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Intrinsic Characteristics of Quasars Redshifts

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ABSTRACT

Using Sloan Digital Sky Survey SDSS catalog, some intrinsic characteristics of Quasars (10,000 points) are developed of these are the strong correlations between redshifts and other parameters, e.g. combined magnitude, luminosity, and absolute magnitude. Moreover, the Karlsson peak of our sample is also computed.

Indexing terms/Keywords

Redshifts, SDSS catalog; combined magnitude; luminosity; and Karlsson peak.

Academic Discipline And Sub-Disciplines

Combined mag. – Luminosity – Correlation between combined mag. and luminosity with redshifts – Karlsson peak.

Mathematics Subject Classification

Mathematical Astrophysics.

Type (Method/Approach)

Double frequency table – Correlation coefficients.

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INTRODUCTION

Since the discovery of Quasars [1] interest in Quasars has grown steadily, because of their peculiar properties and because of their importance in cosmology and galaxy evolution. Quasars have been generally viewed as compact objects with high redshifts. These redshifts are assumed to be due to their recessional velocities in an expanding universe where they are viewed as highly luminous objects.

Over the years, however, observations have accumulated which indicate that high redshift Quasars can be associated with (at the same distance as) low redshift, relatively nearby galaxies.

There are three kinds of evidence for the existence of non-velocity redshifts:

1) Statistical association of objects having much different redshifts. (See e.g. analysis by [2] of the 2dF deep field, and [3])
2) Interaction between objects of different redshift (including high redshifts aligned across active galaxy nuclei).
3) Quasars occurring preferentially at certain specific redshifts.

The latter precludes redshifts caused by recessional velocity because it would require matter distributed in shells and receding velocities in discrete steps.

- *Some aspects of Quasars*

a) Their spectrum contains very broad emission lines unlike any known from stars (from X-rays to the infrared with a peak in the UV optical bands).
b) Their luminosity may be ranged from $10^3 L_{sun}$to 100 times greater than the Milky Way.
c) Can be appearing as a compact region in the center of a massive galaxy.
d) Its size, 10 – 10.000 times of the Schwarzschild radius of the black holes.
e) They are the most luminous, powerful and energetic known objects in the universe.

Many catalogs have gathered together increasing number of Quasars either from heterogeneous samples (see [4],[5], and references therein) or from large surveys, most importantly: the Large Bright Quasar Survey (LBQS, [6] and[7]); the 2dF Quasar Redshift Survey (2QZ, [8] and [9]) and the successive releases of the Sloan Digital Sky Survey (SDSS, [10]) Quasar Catalogs (e.g. [11], for DR7).

- *Birth of Quasars*

As yet it is not possible to look very far into the materialization and assembly of new Quasars in the nuclei of parent galaxies. But we can start to tell when an object looks small because it is at a great distance and when it really is small because it is close by. The argument that fundamental particles obtain their mass by an exchange with the Universe in a Machian type theory has been advanced and serves as an example ofa possible direction to explore.

- *The Karlsson peaks in the Quasar's redshift distribution*

Analysis of the distribution of observed Quasar redshifts suggested that here were performed values with peaks near 1.955 [12] and at multiples of 0.061 [13].

[14] studied 46,400 Quasars in the SDSS Quasar catalog, Third Release (DR3), is examined. Six peaks that fall within the redshift window below z = 4 are visible around z=0.5, 1.8, 3.1 and 3.7, as shown in Fig. 1 (see, [15]), but this not what is looked for by [16] and others. The interesting thing is to find periodic peaks. With special selections between the quasars and special techniques, it is possible to find periodic peaks within this general distribution.

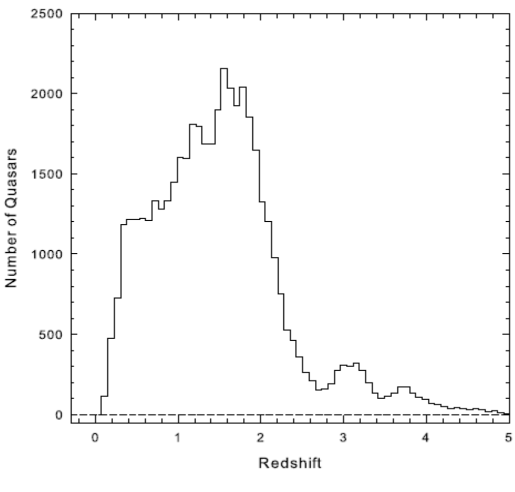

Figure 1: Distribution of 46,400 SDSS Quasars with redshifts below z= 5(Schneider et al. 2005)

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THE DATA SAMPLE

For the present paper, we used the Data Release 9 Quasar (DR9Q) catalog from the Baryon Oscillation Spectroscopic Survey (BOSS) of the Sloan Digital Sky Survey III, (SDSS, [17]).

