

MINIMUM DISTANCES BETWEEN ORBITS OF MINOR PLANETS

M. Kuzmanoski

Institute of Astronomy, Studentski trg 16, Beograd, Yugoslavia

(Received: December 16, 1991)

SUMMARY: Minimum mutual distances with upper limits of 0.001, 0.01, and 0.05 AU were determined for 3859 osculating orbits of numbered minor planets. The 21 pairs were found with the minimum distance less than 150 km, among which three with 7, 12, and 13 km only. The minimum distance distribution reveals that pairs with small minimum distance are more numerous than those with large minimum distance. The distribution by longitude is bimodal, with almost identical maxima, but somewhat different minima.

1. INTRODUCTION

The minor planet belt, as a unique structure in the solar system, is in the state of permanent evolution. Study of the features of the distributions of contemporary orbits of minor planets can, therefore, contribute to understanding the origin of these bodies and developing models of future changes on the cosmogonic time scales. Distributions of orbital elements of minor planets possess a number of common characteristics, but there are specific individual orbits and peculiar groups of orbits, too. In order to analyse in more detail some special kinematic characteristics of the minor planet belt, in this paper the mutual distances between orbits of 3859 numbered minor planets (epoch $JD2447400.5$) have been computed in a systematic way. The determination of minimum distances was performed by means of the procedure described in Lazović (1967), which has already been successfully applied for the determina-

tion of minimum distances of the quasicoplanar minor planets (Lazović and Kuzmanoski, 1978; 1979). The total of 26 990 pairs with minimum distance $\rho \leq 0.001$ AU was found, as well as 259 139 pairs with $\rho \leq 0.01$ AU, and 1 097 459 pairs with $\rho \leq 0.05$ AU.

2. MINIMUM DISTANCES

Orbits of minor planets are continuously changing due to the major planets perturbations, but it is nevertheless interesting to see what are the current minimum distances of these orbits determined by their contemporary osculating elements. The smallest so far known mutual distance of two orbits of 0.000004 AU has been found by Lazović and Kuzmanoski (1978) for the pair (215, 1851). It was, hence, somewhat surprising to find in this analysis as much as 92 pairs of orbits with minimum distance of

Table 1.

<i>j</i>	<i>k</i>	ρ (AU)	ρ (km)	<i>I</i>	$\Delta\Omega$
319	1525	.00000059	88	12.377	92.819
321	2155	.00000028	42	.089	1.585
486	3062	.00000020	31	3.179	16.361
643	1118	.00000100	150	15.137	66.640
666	3037	.00000057	85	22.439	107.616
755	2452	.00000069	103	15.026	174.067
770	1858	.00000094	141	5.640	132.467
805	3458	.00000033	50	13.618	10.220
842	885	.00000100	150	17.371	143.105
900	1375	.00000058	86	15.937	129.975
960	1666	.00000073	109	.772	13.994
1165	2740	.00000088	131	3.600	5.512
1169	1810	.00000066	98	.071	.975
1216	3057	.00000068	102	5.838	46.244
1523	2575	.00000005	7	.682	5.823
1814	2693	.00000020	29	4.818	39.505
2122	2850	.00000023	34	.093	.615
2168	2928	.00000037	55	4.804	3.233
2198	3652	.00000008	12	1.768	22.329
2316	3336	.00000088	132	2.061	94.014
2519	3183	.00000082	122	1.773	44.923
2620	3409	.00000044	66	4.238	138.338
3174	3380	.00000009	13	1.321	20.702
3239	3520	.00000097	145	2.430	28.928

Table 2.

<i>j</i>	<i>k</i>	ρ_1 (AU)	ρ_2 (AU)	<i>I</i>	$\Delta\Omega$
68	464	.0000133	.0004771	9.004	58.250
78	1426	.0000331	.0000707	.456	1.730
158	2555	.0005952	.0000848	.135	5.401
171	2039	.0000053	.0002773	.203	4.583
187	3238	.0000606	.0001687	2.318	10.528
364	1449	.0000061	.0006537	.855	5.236
376	3517	.0000079	.0009643	7.334	114.893
505	521	.0000243	.0002306	.785	1.079
637	2882	.0000402	.0004726	.194	39.795
664	3189	.0000213	.0008127	.474	1.969
669	1410	.0009498	.0000357	.435	.436
707	1147	.0002976	.0000242	1.247	16.717
767	3276	.0000561	.0004297	.472	8.863
846	2524	.0002974	.0000743	.083	16.582
857	1663	.0002083	.0000575	.071	.348
988	3832	.0009115	.0000125	.605	13.450
993	1635	.0000696	.0002257	.040	.225
1153	3397	.0000665	.0005377	23.091	105.304
1259	3174	.0003396	.0000691	.115	2.763

MINIMUM DISTANCES BETWEEN ORBITS OF MINOR PLANETS

Tabelle 2. (continue)

