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MULTICOLOR PHOTOMETR OF THE GALAXIES IN A2255 B THE BEIJING-ARI ONA-TAIWAN-CONNECTICUT SURVE AND SLOAN DIGITAL SK SURVE

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ABSTRACT

W A2255 13 B -A -T -C (BATC) , 3000 10000 A. T (SED) 7000 $V \sim 20$ $58' \times 58'$. A2255 S D S S (SDSS) $V \sim 17.5$ $r' \sim 22.0$ - . A SDSS BATC SED . A 254 A2255 SED . O SED - . B 214 . B A2255 . A - 188 - 254 SED 2522 - . A , 313 0.068 0.090 . T SED - . O - , - , . T , A2255.

Subject headings: : : (A2255) : : :

On-line material: -

1. INTRODUCTION

A , . A - 's 's S . T X- , (C & D 1996). T , A2255, . T A2255 X- , X- , - - , . F 20 (F . 1997). T -

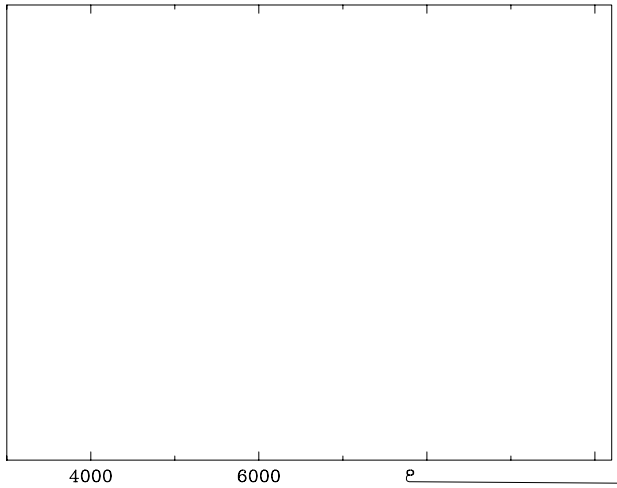
(T 1993). T *ROSAT* A2255 - (D & W 1998). F ' , (B 1994). T - ~1221 $^{-1}$, (, H , & G 1990). F , X- (B . 1995). T . H , A2255 (S , S , & S 1979; . 1990). T - $V \sim 16.0$. R , S D S S (SDSS). H , SDSS

[1] D P , N N U , N H R 122, N 210097, P R C ; @ .
[2] N A O , C A S , B 100012, P R C .

$V \sim 17.5$. B
(L . 1997),
$M_V \sim -18.0$ $V \sim 20.5$,
SDSS . F
$(18.0 < m_$ $< 21.5)$
. T A2255 B -
-A -T -C (BATC) -
. T BATC
(SED) -
0.5 (X . 2002),
60/90 S T B A -
O (BAO) 15 -
. O
1 S T
SED
(∼1 ^{2}) ,
-
- (.
2001). S
(. ., -
) (X
2002), SDSS
(F . 1996) BATC
SED . T
SED
( )
. B
,
A2255
T . §2,
BATC
,
BATC SDSS . T
SDSS SED BATC SED
§3. T SED § 4, SED
A2255 . T
SED § 5. T
§ 6,
. F , § 7. T -
$H_0 = 50$ $^{-1}$ M $^{-1}$ $q_0 = 0.5$
.

2. OBSERVATIONS AND DATA REDUCTION

A2255 $(z \sim 0.0806,$
38.3; S & R 1999)
2 A (1958), II III
B & M (1970). T BATC
A2255 60/90 /3 S
T BAO, X
900 . A F 2048×2048 CCD
F
$\sim 1.0^$ F , $1\farcs7$
. T
59×59 ^{2},
17 08 03.^{s}7 17 16 58.^{s}6,
63°36′31.″5 64°35′28.″8 (J2000.0). T BATC
15 - ,
a–k, *m–p*,



∼3000 10000 A. T BAO S
T , CCD , - F
(F . 1996; . 2000;
. 2001). F SDSS
BATC SDSS
u′, *g′*, *r′*, *i′*, *z′*, -
3560, 4680, 6180, 7500,
8870 A. T BATC SDSS
F 1.
O 13 BATC
A2255. , 40
. A , 113
36
. T BATC
T 1. T -
-
CCD , P 1”, -
BATC . T -
. B -
, G S C (GSC). T
(PSF)
-
P 2” (
2003). A , PSF -
. F A2255,
4 (., 6.″8),
. A -
, (. , SED)
. S
T 1,
.
T *relative* SED , . T

TABLE 1
THE DETAILS OF THE BATC FILTERS AND OUR OBSERVATIONS

N	F N	λ (A)	FWHM (A)	E ( )	N I	S ( )	O D	L ( )
1.....		3907	291	10800	9	4.74	5678	20.5
2.....		4540	332	13200	11	5.45	6816	20.5
3.....		4925	374	12000	10	4.32	7227	20.0
4.....		5267	344	11400	10	4.98	7253	20.0
5.....		5790	289	7200	6	3.96	7337	20.0
6.....		6074	308	6950	7	4.18	7319	20.0
7.....		6656	491	12900	12	4.61	6884	19.5
8.....		7057	238	4800	4	4.36	7437	20.0
9.....		7546	192	4800	4	4.62	7386	19.0
10.....		8023	255	14400	12	4.11	7368	19.0
11.....		8484	167	9600	8	5.13	7047	19.0
12.....		9182	247	12000	10	3.81	7355	18.5
13.....		9739	275	12000	10	4.21	6796	18.5

T .