Here, we collect about 10,000 points, including SDSS-DR9 designation (HHMMSS.ss+DDMMSS.s), galactic longitude *(long.)*, galactic latitude *(lat.)*, redshift *(z)*, and absolute mag. *(m)*. The data set from SDSS 000000.47-002703.9 to SDSS 022617.85-043109.1, where the minimum mag. is about -29.69 and the maximum mag. is about -19.08. Table 1, shows the double frequency table between the *long.* and*lat.* intervals.

Table 1: The double frequency table for selected data

Lang. interval

Lat. Interval	*95-100*	*100-105*	*105-110*	*110-115*	*115-120*	*120-125*	*125-130*	*130-135*	*135-140*	*140-145*	*145-150*	*150-155*	*155-160*	*160-165*	*165-170*	*170-175*	*175-180*
-67_-66				2	6	8	8	1									
-66_-65		3	35	36	23	31	29	15	25	2							
-65_-64	12	42	52	50	33	38	35	13	53	39	18						
-64_-63	25	59	61	91	101	104	90	85	64	40	45	18					
-63_-62	34	96	112	122	125	101	89	118	117	77	53	55	13				
-62_-61	72	112	105	136	80	84	75	104	103	110	137	48	22				
-61_-60	92	108	73	62	57	69	67	44	37	103	118	89	20				1
-60_-59	59	68	47	36	78	56	74	77	17	53	95	113	51		3	13	1
-59_-58	35	41	18	18	39	58	63	58	20	59	52	93	101	17	16	25	
-58_-57	23	13		3	19	16	18	23	16	71	75	55	101	86	48	13	
-57_-56	8	9						1	49	60	74	65	88	127	57		
-56_-55	1	4							44	57	53	67	58	104	72		
-55_-54							2	3	38	83	68	51	70	78	42		
-54_-53							17	25	22	70	82	78	61	68	6		
-53_-52							12	18	10	63	74	67	70	53			
-52_-51							7	2	13	58	41	50	60	29			
-51_-50									7	40	74	24	59	12			
-50_-49									3	70	51	1	17				
-49_-48									24	80	26						
-48_-47									33	76	17						
-47_-46									14	48	30						
-46_-45										19	16						
-45_-44										1	3						

In what follows, and for some statistical manipulations, we have selected only the groups which contain only number of Quasars ≥ 20.For these selected groups (i.e. 146), we have computed both the combined mag. m_c and the luminosity $\log(L/L_{sun})$.

- *The combined mag.* (m_c)

  For stars of magnitudes $m_1, m_2, ..., m_L$ (apparent or absolute), the combined magnitude m_c is given by [18]

  i.e.

$$m_c = -2.5\log\left[\sum_{i=1}^{L} 10^{-0.4 m_{ii}}\right]. \quad (1)$$

- *The luminosity* $\log(L/L_{sun})$

  i.e.

$$\log(L/L_{sun}) = \frac{4.83 - m}{2.5}. \quad (2)$$

Table 2, presents many parameters of the selected groups, like, combined mag.m_c, average luminosity $\left[\log(L/L_{sun})\right]_{avg.}$, and the average redshifts $z_{avg.}$.

Table 2: Data of the selected 146 groups of quasars by SDSS

Group No.	m_c	$\left[\log(L/L_{sun})\right]_{avg.}$	$z_{avg.}$	Group No.	m_c	$\left[\log(L/L_{sun})\right]_{avg.}$	$z_{avg.}$
1	-30.010	12.392	2.329	74	-31.102	12.320	2.241
2	-29.933	12.349	1.904	75	-30.284	12.338	2.207
3	-29.564	12.396	2.157	76	-29.383	12.141	2.066
4	-29.287	12.155	2.004	77	-30.018	12.326	2.328
5	-29.901	12.430	2.292	78	-29.908	12.304	2.113
6	-29.280	12.246	2.243	79	-30.285	12.283	2.286
7	-29.568	12.136	2.054	80	-30.120	12.180	2.127
8	-30.284	12.330	2.178	81	-30.538	12.384	2.166
9	-30.313	12.358	2.242	82	-29.477	12.422	2.411
10	-29.916	12.380	2.307	83	-30.534	12.375	2.230