<i>j</i>	<i>k</i>	ρ_1 (AU)	ρ_2 (AU)	<i>I</i>	$\Delta\Omega$
1446	3034	.0000410	.0000465	.689	6.811
1486	3356	.0000348	.0005021	4.149	134.827
1699	3732	.0003260	.0000525	.440	4.702
1762	3516	.0001487	.0000535	.061	1.086
1896	3005	.0006527	.0000779	.231	4.622
1929	3006	.0006168	.0000346	6.623	56.946
2156	3221	.0000671	.0002576	4.825	61.483
2197	2657	.0005748	.0000438	.387	6.670
2225	3032	.0003164	.0000304	.041	.254
2283	3385	.0007984	.0000399	.128	.877
2458	3010	.0001398	.0000775	.057	1.363
2528	2534	.0005153	.0000901	.304	5.403
3218	3331	.0001605	.0000825	1.174	15.015
3291	3785	.0000832	.0006807	.083	.444
3589	3739	.0000973	.0007243	.227	2.022
3777	3840	.0000921	.0009054	.409	4.280

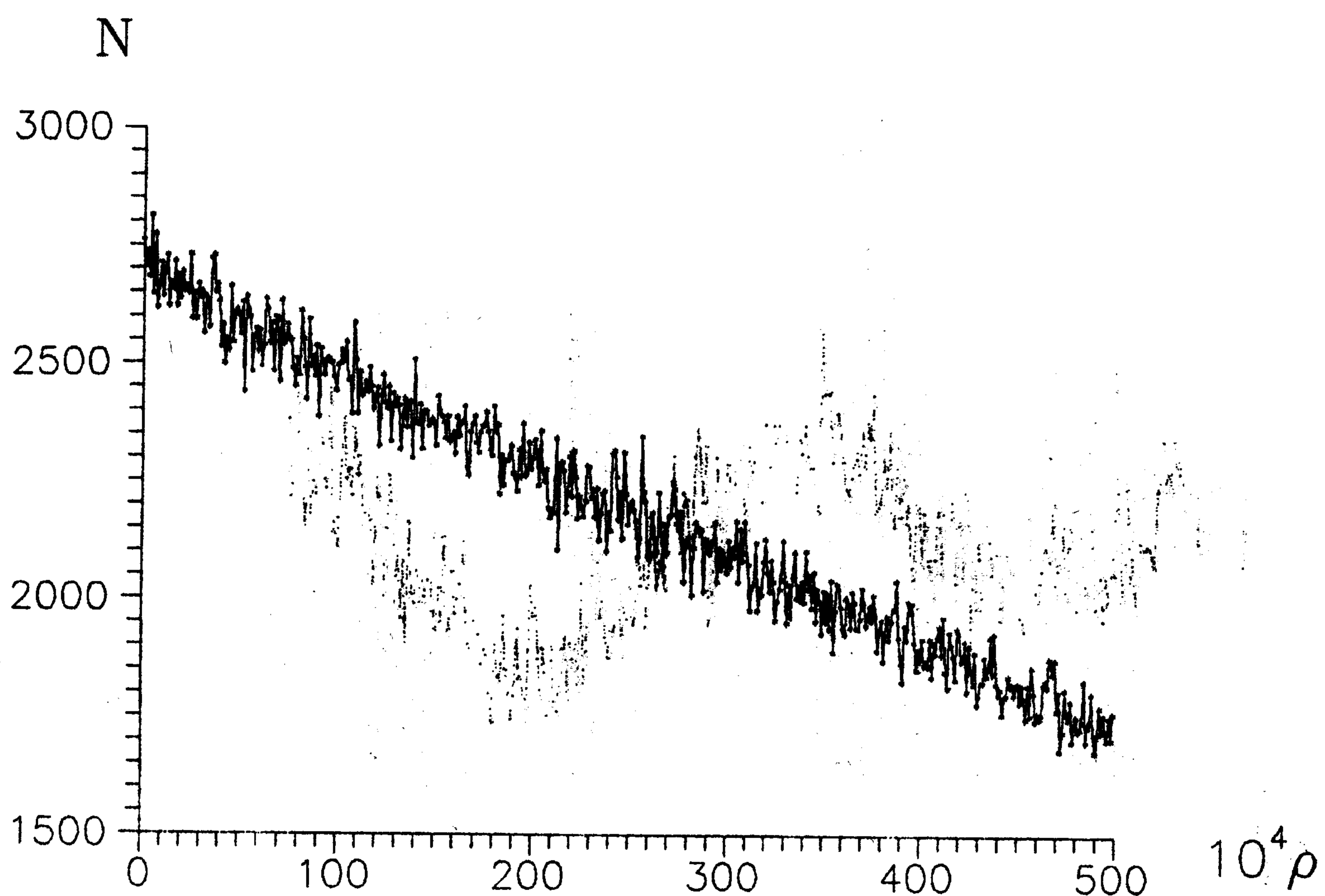


Fig. 1.