SED SED , BATC (. 1999). N SED . I SDSS BATC SED, . T , - . A BATC (2.″0) SDSS . B SED , - . A - SDSS 3651 ( ) 2790 ( ) . F , BATC SDSS NASA/IPAC E D (NED). T 340 274 (81%) 14 (4%) . T , X- , γ- .S 254 NED- . T 254 - BATC SDSS , .

3. METHOD OF COMBINING THE SDSS AND BATC SEDs

I BATC SED SDSS - . T SDSS BATC (. ., $r = 4 \times 1.7 = 6.''8$), SDSS E D R (EDR; S . 2002). T SDSS A2255 0.″4 $^{-1}$. T - 54 , - SDSS (L . 2001).

3.1. *Aperture Correction of the SDSS Photometries for Galaxies*

F SDSS , , , ( ) *model* (*m*), r' . T - : (1) (PSF) , (2) V (1948) $r^{1/4}$, (3) . T - r' . S V (V & C 1979; C . 1990). T *model* (*m*) (*m*)

$$\Delta m = m - m = -2.5 \frac{\int_0^r 2\pi r I(r) dr}{\int_0^\infty 2\pi r I(r) dr}, \quad (1)$$

$I(r)$

$$I(r) = \begin{cases} I_0 \{-7.67[(r/r_e)^{1/4}]\}, & 0 < r \le 7r_e, \\ a_0 I_0 (8 - r/r_e), & 7r_e < r < 8r_e. \end{cases} \quad (2)$$

V $r^{1/4}$,

$$I(r) = \begin{cases} I_0 (-1.68\ r/r_e), & 0 < r \le 3r_e, \\ b_0 I_0 (4 - r/r_e), & 3r_e < r < 4r_e. \end{cases} \quad (3)$$

a_0 b_0 I_0 $7r_e$ $3r_e$, : $a_0 = 3.8178 \times 10^{-6}$ $b_0 = 6.4737 \times 10^{-3}$. T Δm *model* SDSS ,

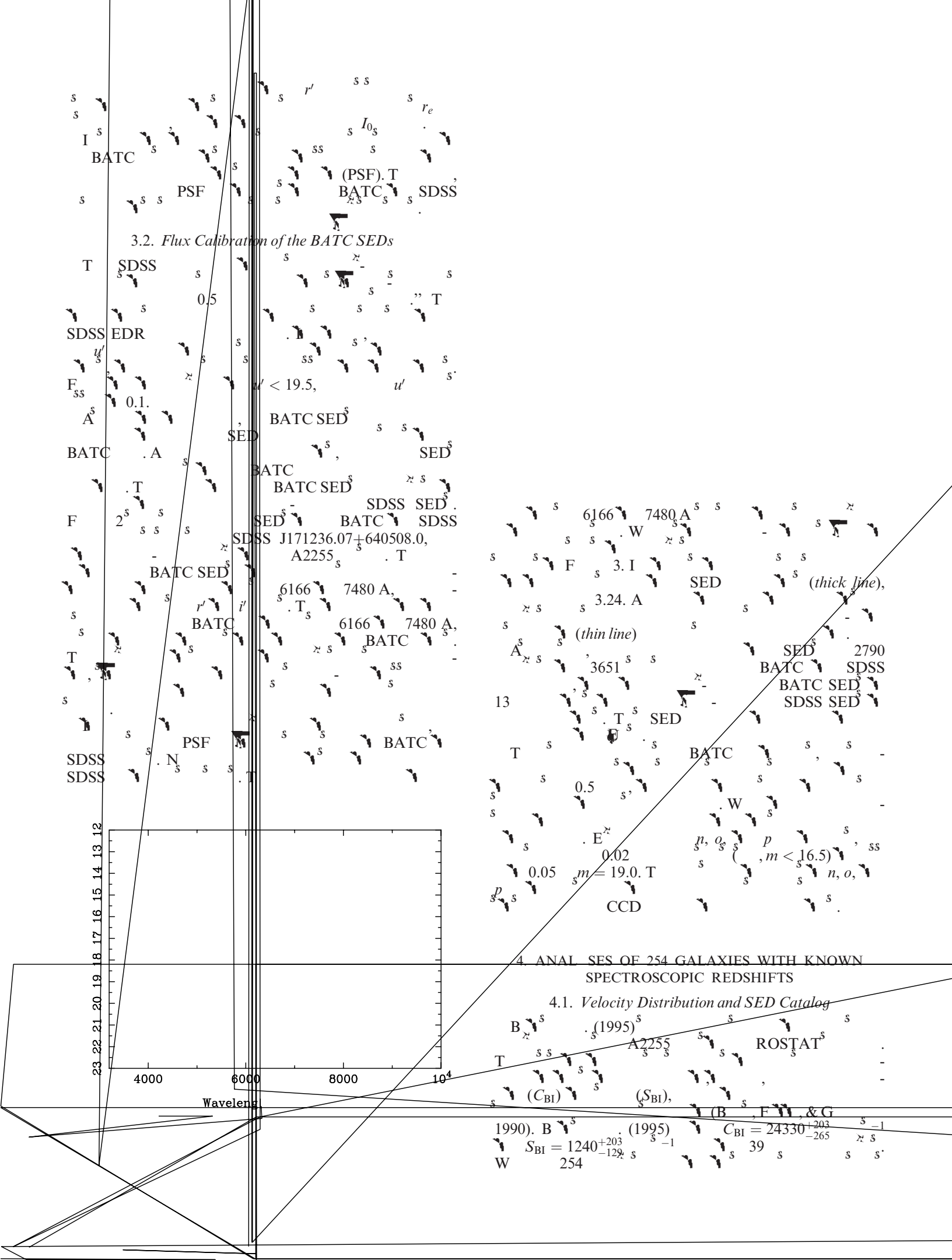
r' r_e I_0

BATC (PSF). T PSF BATC SDSS

3.2. *Flux Calibration of the BATC SEDs*

T SDSS 0.5 ." T SDSS EDR u' F $u' < 19.5$, u' 0.1. A , BATC SED SED BATC . A , SED BATC . T BATC SED - SDSS SED . F 2 SED BATC SDSS SDSS J171236.07+640508.0, - A2255 . T BATC SED - 6166 7480 A, - r' i' . T BATC 6166 7480 A, BATC . T , - PSF BATC SDSS . N SDSS . T

