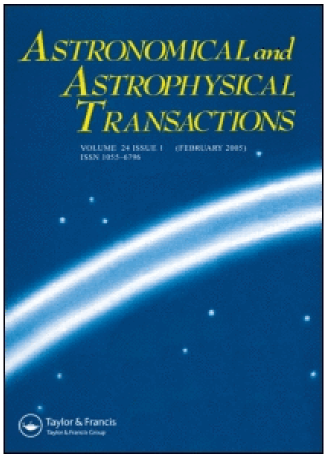

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SEARCH FOR DOUBLE AND MULTIPLE OPEN STAR CLUSTERS†

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The problem of the search tor double and multiple open star clusters is briefly discussed. A preliminary list of probable double open clusters is given.

KEY WORDS Open star clusters, double clusters, multiple clusters

Research into double (binary) open star clusters (OSCs) is a long-term project (Muminov, 1983; Bashtova and Latypov, 1989; Latypov *et al.*, 1997) carried out at the Ulugh Beg Astronomical Institute of the Uzbek Academy of Sciences. At present it is a complex programme partly based on the study of the plates obtained using the Kitab Double Zeiss Astrograph ($F = 3000$ mm, $D = 400$ mm) with the epoch difference over 20 years. The large field of the astrograph ($6° \times 6°$) makes it possible to study a number of OSCs on the same plate. For example, one can find more than 15 OSCs on the plate with centre $\alpha = 0^{\rm h}29^{\rm m}$, $\delta = 62°$. We also put emphasis on some unique double and multiple OSCs.

The Galactic OSCs are known to lie near the Galactic plane, many of them being located in the spiral arms. It is reasonable to search for double OSCs first of all in star complexes (Efremov, 1986) and in regions with optically multiple OSCs. These OSCs can gradually disintegrate due to various dynamic phenomena, such as instabilities of vertical oscillations, differential rotation, etc. To analyse certain problems of the origin and evolution of double and multiple OSCs as well as those of the Galactic disc structure it is reasonable to make a list of each kind of them. With that end in view we have revealed a number of probable double and multiple OSCs in the Galaxy using existing OSC catalogues (Lynga, 1987; Loktin and Matkin, 1994; Mermilliod, 1988; 1992) and other sources, as well as taking into account

†Short version of the report presented to the Moscow conference (1997) of the Soviet Astronomical Society.