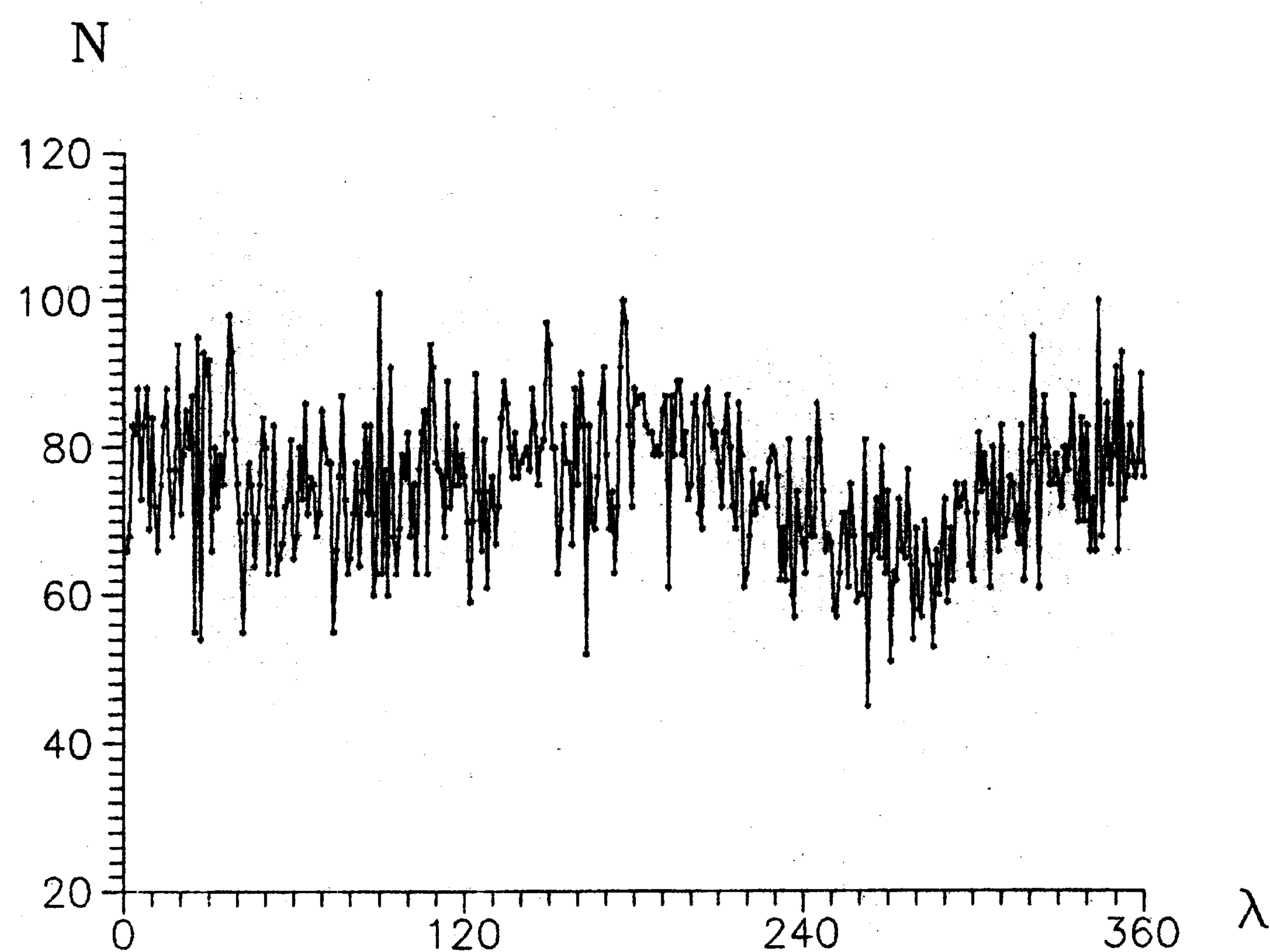


Fig. 2.