6166 7480 A . W - F 3. I SED (*thick line*), 3.24. A - (*thin line*) . A , SED 2790 , 3651 BATC SDSS , - BATC SED 13 , - SDSS SED . T SED . T BATC , - 0.5 , . W - . E *n*, *o*, *p* , 0.02 (, $m < 16.5$) 0.05 $m = 19.0$. T *n*, *o*, *p* CCD .



4. ANALYSES OF 254 GALAXIES WITH KNOWN SPECTROSCOPIC REDSHIFTS

4.1. *Velocity Distribution and SED Catalog*

B . (1995) A2255 ROSTAT . T , , - (C_{BI}) (S_{BI}), (B , F , & G 1990). B . (1995) $C_{BI} = 24330^{+203}_{-265}$ $S_{BI} = 1240^{+203}_{-129}$ 39 W 254

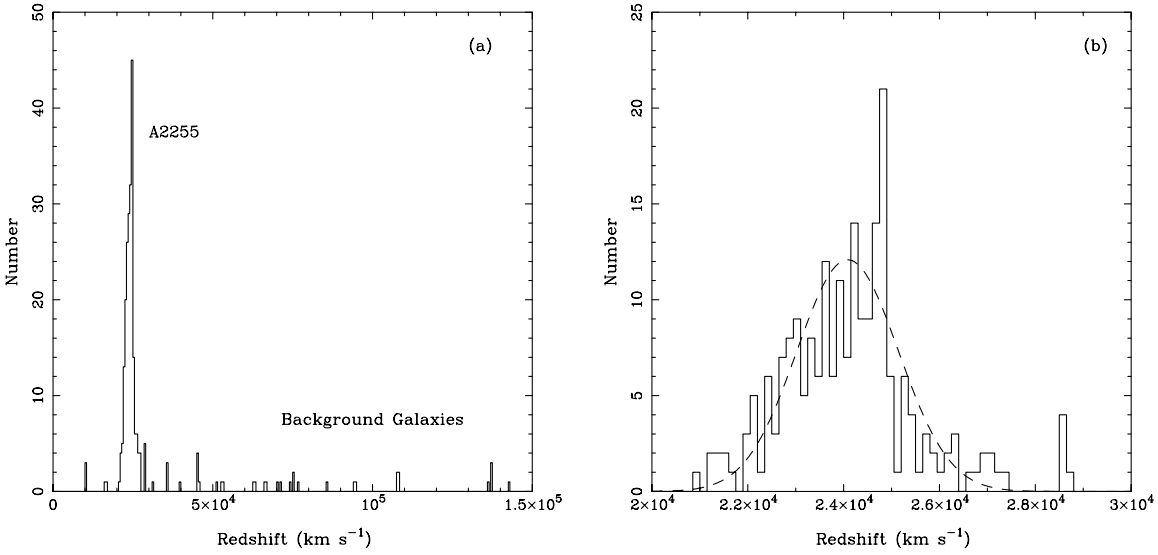


FIG. 4. D (*a*) 254 (*b*) 214 . T 500 150 $^{-1}$, . T - G (*b*).

. T F 4*a*. T 214 21,000 $^{-1} < cz < 29,000$ $^{-1}$, ~24,800 $^{-1}$. W 214 ROSTAT $C_{\rm BI} = 24025 \pm 89$ $S_{\rm BI} = 1315 \pm 86$ $^{-1}$. C B . (1995), W F 4*b* G K -S S -W *W*- G 99%. W KMM (A , B & 1994). T G 23,942 27,454 $^{-1}$ 94.2%:5.8%. T KMM . O 12 (5.8%) G 27,454 $^{-1}$, . T G 100%. T G T 2 SED 254 .

Column (1). N ( ).
Column (2). R.A. 2000 , ,, , NED.
Column (3). D 2000 , ,, , NED.
Column (4). S , NED.
Column (5). P , SED.
Columns (6)–(18). P 13 BATC . T 0.0 .
Columns (19)–(23). A - SDSS . I T 2 . W *relative* SED A2255.

4.2. *Spatial Distribution and Localized Velocity Structure*

F 5*a* 214 , 168 (88%) - 46 (12%) - , NED- A2255, R.A. = 17 12 31 . = 64°05′33″ (J2000). E - .I . W - G $\sigma = 2'$. T - 214 . T . T - D (+") D X- (R.A. = 17 12 45 . = 64°03′54″, ×") *ROSAT* (F . 1997). T (. ., 0.15 $^{-2}$ (, A, B, C, D, E) 0.15 $^{-2}$. H , . T , - - - . D & S (1988) , - Δ- ,