11	-29.977	12.343	2.118	84	-29.960	12.200	2.243
12	-29.906	12.350	1.964	85	-30.770	12.271	2.318
13	-30.245	12.306	2.200	86	-31.079	12.359	2.284
14	-29.653	12.202	2.098	87	-28.749	12.034	1.822
15	-28.954	12.116	1.997	88	-29.386	12.325	1.858
16	-30.381	12.314	2.182	89	-29.431	12.342	1.892
17	-30.369	12.294	2.176	90	-31.056	12.503	2.117
18	-30.800	12.288	2.210	91	-30.412	12.222	2.013
19	-30.853	12.269	2.390	92	-30.109	12.235	2.156
20	-31.264	12.421	2.333	93	-30.633	12.181	2.198
21	-30.687	12.253	2.299	94	-31.186	12.472	2.246
22	-30.848	12.342	2.185	95	-30.197	12.329	2.025
23	-30.057	12.149	1.927	96	-29.955	12.224	1.949
24	-29.845	12.268	2.201	97	-30.512	12.359	2.163
25	-30.194	12.356	2.094	98	-30.220	12.151	1.868
26	-30.098	12.440	2.210	99	-30.438	12.294	2.285
27	-30.845	12.288	2.131	100	-30.759	12.291	2.128
28	-30.986	12.277	2.138	101	-31.191	12.305	2.248
29	-31.224	12.335	2.230	102	-30.778	12.487	2.204
30	-31.071	12.264	2.399	103	-30.035	12.303	2.106
31	-31.161	12.392	2.365	104	-30.023	12.185	2.045
32	-30.764	12.288	2.175	105	-30.408	12.371	2.079
33	-31.089	12.296	2.168	106	-30.352	12.247	2.109
34	-30.861	12.208	2.122	107	-30.451	12.349	2.129
35	-30.770	12.353	2.161	108	-30.851	12.256	2.231
36	-29.754	12.109	1.832	109	-30.705	12.357	2.388
37	-30.326	12.322	2.279	110	-29.945	12.330	2.045
38	-30.577	12.305	2.258	111	-30.701	12.293	2.094
39	-31.371	12.431	2.027	112	-30.209	12.183	1.875
40	-30.555	12.133	2.043	113	-30.296	12.343	2.141
41	-31.328	12.330	2.202	114	-30.603	12.328	2.153
42	-30.649	12.289	1.992	115	-30.505	12.242	2.131
43	-31.119	12.455	2.061	116	-30.150	12.369	2.279
44	-30.844	12.394	2.125	117	-29.494	12.332	2.097
45	-31.089	12.350	2.189	118	-29.561	12.414	2.316
46	-30.778	12.231	1.841	119	-30.398	12.246	1.920
47	-30.969	12.278	2.179	120	-31.025	12.428	2.207
48	-31.600	12.435	2.223	121	-30.568	12.267	2.100
49	-30.331	12.383	2.203	122	-30.570	12.375	2.103
50	-29.039	12.205	2.091	123	-30.669	12.367	2.178
51	-30.948	12.347	2.351	124	-30.725	12.423	2.105
52	-30.997	12.297	2.087	125	-30.481	12.255	2.137
53	-30.522	12.278	1.971	126	-30.675	12.376	2.050
54	-30.685	12.414	2.229	127	-31.133	12.540	2.209
55	-30.283	12.289	2.159	128	-30.428	12.379	2.109
56	-30.171	12.161	2.037	129	-30.299	12.288	1.928
57	-30.064	12.131	2.106	130	-29.926	12.289	2.151
58	-30.064	12.204	2.165	131	-29.998	12.224	2.065
59	-29.545	12.182	2.119	132	-30.514	12.359	2.302
60	-30.727	12.210	2.127	133	-29.396	12.228	1.918
61	-30.888	12.215	2.159	134	-29.732	12.223	2.120
62	-30.759	12.286	2.254	135	-30.827	12.393	2.188
63	-29.151	12.291	2.195	136	-30.103	12.593	2.359
64	-30.365	12.307	2.232	137	-30.389	12.317	2.143
65	-30.638	12.355	2.111	138	-30.581	12.319	2.146
66	-30.116	12.306	2.052	139	-30.375	12.374	2.009
67	-29.741	12.272	2.138	140	-29.648	12.411	2.082
68	-30.785	12.354	2.217	141	-30.995	12.427	2.121
69	-30.147	12.242	2.012	142	-29.660	12.381	2.199
70	-30.797	12.381	2.333	143	-29.408	12.176	2.003
71	-30.523	12.255	2.096	144	-30.981	12.444	2.205
72	-30.124	12.257	1.959	145	-30.178	12.322	1.840
73	-30.741	12.251	2.130	146	-29.574	12.285	1.988

NUMERICAL RESULTS

We computed the correlation coefficients

a) Between redshift z and absolute mag. m (in same group – 146 points).

b) Between redshift z and computed luminosity $\log(L/L_{sun})$ (in same group – 146 points).

c) Between average redshift $z_{avg.}$ (for each group) and computed combined mag. m_c (for same group).