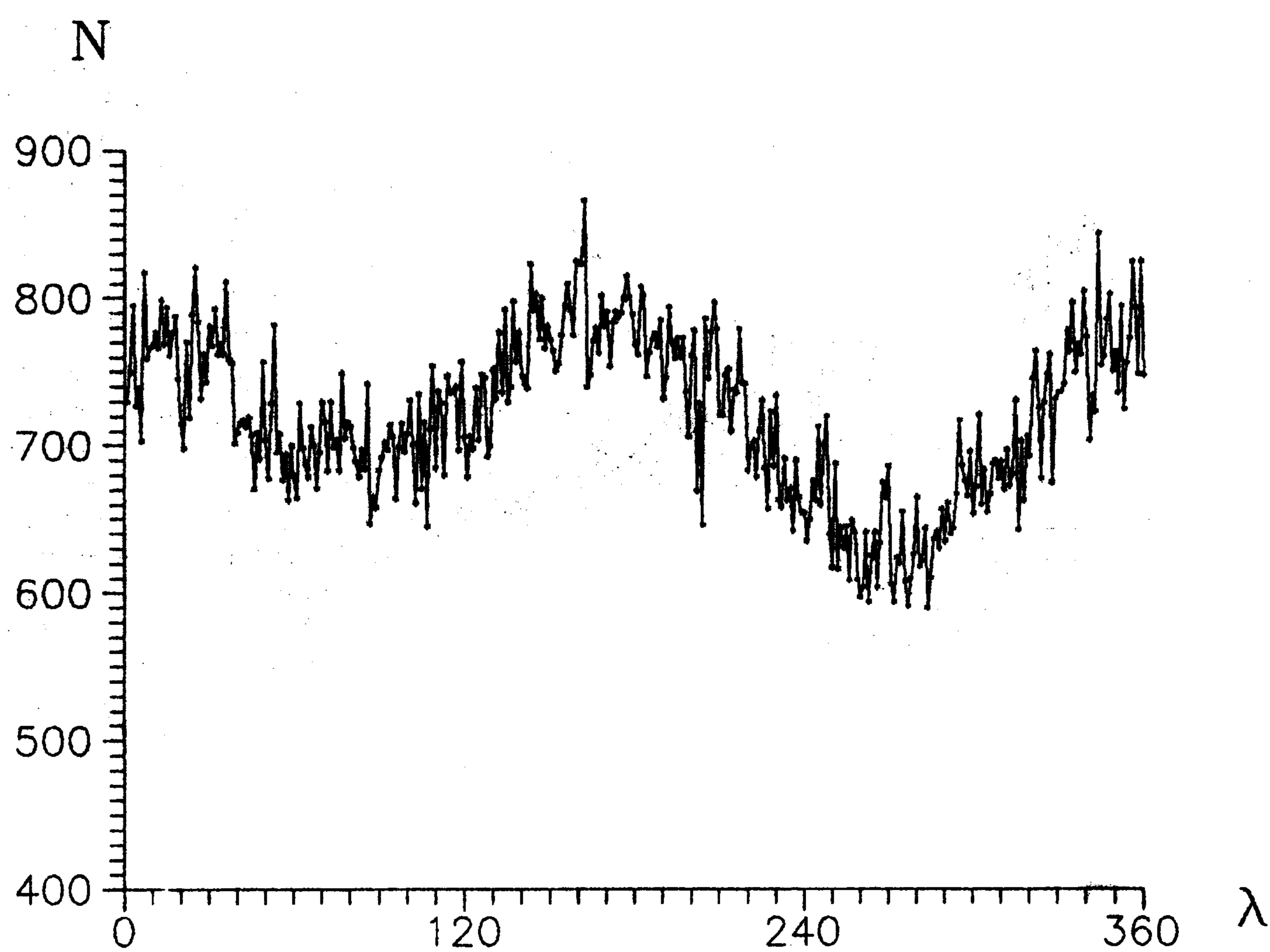
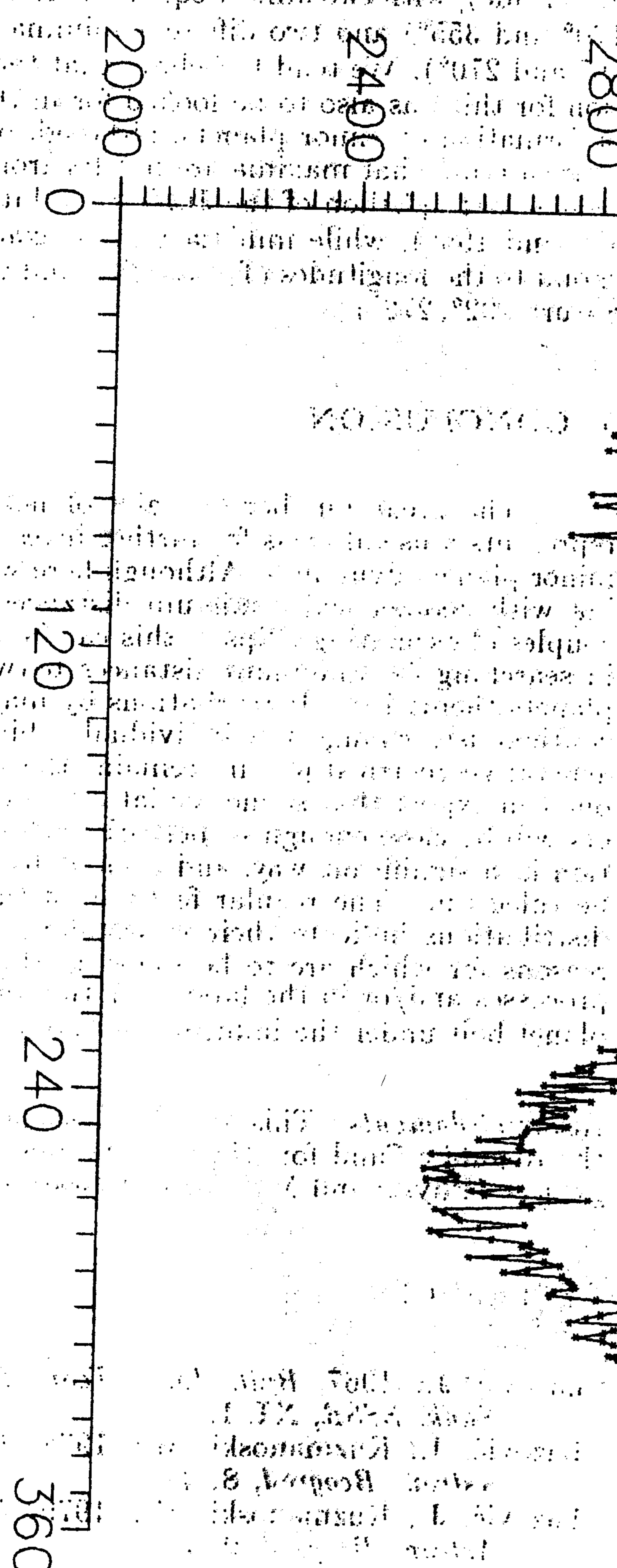


Fig. 3.