TABLE 2

THE COMBINED SPECTRAL ENERGY DISTRIBUTIONS OF 254 KNOWN GALAXIES IN THE REGION OF A2255

N (1)	R.A. (J2000) (2)	D . (J2000) (3)	*z* (4)	*z* (5)	*b* (6)	*d* (7)	*e* (8)	*f* (9)	*g* (10)	*h* (11)	*i* (12)	*j* (13)	*k* (14)	*m* (15)	*n* (16)	*o* (17)	*p* (18)	*u*′ (19)	*g*′ (20)	*r*′ (21)	*i*′ (22)	*z*′ (23)
1.....	17 12 34.1	64 05 50	0.076180	0.098	18.16	17.78	17.68	17.57	17.65	17.66	17.55	17.17	17.53	17.49	17.66	17.54	17.30	18.59	17.82	17.68	17.44	17.48
2.....	17 12 36.1	64 05 08	0.082686	0.079	20.07	18.77	18.15	17.90	17.60	17.50	17.26	17.23	17.14	16.97	16.93	16.80	16.55	20.36	18.44	17.52	17.09	16.74
3.....	17 12 26.4	64 04 56	0.079492	0.083	19.51	18.45	18.05	17.79	17.53	17.33	17.15	17.08	16.99	16.84	16.79	16.66	16.62	20.25	18.34	17.36	16.94	16.59
4.....	17 12 28.7	64 06 33	0.074143	0.095	18.36	17.83	17.70	17.67	17.60	17.53	17.43	17.03	17.38	17.31	17.25	17.26	17.06	18.59	17.86	17.55	17.29	17.18
5.....	17 12 33.2	64 04 18	0.084356	0.086	19.96	18.94	18.39	18.15	17.96	17.81	17.57	17.52	17.40	17.24	17.13	17.06	16.98	20.48	18.82	17.81	17.38	16.98
6.....	17 12 34.9	64 04 14	0.082410	0.083	18.02	16.88	16.31	16.06	15.78	15.65	15.42	15.35	15.24	15.07	14.98	14.89	14.77	18.69	16.67	15.66	15.21	14.85
7.....	17 12 41.0	64 04 22	0.083474	0.083	18.74	17.53	16.94	16.70	16.41	16.31	16.07	16.01	15.90	15.75	15.70	15.56	15.46	19.34	17.29	16.30	15.88	15.52
8.....	17 12 28.8	64 03 39	0.073363	0.068	17.70	16.57	16.03	15.81	15.54	15.41	15.20	15.12	15.02	14.85	14.81	14.69	14.55	18.38	16.38	15.41	15.00	14.66
9.....	17 12 24.0	64 03 34	0.086135	0.079	20.33	18.96	18.39	18.16	17.88	17.80	17.55	17.44	17.31	17.24	17.19	17.01	17.00	20.47	18.77	17.76	17.33	16.90
10.....	17 12 51.2	64 04 23	0.073791	0.078	18.27	17.48	17.04	16.84	16.58	16.46	16.25	16.06	16.09	15.92	15.88	15.78	15.61	19.23	17.45	16.49	16.02	15.66

NOTES. Ü

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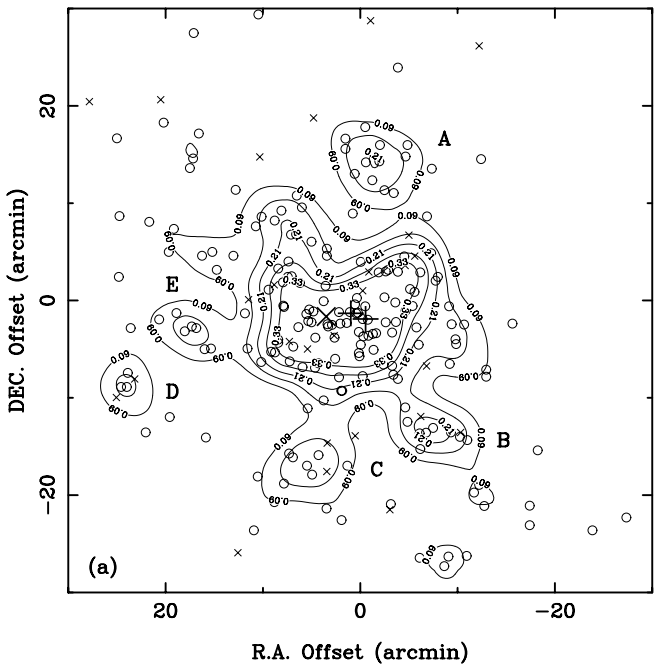
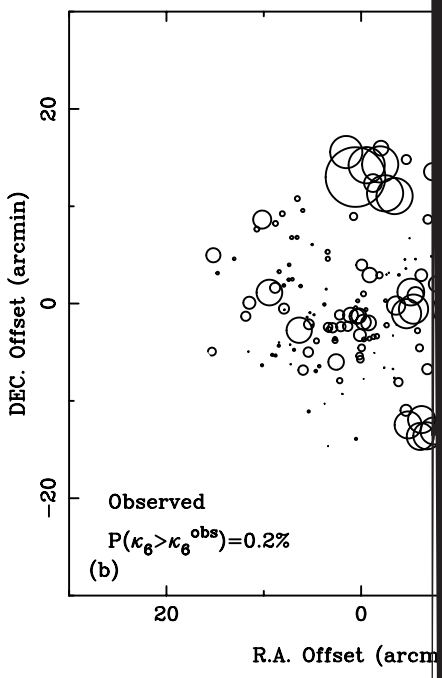




s . I s Δ- s , C ss &
D (1996) (- sκ-) ,
E
s s s s κn
n s . T F 5s
κn,
s s - C D E s
. T s κn s
κn s P(κn > κn s), s M C s
. T 3
κ- 214 ,
10^3 .
T A2255 -
. T
F 5b s

