15	41.46	-35	55	49.6	18.4	1.29	400			
543	B0206	20	19	54.57	-37	28	42.2	18.1	2.22	340			
544	C0612	20	29	58.91	-43	18	35.6	18.2	2.20	285			
545	H0503	20	32	13.99	-56	23	48.5	18.0	2.35	186			

TABLE 1 (CONTINUED)

CT#	Object	α		(J2000.0)		δ		B	z	ESO
		h	m	s	°	'	"			
546	A0518	20	39	13.86	−34	57	38.1	18.5	1.41	401
547	H0501	20	39	15.12	−53	50	37.5	18.3	2.17	186
548	C0613	20	44	59.40	−45	14	23.4	18.6	1.39	285
549	A0517	20	47	10.64	−33	21	08.9	18.4	2.09	401
550	A0519	20	51	19.51	−35	00	01.8	18.5	1.32	401
551*	A0520	20	54	29.01	−37	08	35.4	18.3	2.60	401
552	C0765	21	07	48.43	−46	26	51.4	18.2	2.06	286
553*	C0762	21	16	54.25	−43	32	34.6	18.1	2.0	286
554	C0761	21	17	39.46	−43	35	38.5	18.3	2.05	286
555	H0801	21	19	19.56	−56	48	41.3	18.2	2.32	188
556	H0803	21	20	18.66	−54	56	51.0	18.2	2.26	188
557*	B0505	21	26	18.47	−40	35	35.4	18.0	2.27	342
558*	C0906	21	37	47.83	−42	26	11.7	17.7	1.81	287
559*	C0903	21	38	21.36	−46	18	53.8	18.6	2.21	287
560*	C0905	21	39	40.03	−42	47	47.1	18.0	1.34	287
561	H0901	21	41	44.30	−55	09	30.2	18.0	1.92	188
562	B0611	21	45	32.46	−38	49	44.9	18.6	1.98	343
563	C1020	21	49	50.07	−44	44	06.0	16.0	1.51	288
564	C0908	21	50	15.97	−44	11	23.9	17.4	2.66	288
565	C1025	21	52	24.24	−43	21	18.2	17.6	2.00	288
566	C1019	21	55	45.79	−44	31	05.8	18.2	2.05	288
567	A0993	21	56	52.12	−36	48	48.9	19.4	1.94	404
568	C1028	22	00	53.93	−45	12	03.4	18.8	2.05	288
569	C1027	22	03	01.25	−45	03	46.0	18.4	2.20	288
570	C1021	22	05	08.77	−42	35	58.9	18.3	1.57	288
571	H1002	22	05	31.29	−54	05	41.3	17.7	1.15	189
572	A0986	22	06	38.07	−33	31	41.9	18.6	1.92	404
573	A0982	22	07	43.67	−34	24	05.8	18.2	2.26	404
574	C1107	22	10	54.05	−46	03	09.0	18.2	1.36	288
575	A1029	22	14	29.86	−35	24	09.0	18.0	2.07	404
576	H1105	22	15	31.14	−53	15	31.9	17.4	1.96	189
577	C1106	22	18	58.50	−43	50	31.3	17.0	1.44	289
578	H1101	22	22	55.19	−52	25	16.4	17.6	1.55	190
579	H1108	22	30	35.54	−56	49	31.2	18.8	2.03	190
580	C1209	22	32	11.36	−45	45	54.3	18.4	2.72	289
581	H1215	22	34	29.24	−56	24	38.6	18.5	2.07	190
582	H1103	22	40	18.84	−52	31	52.4	17.8	0.49	190
583	C1208	22	40	28.70	−44	53	16.9	18.8	2.20	289
584	H1201	22	42	33.89	−53	19	32.8	18.3	1.95	190
585	H1206	22	47	07.05	−54	08	57.0	18.6	2.09	190
586	H1207	22	47	33.77	−54	04	40.1	18.2	1.62	190
587	H1211	22	48	14.71	−54	30	56.1	19.2	2.19	190
588	H1208	22	49	54.95	−54	10	46.5	18.4	2.13	190
589	H1204	22	52	39.90	−53	43	40.8	18.3	2.18	191
590	H1205	22	59	21.02	−53	17	24.2	17.3	1.02	191
591*	C1432	23	03	50.01	−43	55	38.8	17.2	2.09	290
592	A1227	23	04	48.07	−35	25	46.8	19.1	2.38	407