MINIMUM DISTANCES BETWEEN ORBITS OF MINOR PLANETS

entre 1900 e 1960, de 1960 a 1980, entre 1980 e 2000, entre 2000 e 2020, entre 2020 e 2040, entre 2040 e 2060, entre 2060 e 2080, entre 2080 e 2100, entre 2100 e 2120, entre 2120 e 2140, entre 2140 e 2160, entre 2160 e 2180, entre 2180 e 2200, entre 2200 e 2220, entre 2220 e 2240, entre 2240 e 2260, entre 2260 e 2280, entre 2280 e 2300, entre 2300 e 2320, entre 2320 e 2340, entre 2340 e 2360, entre 2360 e 2380, entre 2380 e 2400, entre 2400 e 2420, entre 2420 e 2440, entre 2440 e 2460, entre 2460 e 2480, entre 2480 e 2500, entre 2500 e 2520, entre 2520 e 2540, entre 2540 e 2560, entre 2560 e 2580, entre 2580 e 2600, entre 2600 e 2620, entre 2620 e 2640, entre 2640 e 2660, entre 2660 e 2680, entre 2680 e 2700, entre 2700 e 2720, entre 2720 e 2740, entre 2740 e 2760, entre 2760 e 2780, entre 2780 e 2800, entre 2800 e 2820, entre 2820 e 2840, entre 2840 e 2860, entre 2860 e 2880, entre 2880 e 2900, entre 2900 e 2920, entre 2920 e 2940, entre 2940 e 2960, entre 2960 e 2980, entre 2980 e 3000, entre 3000 e 3020, entre 3020 e 3040, entre 3040 e 3060, entre 3060 e 3080, entre 3080 e 3100, entre 3100 e 3120, entre 3120 e 3140, entre 3140 e 3160, entre 3160 e 3180, entre 3180 e 3200, entre 3200 e 3220, entre 3220 e 3240, entre 3240 e 3260, entre 3260 e 3280, entre 3280 e 3300, entre 3300 e 3320, entre 3320 e 3340, entre 3340 e 3360, entre 3360 e 3380, entre 3380 e 3400, entre 3400 e 3420, entre 3420 e 3440, entre 3440 e 3460, entre 3460 e 3480, entre 3480 e 3500, entre 3500 e 3520, entre 3520 e 3540, entre 3540 e 3560, entre 3560 e 3580, entre 3580 e 3600, entre 3600 e 3620, entre 3620 e 3640, entre 3640 e 3660, entre 3660 e 3680, entre 3680 e 3700, entre 3700 e 3720, entre 3720 e 3740, entre 3740 e 3760, entre 3760 e 3780, entre 3780 e 3800, entre 3800 e 3820, entre 3820 e 3840, entre 3840 e 3860, entre 3860 e 3880, entre 3880 e 3900, entre 3900 e 3920, entre 3920 e 3940, entre 3940 e 3960, entre 3960 e 3980, entre 3980 e 4000, entre 4000 e 4020, entre 4020 e 4040, entre 4040 e 4060, entre 4060 e 4080, entre 4080 e 4100, entre 4100 e 4120, entre 4120 e 4140, entre 4140 e 4160, entre 4160 e 4180, entre 4180 e 4200, entre 4200 e 4220, entre 4220 e 4240, entre 4240 e 4260, entre 4260 e 4280, entre 4280 e 4300, entre 4300 e 4320, entre 4320 e 4340, entre 4340 e 4360, entre 4360 e 4380, entre 4380 e 4400, entre 4400 e 4420, entre 4420 e 4440, entre 4440 e 4460, entre 4460 e 4480, entre 4480 e 4500, entre 4500 e 4520, entre 4520 e 4540, entre 4540 e 4560, entre 4560 e 4580, entre 4580 e 4600, entre 4600 e 4620, entre 4620 e 4640, entre 4640 e 4660, entre 4660 e 4680, entre 4680 e 4700, entre 4700 e 4720, entre 4720 e 4740, entre 4740 e 4760, entre 4760 e 4780, entre 4780 e 4800, entre 4800 e 4820, entre 4820 e 4840, entre 4840 e 4860, entre 4860 e 4880, entre 4880 e 4900, entre 4900 e 4920, entre 4920 e 4940, entre 4940 e 4960, entre 4960 e 4980, entre 4980 e 5000, entre 5000 e 5020, entre 5020 e 5040, entre 5040 e 5060, entre 5060 e 5080, entre 5080 e 5100, entre 5100 e 5120, entre 5120 e 5140, entre 5140 e 5160, entre 5160 e 5180, entre 5180 e 5200, entre 5200 e 5220, entre 5220 e 5240, entre 5240 e 5260, entre 5260 e 5280, entre 5280 e 5300, entre 5300 e 5320, entre 5320 e 5340, entre 5340 e 5360, entre 5360 e 5380, entre 5380 e 5400, entre 5400 e 5420, entre 5420 e 5440, entre 5440 e 5460, entre 5460 e 5480, entre 5480 e 5500, entre 5500 e 5520, entre 5520 e 5540, entre 5540 e 5560, entre 5560 e 5580, entre 5580 e 5600, entre 5600 e 5620, entre 5620 e 5640, entre 5640 e 5660, entre 5660 e 5680, entre 5680 e 5700, entre 5700 e 5720, entre 5720 e 5740, entre 5740 e 5760, entre 5760 e 5780, entre 5780 e 5800, entre 5800 e 5820, entre 5820 e 5840, entre 5840 e 5860, entre 5860 e 5880, entre 5880 e 5900, entre 5900 e 5920, entre 5920 e 5940, entre 