n = 6, − [PKS(D

A, B, C

4.3. *Color-Magnitude Co*

A
- , C-M
E 1992). F
,
BATC SDSS
A2255
F 6
u′−o, h
A2255. T
C-M
,

$$u' - p = -0.136(\pm 0.04)h + 5.7$$

$$u' - o = -0.134(\pm 0.04)h + 5.6$$

T

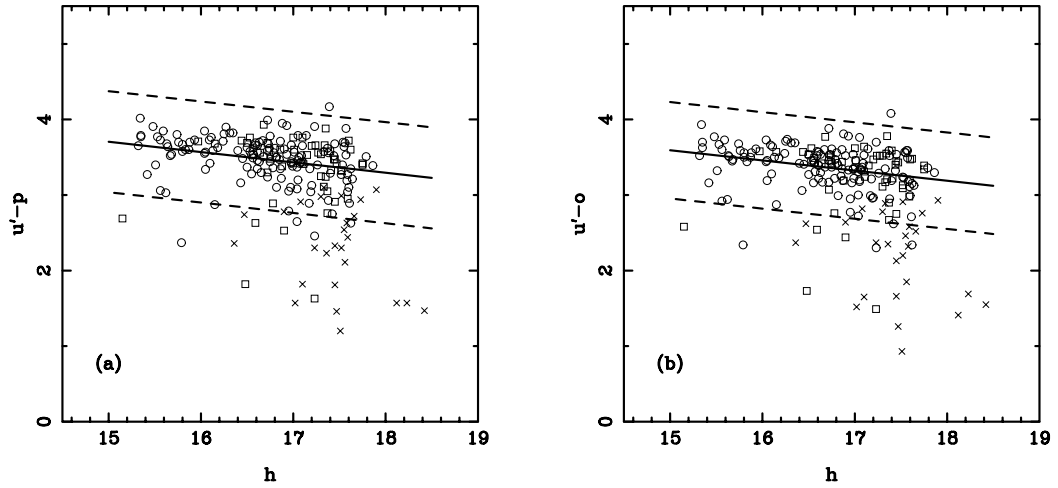


FIG. 6. C - A2255, . ., *u′−p* *u′−o* . *h* 137 (*open circles*), 51 (*open squares*), 26 (*crosses*).

(*a*) (*b*) $\sigma_{\rm C.I.} = 0.669$ 0.638, . M 95% . T A2634 (. 2001). I , C-M . B , C-M (. ., C & D 1996).

4.4. *Application of the Photometric Redshift Technique*

T SED . F , (χ^2-) SED . B SED- H PER (B , M , & P 2000), BATC (X . 2002). T AGN (13 BATC SDSS), T 254 - SED SDSS BATC z $z < 0.5$. F 7 (z) (z) 254 , . $A_V \sim 0.3$ C . (2000) . T - 0.0 1.0, 0.01. T F 7 $z = z$,

z 68% . I z : 90% A2255 $z \sim 0.075 \pm 0.015$, $z < 0.5$ $z = z$. C A2634 ($z \sim 0.03$) BATC SED (F 6 . 2001), . F 8 SED - SDSS J171236.07+640508.0. T SED

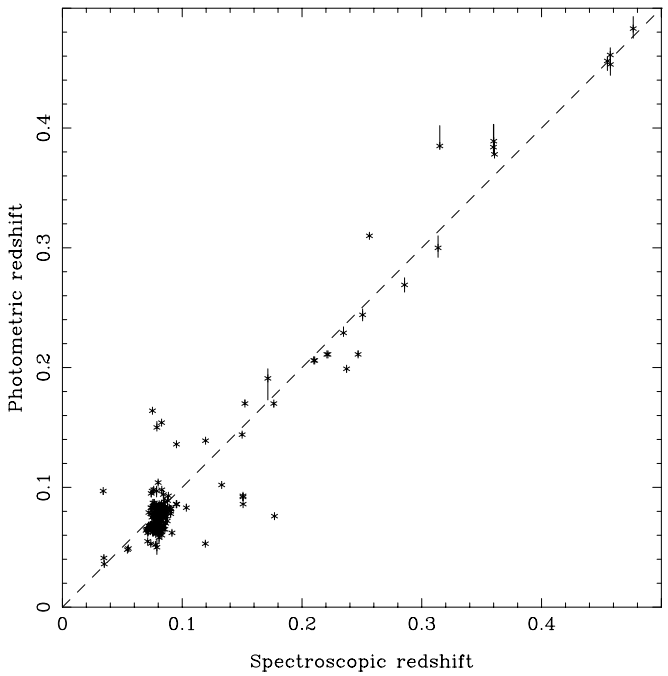


FIG. 7. C (z) (z) 254 A2255.