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The results are listed in Table 3, showing strong correlations between all of the parameters and redshifts.

Table 3: Correlation coefficients between average redshift and other parameters

Correlation coefficient	Min.	Max.
z and m	-0.910	-0.472
z and $\log(L/L_{sun})$	-0.866	-0.123
$z_{avg.}$ and m_c	-0.357	

Relations between redshifts and other parameters are shown in Fig. 2, into which, a) relation between redshift & combined mag., and b) relation between redshift & luminosity.

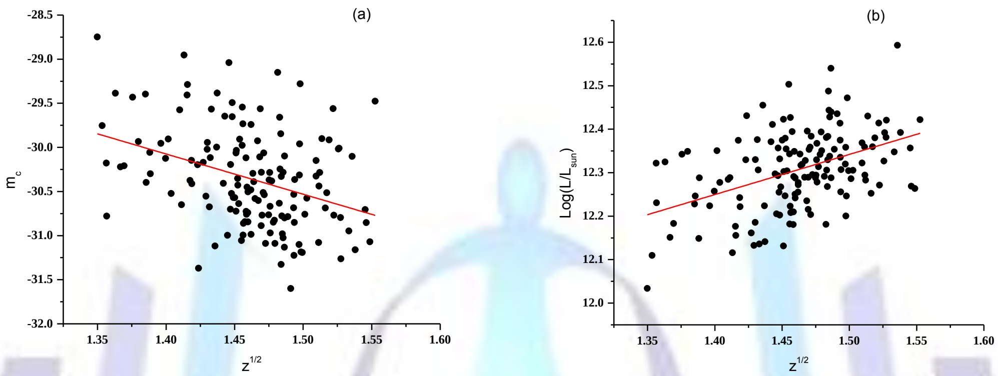

Figure 2 (a): The relation between $z^{1/2}$ vs. m_c with its fitted line, and (b) The relation between $z^{1/2}$ vs. $\log(L/L_{sun})$ with its fitted line

The last figures shows the fitted lines where the number of the points above the line equal to the number of the points below the line, indicating that the residuals are normally distributed.

Also, we have been calculated the residuals $(\Delta = o - c)$ of these points. Table 4, presents the residuals of first and second points.

Table 4: Residuals of the first and second fitted points

Group No.	$(\Delta = o - c)_a$	Group No.	$(\Delta = o - c)_a$	Group No.	$(\Delta = o - c)_b$	Group No.	$(\Delta = o - c)_b$
1	0.026	74	-0.020	1	0.641	74	-0.223
2	0.118	75	0.009	2	0.049	75	1.296
3	0.082	76	-0.143	3	0.825	76	0.138
4	-0.109	77	-0.039	4	0.859	77	-0.321
5	0.075	78	0.005	5	0.692	78	0.106
6	-0.094	79	-0.071	6	1.241	79	0.617
7	-0.144	80	-0.123	7	0.658	80	-0.305
8	0.010	81	0.068	8	0.136	81	0.013
9	0.019	82	0.031	9	0.205	82	-0.141
10	0.020	83	0.039	10	0.701	83	-0.230
11	0.042	84	-0.140	11	0.350	84	-0.051
12	0.099	85	-0.091	12	0.176	85	-0.394
13	-0.021	86	0.007	13	0.209	86	-0.584
14	-0.092	87	-0.170	14	0.642	87	0.181
15	-0.146	88	0.109	15	1.180	88	0.862
16	-0.007	89	0.115	16	0.045	89	0.630
17	-0.025	90	0.202	17	0.049	90	0.412
18	-0.041	91	-0.045	18	-0.331	91	0.301
19	-0.116	92	-0.078	19	-0.112	92	0.221
20	0.053	93	-0.145	20	-0.608	93	-0.136
21	-0.104	94	0.131	21	-0.082	94	1.293
22	0.020	95	0.058	22	-0.416	95	-0.034
23	-0.090	96	-0.022	23	-0.037	96	0.559
24	-0.059	97	0.044	24	0.611	97	-0.137
25	0.063	98	-0.068	25	0.095	98	-0.496
26	0.110	99	-0.058	26	0.371	99	1.097
27	-0.017	100	-0.013	27	-0.498	100	0.520
28	-0.030	101	-0.037	28	-0.628	101	0.533
29	-0.001	102	0.160	29	-0.724	102	-0.730
30	-0.123	103	0.006	30	-0.318	103	-0.251
31	0.015	104	-0.092	31	-0.457	104	0.277
32	-0.031	105	0.083	32	-0.348	105	-0.182