5940 e 5960, entre 5960 e 5980, entre 5980 e 6000, entre 6000 e 6020, entre 6020 e 6040, entre 6040 e 6060, entre 6060 e 6080, entre 6080 e 6100, entre 6100 e 6120, entre 6120 e 6140, entre 6140 e 6160, entre 6160 e 6180, entre 6180 e 6200, entre 6200 e 6220, entre 6220 e 6240, entre 6240 e 6260, entre 6260 e 6280, entre 6280 e 6300, entre 6300 e 6320, entre 6320 e 6340, entre 6340 e 6360, entre 6360 e 6380, entre 6380 e 6400, entre 6400 e 6420, entre 6420 e 6440, entre 6440 e 6460, entre 6460 e 6480, entre 6480 e 6500, entre 6500 e 6520, entre 6520 e 6540, entre 6540 e 6560, entre 6560 e 6580, entre 6580 e 6600, entre 6600 e 6620, entre 6620 e 6640, entre 6640 e 6660, entre 6660 e 6680, entre 6680 e 6700, entre 6700 e 6720, entre 6720 e 6740, entre 6740 e 6760, entre 6760 e 6780, entre 6780 e 6800, entre 6800 e 6820, entre 6820 e 6840, entre 6840 e 6860, entre 6860 e 6880, entre 6880 e 6900, entre 6900 e 6920, entre 6920 e 6940, entre 6940 e 6960, entre 6960 e 6980, entre 6980 e 7000, entre 7000 e 7020, entre 7020 e 7040, entre 7040 e 7060, entre 7060 e 7080, entre 7080 e 7100, entre 7100 e 7120, entre 7120 e 7140, entre 7140 e 7160, entre 7160 e 7180, entre 7180 e 7200, entre 7200 e 7220, entre 7220 e 7240, entre 7240 e 7260, entre 7260 e 7280, entre 7280 e 7300, entre 7300 e 7320, entre 7320 e 7340, entre 7340 e 7360, entre 7360 e 7380, entre 7380 e 7400, entre 7400 e 7420, entre 7420 e 7440, entre 7440 e 7460, entre 7460 e 7480, entre 7480 e 7500, entre 7500 e 7520, entre 7520 e 7540, entre 7540 e 7560, entre 7560 e 7580, entre 7580 e 7600, entre 7600 e 7620, entre 7620 e 7640, entre 7640 e 7660, entre 7660 e 7680, entre 7680 e 7700, entre 7700 e 7720, entre 7720 e 7740, entre 7740 e 7760, entre 7760 e 7780, entre 7780 e 7800, entre 7800 e 7820, entre 7820 e 7840, entre 7840 e 7860, entre 7860 e 7880, entre 7880 e 7900, entre 7900 e 7920, entre 7920 e 7940, entre 7940 e 7960, entre 7960 e 7980, entre 7980 e 8000, entre 8000 e 8020, entre 8020 e 8040, entre 8040 e 8060, entre 8060 e 8080, entre 8080 e 8100, entre 8100 e 8120, entre 8120 e 8140, entre 8140 e 8160, entre 8160 e 8180, entre 8180 e 8200, entre 8200 e 8220, entre 8220 e 8240, entre 8240 e 8260, entre 8260 e 8280, entre 8280 e 8300, entre 8300 e 8320, entre 8320 e 8340, entre 8340 e 8360, entre 8360 e 8380, entre 8380 e 8400, entre 8400 e 8420, entre 8420 e 8440, entre 8440 e 8460, entre 8460 e 8480, entre 8480 e 8500, entre 8500 e 8520, entre 8520 e 8540, entre 8540 e 8560, entre 8560 e 8580, entre 8580 e 8600, entre 8600 e 8620, entre 8620 e 8640, entre 8640 e 8660, entre 8660 e 8680, entre 8680 e 8700, entre 8700 e 8720, entre 8720 e 8740, entre 8740 e 8760, entre 8760 e 8780, entre 8780 e 8800, entre 8800 e 8820, entre 8820 e 8840, entre 8840 e 8860, entre 8860 e 8880, entre 8880 e 8900, entre 8900 e 8920, entre 8920 e 8940, entre 8940 e 8960, entre 8960 e 8980, entre 8980 e 9000, entre 9000 e 9020, entre 9020 e 9040, entre 9040 e 9060, entre 9060 e 9080, entre 9080 e 9100, entre 9100 e 9120, entre 9120 e 9140, entre 9140 e 9160, entre 9160 e 9180, entre 9180 e 9200, entre 9200 e 9220, entre 9220 e 9240, entre 9240 e 9260, entre 9260 e 9280, entre 9280 e 9300, entre 9300 e 9320, entre 9320 e 9340, entre 9340 e 9360, entre 9360 e 9380, entre 9380 e 9400, entre 9400 e 9420, entre 9420 e 9440, entre 9440 e 9460, entre 9460 e 9480, entre 9480 e 9500, entre 9500 e 9520, entre 9520 e 9540, entre 9540 e 9560, entre 9560 e 9580, entre 9580 e 9600, entre 9600 e 9620, entre 9620 e 9640, entre 9640 e 9660, entre 9660 e 9680, entre 9680 e 9700, entre 9700 e 9720, entre 9720 e 9740, entre 9740 e 9760, entre 9760 e 9780, entre 9780 e 9800, entre 9800 e 9820, entre 9820 e 9840, entre 9840 e 9860, entre 9860 e 9880, entre 9880 e 9900, entre 9900 e 9920, entre 9920 e 9940, entre 9940 e 9960, entre 9960 e 9980, entre 9980 e 10000.