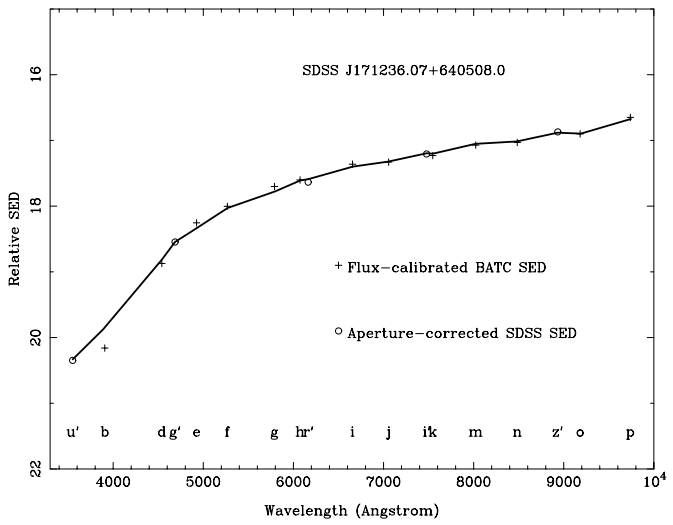
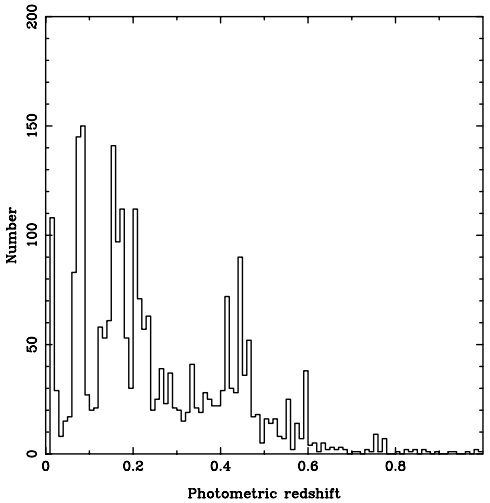


FIG. 8. B SED SDSS J171236.07+640508.0, - A2255 .

z . T SED- , SDSS BATC . O SED SDSS BATC . O - A2255 . I .

5. SED SELECTION OF FAINT CLUSTER GALAXIES

, 6441 BATC SDSS , 2776 SDSS / , *frames*, (.,). A 254 , 2522 . B SED , z - . S z (, S_{BI}) , z ~0.08 . F 9 z 2522 . T $z \sim 0.08$ A2255. B 98% - 20,400 $< cz <$ 27,000 (F . 4), - . A , 328 0.068 0.090 . A 328 , 266 (81%) SED- - . A C-M - . W - C-M - 137 - § 4.3. H - , 48 - , 2σ , - . T - , 48 15 $0.068 < z <$ 0.090. T , 33 - F , 313 (218 - 95 -) A2255. T 4 SED , SDSS- , z - , *T* (E, S0, S , S , S , S , I 1 7,).



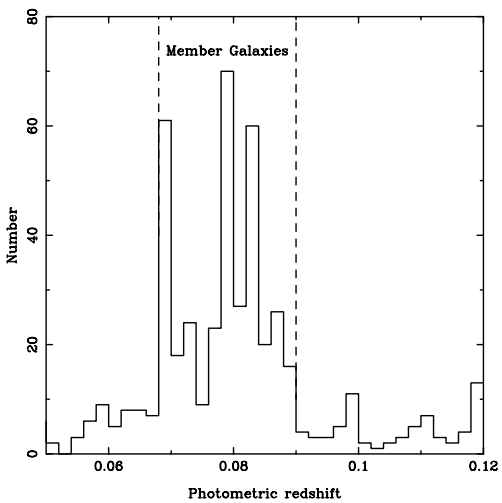


FIG. 9. D 2522

TABLE 4

THE COMBINED SPECTRAL ENERGY DISTRIBUTIONS OF 313 NEWLY SELECTED MEMBER GALAXIES IN THE REGION OF A2255

N (1)	R.A. (J2000) (2)	D . (J2000) (3)	*z* (4)	*T* (5)	*b* (6)	*d* (7)	*e* (8)	*f* (9)	*g* (10)	*h* (11)	*i* (12)	*j* (13)	*k* (14)	*m* (15)	*n* (16)	*o* (17)	*p* (18)	*u′* (19)	*g′* (20)	*r′* (21)	*i′* (22)	*z′* (23)
1.....	17 16 02.36	63 57 55.04	0.079	2	19.85	19.00	18.77	18.62	18.29	18.21	17.98	17.87	17.80	17.58	17.72	17.55	17.41	20.20	18.90	18.16	17.82	17.76
2.....	17 10 16.85	64 21 07.74	0.073	3	20.40	20.01	19.44	19.23	18.91	18.80	18.55	18.46	18.50	18.06	18.21	18.07	18.34	23.02	19.61	18.83	18.43	18.24
3.....	17 12 02.43	63 40 17.14	0.071	1	21.17	20.67	20.53	20.37	19.77	20.03	19.65	19.58	19.32	19.14	19.60	19.12	18.68	22.61	20.64	19.84	19.49	19.31
4.....	17 15 02.65	63 41 03.77	0.086	1	20.32	19.09	18.49	18.26	18.04	17.96	17.71	17.67	17.61	17.47	17.42	17.22	17.02	20.50	18.80	17.96	17.58	17.32
5.....	17 12 45.23	63 41 07.68	0.073	1	22.62	20.62	20.52	20.61	20.25	19.98	19.68	19.70	19.74	19.24	19.32	18.94	19.11	21.99	21.13	20.05	19.61	19.22
6.....	17 10 01.20	63 40 51.23	0.068	1	19.96	19.36	19.15	18.99	18.71	18.76	18.56	18.50	18.50	18.31	18.44	18.19	17.99	20.81	19.41	18.77	18.45	18.26
7.....	17 10 38.30	63 41 00.66	0.087	7	20.55	20.37	20.28	19.92	20.20	20.10	19.83	19.78	19.55	19.56	20.11	20.27	18.94	21.35	20.34	20.04	19.59	19.68
8.....	17 10 21.96	63 41 50.38	0.070	1	23.50	20.84	20.61	20.34	20.07	19.71	19.67	19.35	19.71	19.04	19.27	18.85	19.06	21.94	20.94	19.91	19.45	19.07
9.....	17 14 05.27	63 42 37.08	0.070	3	19.61	23.45	23.06	21.00	20.47	21.02	20.48	20.81	19.77	20.92	19.90	24.62	19.47	21.93	21.41	20.58	20.26	19.87
10.....	17 15 45.57	63 43 12.36	0.088	5	20.48	19.91	19.83	19.92	19.67	19.57	19.52	19.42	19.37	19.45	19.85	19.39	19.83	20.61	19.92	19.50	19.45	19.20