33	-0.021	106	-0.051	33	-0.683	106	-0.662
34	-0.094	107	0.045	34	-0.528	107	-0.017
35	0.039	108	-0.081	35	-0.376	108	0.102
36	-0.097	109	-0.027	36	0.107	109	-0.114
37	-0.029	110	0.053	37	0.248	110	-0.298
38	-0.039	111	0.000	38	-0.034	111	0.145
39	0.160	112	-0.038	39	-1.188	112	-0.416
40	-0.144	113	0.035	40	-0.347	113	-0.663
41	0.002	114	0.016	41	-0.870	114	-0.318
42	0.029	115	-0.063	42	-0.523	115	0.273
43	0.173	116	0.018	43	-0.881	116	0.189
44	0.092	117	0.037	44	-0.507	117	-0.143
45	0.027	118	0.052	45	-0.652	118	-0.039
46	0.021	119	0.010	46	-0.901	119	-0.106
47	-0.042	120	0.100	47	-0.548	120	-0.350
48	0.102	121	-0.028	48	-1.111	121	0.032
49	0.056	122	0.079	49	0.127	122	0.268
50	-0.087	123	0.047	50	1.245	123	-0.412
51	-0.025	124	0.126	51	-0.265	124	-0.274
52	0.006	125	-0.052	52	-0.718	125	0.068
53	0.025	126	0.097	53	-0.431	126	-0.221
54	0.078	127	0.211	54	-0.186	127	-0.158
55	-0.025	128	0.081	55	0.109	128	0.424
56	-0.113	129	0.049	56	0.027	129	0.801
57	-0.165	130	-0.022	57	0.244	130	1.070
58	-0.112	131	-0.060	58	0.336	131	-0.390
59	-0.119	132	0.002	59	0.784	132	-0.561
60	-0.094	133	-0.008	60	-0.385	133	-0.269
61	-0.098	134	-0.079	61	-0.497	134	-0.266
62	-0.057	135	0.071	62	0.641	135	-0.248
63	-0.034	136	0.218	63	0.049	136	-0.417
64	-0.029	137	0.008	64	0.825	137	-0.124
65	0.056	138	0.010	65	0.859	138	-0.456
66	0.027	139	0.109	66	0.692	139	-0.664
67	-0.035	140	0.122	67	1.241	140	-0.115
68	0.022	141	0.125	68	0.658	141	-0.276
69	-0.024	142	0.055	69	0.136	142	0.454
70	0.014	143	-0.087	70	0.205	143	0.245
71	-0.039	144	0.115	71	0.701	144	0.095
72	0.008	145	0.112	72	0.350	145	0.610
73	-0.054	146	0.026	73	0.176	146	0.598

Now, we aimed to calculate the Karlsson peak for our data, Fig. 3 shows the peak present at z≈1.5, which is good agreement with well-established peak at 1.955.

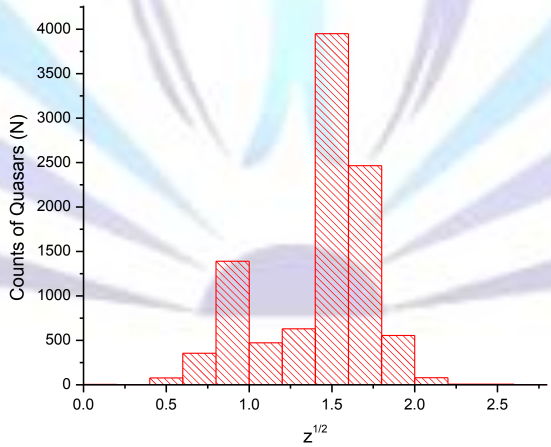

Figure 3: Karlsson peak (z≈1.5) due to our present data

CONCLUSION

In the present work, we have focused on some properties of the Quasars, showing that strong correlations between some intrinsic parameters and redshifts *(z).*

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