Table 1. The preliminary list of probable open star clusters

No.	*OSC name*	*Longitude*	*Latitude*	*Distance r (pc)*	*Z (pc)*	*log age*	E_{b-v}	*Angular distance*
1	Coll 394	14.83	−9.55	643	−106	7.89	0.25	33.8
	NGC 6716	15.39	−9.59	612	−101	8.03	0.12	
2	NGC 6755	38.55	−1.70	1675	−49	7.08	0.93	30.2
	NGC 6756	39.06	−1.69	1507	−44	7.79	1.18	
3	NGC 6882	65.43	−3.58	600	−42	9.14	0.08	5.7
	NGC 6885	65.53	−4.07	597	−42	9.14	0.08	
4	Berk. 86	76.66	1.26	1112	24	7.61	0.99	42.4
	NGC 6913	76.92	0.60	1343	14	7.00	0.78	
5	Basel 12	88.30	−1.24	1466	−31	8.50	0.57	27.4
	Basel 13	88.75	−1.24	1236	−26	8.80	0.34	
6	IC 1442	101.36	−2.20	1738	−66	7.54	0.43	20.0
	NGC 7245	101.37	−1.87	1845	−60	8.19	0.49	
7	King 14	120.72	0.36	2767	17	7.61	0.47	11.4
	NGC 146	120.87	0.49	3192	27	7.61	0.58	
8	NGC 189	121.51	−1.77	752	−23	7.00	0.42	51.2
	NGC 225	121.99	−1.08	614	−11	8.11	0.29	
9	NGC 869	134.63	−3.72	2232	−144	7.26	0.54	27.9
	NGC 884	135.08	−3.60	2222	−139	7.26	0.60	
10	NGC 1528	152.04	0.27	745	3	8.34	0.30	78.5
	NGC 1545	153.36	0.17	759	2	8.30	0.36	
11	NGC 1912	172.27	0.70	1234	15	8.19	0.24	31.9
	NGC 1907	172.62	0.30	1330	6	8.11	0.42	
12	NGC 2251	203.60	0.13	1556	3	8.66	0.20	28.2
	Basel 7	203.81	0.54	1578	14	8.46	0.28	
13	NGC 2335	223.62	−1.27	1022	−22	8.03	0.38	42.3
	NGC 2343	224.32	−1.16	870	−17	7.89	0.16	
14	Haff 6	227.85	0.25	1122	4	9.03	0.00	57.5
	NGC 2374	228.42	1.04	1211	21	8.34	0.15	
15	Czern 29	230.80	0.93	2938	47	7.89	0.55	4.5
	Haff 10	230.82	1.00	2938	51	7.08	0.55	
16	NGC 2422	230.97	3.13	474	25	7.89	0.08	38.7
	NGC 2423	230.47	3.55	749	46	8.60	0.21	
17	NGC 2579	254.67	0.27	1033	4	7.61	0.15	15.1
	Coll 185	254.76	0.45	1486	11	8.11	0.21	
18	Pismis 6	264.81	−2.87	1670	−83	7.08	0.41	12.1
	Waterlo 6	264.86	−2.67	1820	−84	7.61	0.48	
19	NGC 2670	267.47	−3.61	955	−60	7.61	0.48	56.0
	IC 2395	266.57	−3.81	946	−62	7.00	0.11	
20	NGC 2910	275.29	−1.18	1272	−26	8.42	0.07	43.9
	NGC 2925	276.02	−1.24	774	−16	7.85	0.08	
21	Tr 14	287.42	−0.58	2867	−29	7.00	0.56	12.9
	Tr 16	287.61	−0.65	2630	−29	7.00	0.49	
22	Basel 18	307.20	0.20	1528	5	7.98	0.15	37.3
	Tr 21	307.57	−0.30	1112	−5	7.89	0.21	
23	NGC 5168	307.74	1.57	1312	35	7.89	0.32	21.2
	Hogg 16	307.47	1.34	1136	26	7.79	0.41	
24	NGC 6134	334.92	−0.19	649	−2	8.50	0.45	70.7
	NGC 6167	335.32	−1.28	598	−13	7.85	0.89	
25	NGC 6383	355.68	0.05	1333	1	7.54	0.34	25.8
	Tr 28	355.98	−0.26	1374	−6	8.30	0.74	

the similarity of the OSC component in their individual characteristics, such as coordinates, distances from the Sun, age, etc. In particular, we applied a computer search to the Lynga catalogue.

We present in this article a preliminary list of probable double OSCs (see Table 1).

The OSC coordinates (except NGC 6882), their age, the altitude above the Galactic plane and the OSC distances (r) were taken from the Lynga (1987) catalogue. The last column contains the angular distances between the double OSC components in minutes of arc calculated by the authors. It goes without saying that the angular distance cannot be a real criterion for OSC duality, but it makes it possible to calculate the spatial distance between double OSC components if their r's have been reliably determined. We have also calculated the distances between the double OSC components to compare the OSC pairs from our list. However, it is necessary to take into account that a number of the OSC distances given by various authors have a rather great spread in values. So they require a more precise definition and some analysis of heterogeneous methods of distance determination. So the inclusion in Table 1 of spatial distances between the components or the OSC listed is perhaps premature.

Some double OSCs were not included in the list as they are probable members of multiple systems. For example, the double clusters NGC 3572+Collinder 240 and Hogg 10+Hogg 11 form a four-fold system. The open clusters NGC 6405+6416 together with NGC 6425+6451 and Basel 5 probably form a quintuple system. The OSCs NGC 5617, Tr 22 and Hogg 17 form perhaps a three-fold system. Probable multiple OSCs will be listed in our future work.

After this article had been written we discovered that Subramaniam *et al.* (1995) had dealt with probable double OSC searches. Five double OSCs in our list and those authors' lists are the same. For the rest the parameter largest differences in our list are smaller than those of Subramaniam *et al.* A final comparison of the results and a list of new probable double OSCs will be published later.

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