NOTES. Ö . T 4 .
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6. ANAL SES OF THE ENLARGED SAMPLE OF CLUSTER GALAXIES

6.1. *Velocity Distributions and Substructures*

S X- A2255 / (F . 1997). F 10 (1) 203 10′, (2) 406 - , (3) 121 - , (4) 527 . S , 24,900 23,700 $^{-1}$, , (1), (2), G KMM - . H , G . C 214 F 4*b*, (1848 $^{-1}$). T 313 , F 4*b*.

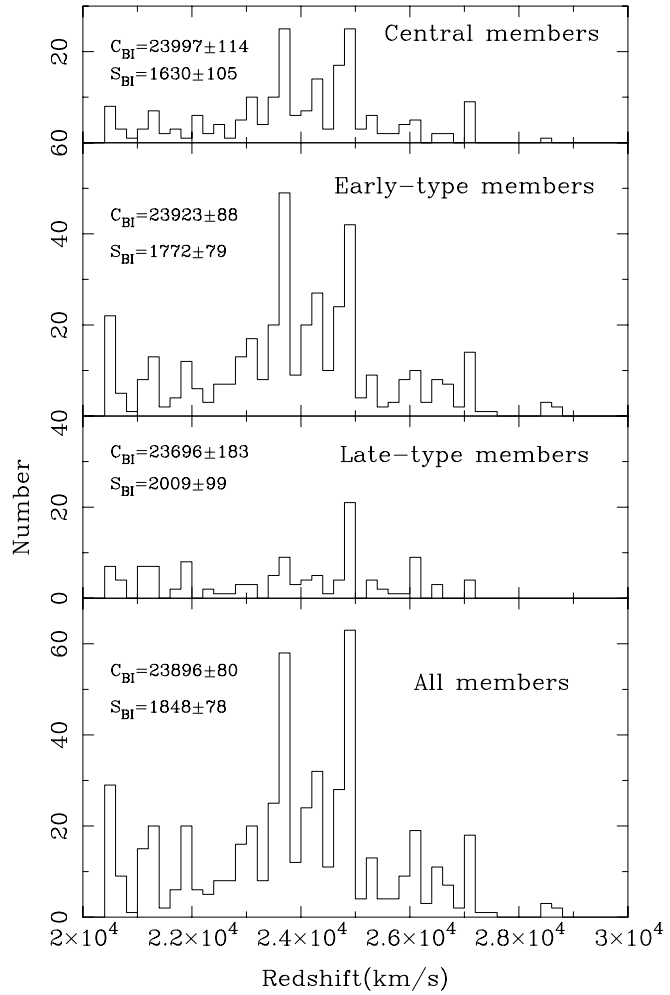
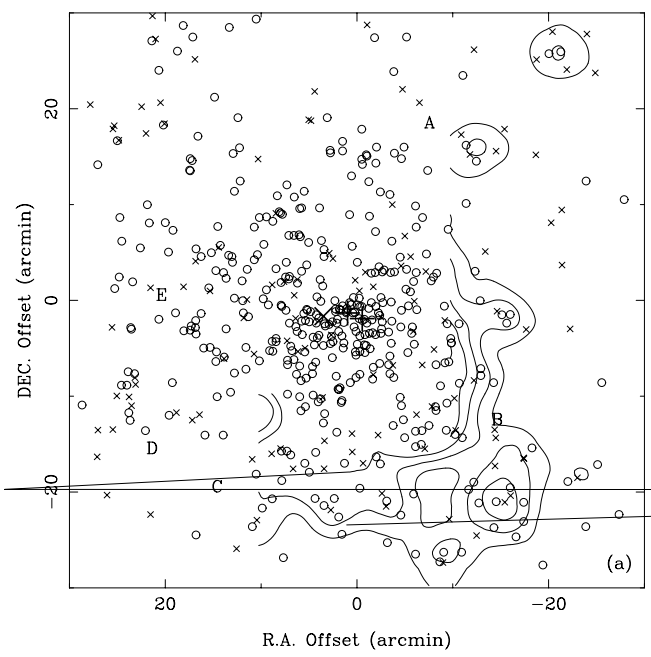


FIG. 10. R (1) 203 10′, (2) 406 - , (3) 121 - , (4) 527 .

T 313 $h \sim 17.6$, - 10′ . C 214 (30%), - . T 527 F 11*a*. , - . T F 5*a*. T , - . T κ- 10^3 T 5. F $n \leq 8$, $P(\kappa_n > \kappa_n^{\,s}) < 10\%$. T F 11*b*. C F 5*b*, A , B C . A , D E F 11*b*, D E . W A, B, C, 0.15 $^{-2}$ F 5*a*, 10, 17, 8 , . T 6 . B , ROSTAT . I A C , 0.0806. I 214 ($C_{BI} = 24025 \pm 89$) , A 99%, C B 2 σ . A , B C. T . W . T - A2255.