Fig. 4.



λ

entre 1900 e 1920 (1600 km), entre 1920 e 1940 (1600 km), entre 1940 e 1960 (1600 km), entre 1960 e 1980 (1600 km), entre 1980 e 2000 (1600 km), entre 2000 e 2020 (1600 km), entre 2020 e 2040 (1600 km), entre 2040 e 2060 (1600 km), entre 2060 e 2080 (1600 km), entre 2080 e 2100 (1600 km), entre 2100 e 2120 (1600 km), entre 2120 e 2140 (1600 km), entre 2140 e 2160 (1600 km), entre 2160 e 2180 (1600 km), entre 2180 e 2200 (1600 km), entre 2200 e 2220 (1600 km), entre 2220 e 2240 (1600 km), entre 2240 e 2260 (1600 km), entre 2260 e 2280 (1600 km), entre 2280 e 2300 (1600 km), entre 2300 e 2320 (1600 km), entre 2320 e 2340 (1600 km), entre 2340 e 2360 (1600 km), entre 2360 e 2380 (1600 km), entre 2380 e 2400 (1600 km), entre 2400 e 2420 (1600 km), entre 2420 e 2440 (1600 km), entre 2440 e 2460 (1600 km), entre 2460 e 2480 (1600 km), entre 2480 e 2500 (1600 km), entre 2500 e 2520 (1600 km), entre 2520 e 2540 (1600 km), entre 2540 e 2560 (1600 km), entre 2560 e 2580 (1600 km), entre 2580 e 2600 (1600 km), entre 2600 e 2620 (1600 km), entre 2620 e 2640 (1600 km), entre 2640 e 2660 (1600 km), entre 2660 e 2680 (1600 km), entre 2680 e 2700 (1600 km), entre 2700 e 2720 (1600 km), entre 2720 e 2740 (1600 km), entre 2740 e 2760 (1600 km), entre 2760 e 2780 (1600 km), entre 2780 e 2800 (1600 km), entre 2800 e 2820 (1600 km), entre 2820 e 2840 (1600 km), entre 2840 e 2860 (1600 km), entre 2860 e 2880 (1600 km), entre 2880 e 2900 (1600 km), entre 2900 e 2920 (1600 km), entre 2920 e 2940 (1600 km), entre 2940 e 2960 (1600 km), entre 2960 e 2980 (1600 km), entre 2980 e 3000 (1600 km), entre 3000 e 3020 (1600 km), entre 3020 e 3040 (1600 km), entre 3040 e 3060 (1600 km), entre 3060 e 3080 (1600 km), entre 3080 e 3100 (1600 km), entre 3100 e 3120 (1600 km), entre 3120 e 3140 (1600 km), entre 3140 e 3160 (1600 km), entre 3160 e 3180 (1600 km), entre 3180 e 3200 (1600 km), entre 3200 e 3220 (1600 km), entre 3220 e 3240 (1600 km), entre 3240 e 3260 (1600 km), entre 3260 e 3280 (1600 km), entre 3280 e 3300 (1600 km), entre 3300 e 3320 (1600 km), entre 3320 e 3340 (1600 km), entre 3340 e 3360 (1600 km), entre 3360 e 3380 (1600 km), entre 3380 e 3400 (1600 km), entre 3400 e 3420 (1600 km), entre 3420 e 3440 (1600 km), entre 3440 e 3460 (1600 km), entre 3460 e 3480 (1600 km), entre 3480 e 3500 (1600 km), entre 3500 e 3520 (1600 km), entre 3520 e 3540 (1600 km), entre 3540 e 3560 (1600 km), entre 3560 e 3580 (1600 km), entre 3580 e 3600 (1600 km), entre 3600 e 3620 (1600 km), entre 3620 e 3640 (1600 km), entre 3640 e 3660 (1600 km), entre 3660 e 3680 (1600 km), entre 3680 e 3700 (1600 km), entre 3700 e 3720 (1600 km), entre 3720 e 3740 (1600 km), entre 3740 e 3760 (1600 km), entre 3760 e 3780 (1600 km), entre 3780 e 3800 (1600 km), entre 3800 e 3820 (1600 km), entre 3820 e 3840 (1600 km), entre 3840 e 3860 (1600 km), entre 3860 e 3880 (1600 km), entre 3880 e 3900 (1600 km), entre 3900 e 3920 (1600 km), entre 3920 e 3940 (1600 km), entre 3940 e 3960 (1600 km), entre 3960 e 3980 (1600 km), entre 3980 e 4000 (1600 km), entre 4000 e 4020 (1600 km), entre 4020 e 4040 (1600 km), entre 4040 e 4060 (1600 km), entre 4060 e 4080 (1600 km), entre 4080 e 4100 (1600 km), entre 4100 e 4120 (1600 km), entre 4120 e 4140 (1600 km), entre 4140 e 4160 (1600 km), entre 4160 e 4180 (1600 km), entre 4180 e 4200 (1600 km), entre 4200 e 4220 (1600 km), entre 4220 e 4240 (1600 km), entre 4240 e 4260 (1600 km), entre