TABLE 1 (CONTINUED)

CT#	Object	α			(J2000.0)			δ	B	z	ESO
		h	m	s	°	'	"				
593	H1305	23	07	11.35	-56	29	54.6	18.0	2.49	191	
594	H1404	23	17	32.95	-53	31	40.0	18.3	2.02	191	
595	H1412	23	17	53.70	-55	14	20.7	18.6	2.11	191	
596	H1405	23	18	20.75	-53	25	21.1	18.5	2.41	191	
597	H1401	23	20	11.58	-52	20	41.9	18.1	2.20	191	
598	A1425	23	36	45.47	-36	11	01.3	18.0	1.48	408	
599	H1503	23	42	35.52	-55	34	39.2	16.7	2.70	192	
600	H1610	23	48	17.20	-54	14	57.3	18.2	2.21	192	

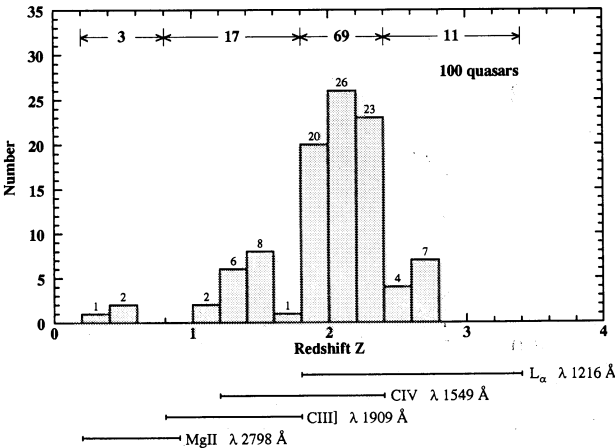


Fig. 2. Histogram of the redshift distribution of Calán-Tololo quasars contained in List No. 7. Horizontal lines at the bottom indicate the redshift range where the most prominent emission lines in quasars are found on our objective prism spectra.

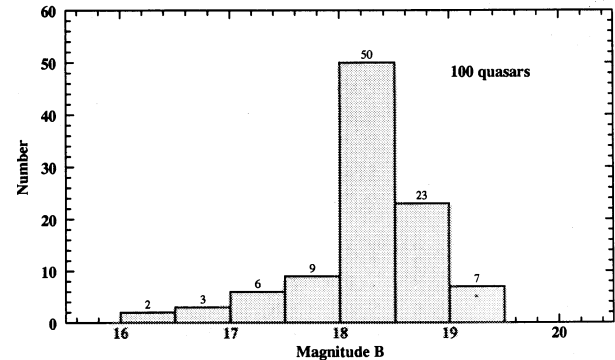


Fig. 3. Histogram of the *B* magnitude distribution of the Calán-Tololo quasars in List No. 7. Twenty objects have *B* < 18 and thirty have *B* > 18.5.

4. STATISTICAL PROPERTIES OF LIST No. 7

In List No. 5 (Maza et al. 1993) a preliminary analysis of the statistical properties of quasars found in the CTS was performed. Figure 2 presents a histogram of the redshifts for these one hundred new quasars. In the lower part of Figure 2, four horizontal lines show the redshift interval of visibility in our objective prism spectra for the most prominent emission lines present in quasars, as labeled to the right of the horizontal lines.

In the upper part of Figure 2 the redshift range has been divided in four intervals containing 3, 17, 69, and 11 objects respectively. If we divide in the same way the histogram in Figure 2 of List No. 5 (Maza et al. 1993), the numbers are 13, 23, 92 and 72 for a total of 200 objects (or 6.5%, 11.5%, 46%, and 36%, respectively). On the other hand List No. 6 (Maza et al. 1995) contains 7, 20, 53, and 20 quasars respectively, in those redshift intervals.

Figure 3 presents the histogram of the *B* magnitudes. A total of 82 quasars have a *B* mag in the interval (17.5, 19.0). A comparison between Figure 3 and Figure 3 in List No. 5 (Maza et al. 1993), and Figure 3 in List No. 6 (Maza et al. 1995) reveals this new group of quasars has the same photometric properties than the first three hundred quasars.

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