TABLE 5
RESULT OF κ-TEST FOR 527 CLUSTER GALAXIES

n	$P(\kappa_n > \kappa_n^{\,s})$
5	0.026
6	0.017
7	0.057
8	0.097
9	0.133
12	0.174
15	0.184
20	0.223

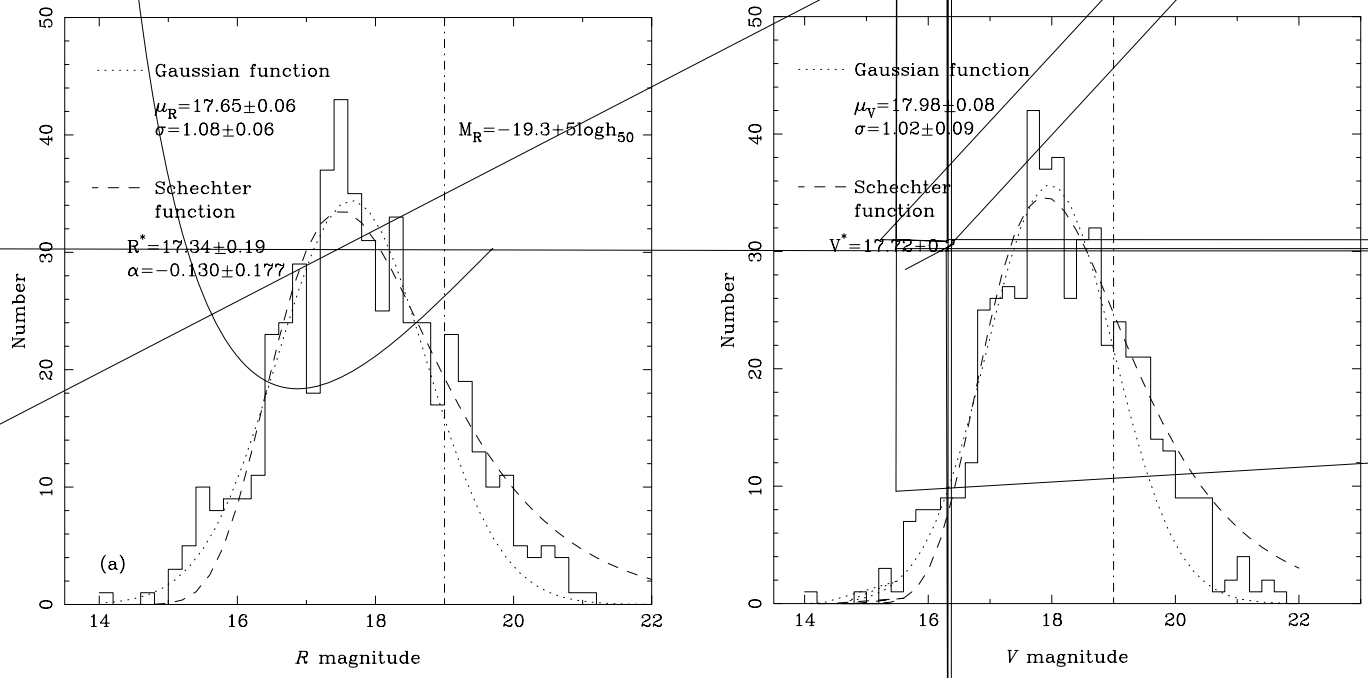


6.2. *Color Properties and Luminosity Function*

T C-M s s s F 12, s *h* s 15.0 20.5. T SDSS s s s s $r' < 17.77$ (S . 2002), s s F 12. T s - s s . T s s s s 4250 A, s s - S s - s s V C , s s (B . 1992). F , s - s - (. 2001).

T s (LF) s s - . R s s s LF s s , (B . 1995; D , A , & L 2002). O A2255 s s LF s s s . S s s - LF, G s s s S (D . 1999). F , LF *R*- *V*- - $R = i + 0.1036(\pm 0.055)$ $V = g + 0.3292(f - h) + 0.0476(\pm 0.027)$ (. 2003). F 13 s s *R* *V* - s A2255. T LF , $R \sim 17.5$ $V \sim 17.7$, - . T ($R < 17.5$ $V < 17.8$) SDSS . I LF LF .

T F G $G(m) = K_G [-(m-\mu_m)^2/(2\sigma_m^2)]$.
254 T - F 13.
$0.068 < z < 0.090$ 10% - T
5% , .
T SED- 80% . T LF
G . T LF
F 13 BATC $\mu_{M_V} = -20.3(\pm0.1)$ G $\sigma \sim 1.02(\pm0.09)$,
19.0 C LF, $\mu_{M_V} = -20.4(\pm0.2)$ $\sigma = 1.1(\pm0.3)$ (L
(T 1). T - . 1997). A LF
19.0 S
LF . $M_V^* = -20.58(\pm0.25)$ $\alpha = -0.136(\pm0.275)$,
T , χ^2 LF . T LF
LF (1) S : 19.0
$S(m) = K_S 10^{0.4(m^*-m)(\alpha+1)} [-10^{0.4(m^*-m)}]$; (2) G ,



S . H , BATC . T BATC SED A2255.

7. SUMMAR

T A2255, 60/ 90 S T BAO 13 BATC . A SED SDSS BATC A SDSS *model* BATC , SED . A 254 A2255 SED W 90% 0.068 0.090, . T SED . W 214 SED , . W A2255 - , - . 137 - - T - SDSS- SED 2522 . B SED , SED- . T - . A , 313

. T C-M - , - . O 527 $V = 19.0, 1$ LF LF . S A C / , X- . I SED BATC SDSS , . O - SDSS . F - / , .

W . W R. C. B K. M. A ROSTAT KMM . W NASA/IPAC E D (NED), J P L , C T , N A S A . T N K B S R F TG1999075402 - C N S F (NSF) 10273007. W P . J C , J M , H W , , P . H A B . W .

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