7 km only, (2198, 3652) with 12 km, and (3174, 3380) with 13 km. In the table are besides given the mutual inclination of the orbital planes I and the difference of the longitudes of node $\Delta\Omega$. One notices that pairs with small mutual inclination are more frequent, and this holds for the sample of all 92 pairs as well. However, chance distribution of differences of nodal longitudes prevents any general conclusion on the position of orbital planes to be drawn from these data.

As minimum distances occur mostly close to the relative nodes of the orbits, it oftenly happens that a particular pair has both proximities below the given upper limit. In Table 2 list of 35 such pairs is shown, with upper limit for both distances of 0.001 AU. From the values of I and $\Delta\Omega$ one can conclude that having both proximities below a given limit is typical of the quasicoplanar minor planets. Since the number of such pairs increases rapidly with the increase of the upper limit, it could be interesting to investigate such pairs in more detail, in particular to find out for how long do they keep this behaviour.

3. DISTRIBUTION OF MINIMUM DISTANCES

A great number of minimum distances for all three upper limits enables a statistical treatment of the obtained results. In Fig. 1 the distribution of minimum distances up to 0.05 AU is shown; on the x-axis $\rho \cdot 10^4$ values are shown with a step in ρ of 0.0001 AU, while on y-axis number of pairs N is given of orbits of minor planets with corresponding minimum distances. The plot exhibits a strict linear dependence (N decreasing with increasing ρ), which is, at first sight, an unexpected result. If the future analyses prove that the observed pairs eventually form some distinct groups (let's call them "arrays"), this fact will probably have to be ascribed to cosmogonic causes (origin).

Longitudes of points on the orbits forming a pair, that correspond to a minimum distance, differ very little due to small ρ 's, and are, in principle, very close to the longitudes of relative nodes. The distributions of minimum distances by longitudes are shown on Figs. 2,3 and 4, for $\rho \leq 0.001$ AU, $\rho \leq 0.01$ AU, and $\rho \leq 0.05$ AU, respectively. On the x-axes longitude of minimum distance for the first (lower number) orbit in a pair is given, with a corre-

sponding number of pairs on the y-axes. The bimodal distribution is clearly seen in all the plots (that for $\rho \leq 0.001$ AU having a somewhat smaller amplitude), with two almost equal maxima (at about 170° and 355°) and two different minima (at about 90° and 270°). We tend to believe that the explanation for this has also to be looked for in the process of formation of minor planets, although one should bear in mind that maxima are not far from the perihelion and aphelion of the Jupiter's orbit (being at 15° and 195°), while minima almost exactly correspond to the longitudes of perihelion and aphelion of Saturn (92° , 272°).

4. CONCLUSION

The great number of pairs of nearby orbits represents a useful basis for further investigations of minor planets dynamics. Although here we are dealing with geometrical minimum distances between couples of osculating ellipses, this can be a first step in searching for minimum distances between minor planets themselves. Perturbations by major planets continuously change the individual orbits, but the general geometrical picture remains the same; thus, one can expect that sooner or later two minor planets will be close enough to perturb each other's motion in a significant way, and even collisions cannot be ruled out. The regular features of the obtained distributions indicate their nonrandom nature, the reasons for which are to be found in the formation processes and/or in the later evolution of the minor planet belt under the influence of major planets.

Acknowledgments – This work has been supported by the Republic Fund for science in Serbia through the project "Physic and Motions of Celestial Bodies".

REFERENCES:

- Lazović, J.: 1967, *Bull. Inst. Teor. Astr. Akad. Nauk. SSSR*, XI, 1, 57.
- Lazović, J., Kuzmanoski, M.: 1978, *Publ. Dept. Astron. Beograd*, 8, 47.
- Lazović, J., Kuzmanoski, M.: 1979, *Publ. Dept. Astron. Beograd*, 9, 49.

МИНИМАЛНЕ ДАЉИНЕ ИЗМЕЂУ ПУТАЊА МАЛИХ ПЛАНЕТА
М. Кузманоски

Институт за астрономију, Студентски трг 16, Београд, Југославија

УДК 521.4
Претходно саопштење

За 3859 оскулаторних путања малих планета одређене су њихове међусобне минималне даљине са горњим границама од 0.001, 0.01 и 0.05 AU. Нађен је 21 пар са међусобним растојањима мањим од 150 km, од којих три пара са 7, 12 и 13 km. Расподела минималних даљина показује да је број

парова путања са мањим међусобним даљинама већи од броја парова путања са већим међусобним даљинама. Лонгитудинална расподела минималних даљина је бимодална, са два скоро идентична максимума и два нешто различита минимума.