THE TIME EVOLUTION OF PERIODIC COMET RUSSEL 3, 1983i

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Abstract. The orbit of the newly-discovered comet P/Russel 3 (1983i) is integrated backward and forward to study its evolution within time. Two close approaches with Jupiter in the limited calculation are found: one on December, 1941 and the other on May, 2024. Since its aphelion lies near the Jupiter orbit the orbit of P/Russel 3 appears to be rather unstable.

Periodic comet Russel 3 was discovered on June 1983 (Marsden, 1983a) on exposures taken with the 1.2-m Schmidt telescope at Siding Spring. The first orbit computed by Marsden (1983b) showed that this comet has a period of about 7 yr, which places the comet in the Jupiter family. Commenting on the characteristics of the orbit, Marsden (1983b) suggested that this comet might have made a close approach to Jupiter in 1965. In order to study the close encounters of this comet with that giant planet, we have integrated the orbit of comet P/Russel 3 backward and forward in time, taking into account the perturbations of all the planets. Due to the uncertainty in the elements, while integrating the orbit, we did not go to far into the past (nor into the future).

In order to perform this integration, we have found the necessary osculating elements using 34 observations made within the interval June 14–September 8, 1983 and taking into account the perturbations of all nine planets. The mean O–C residual is 1.5 arcsec. These elements are given in Table I.

The backward time integration of this orbit showed that the comet made a close approach to Jupiter on December 4, 1941, at which time the minimum distance between the two bodies was 0.069 AU.

The major effects of this encounter are to be found in the decrease of the perihelion distance from 4.54 to 2.51 AU, thus making possible the discovery of the comet, and in the eccentricity that increases from 0.09 to 0.34. The period diminishes from about 11.3 yr to the actual 7 and half, while the line of the apsides changes direction and now almost coincides with the nodal line. The elements at each perihelion passage are given in Table II, where we have also listed their evolution during the event. The 1938

TABLE I

Starting osculating elements for P/Russel 3

T_0 = 1982 Dec. 17.0		e = 0.344 341 84	
T = 1982 Nov. 23.156 10		i = 14°.099 14	1950.0
q = 2.510 406 35		ω = 353°.436 00	
a = 3.828 834 12		Ω = 248°.003 81	

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TABLE II

Osculating elements for comet P/Russel 3, 1983i. Equinox 1950.0

T_0	T	q	e	i	ω	Ω	a	P	Dj
1938 Dec. 8.0	1938 Dec. 7.69	4.5411	0.0992	18°.34	72°.37	258°.39	5.0414	11.32	1.71
1941 Aug. 23.0	1938 Dec. 4.78	4.5397	0.1004	20.35	75.10	255.26	5.0466	11.34	0.31
1941 Sep. 22.0	1938 Nov. 10.23	4.5281	0.0988	21.21	72.84	255.02	5.0247	11.26	0.23
1941 Oct. 2.0	1938 Oct. 24.00	4.5198	0.0978	21.65	71.17	254.94	5.0100	11.21	0.20
1941 Oct. 12.0	1938 Sep. 26.59	4.5062	0.0965	22.21	68.45	254.86	4.9875	11.14	0.17
1941 Oct. 22.0	1938 Aug. 11.41	4.4816	0.0948	22.96	63.77	254.80	4.9512	11.02	0.15
1941 Nov. 1.0	1938 May 21.20	4.4314	0.0937	23.97	55.18	254.74	4.8893	10.81	0.12
1941 Nov. 13.0	1937 Nov. 20.70	4.2714	0.1001	25.68	34.83	254.73	4.7466	10.34	0.09
1941 Nov. 21.0	1937 June 27.58	4.0095	0.1242	27.05	15.28	254.76	4.5783	9.80	0.08
1941 Nov. 25.0	1937 May 9.73	3.8062	0.1480	27.65	6.21	254.78	4.4673	9.44	0.07
1941 Nov. 27.0	1937 Apr. 25.73	3.6878	0.1631	27.88	2.35	254.80	4.4065	9.25	0.07
1941 Dec. 13.0	1945 May 14.68	2.7709	0.3036	26.27	348.55	254.65	3.9790	7.94	0.08
1941 Dec. 21.0	1945 Feb. 28.81	2.5586	0.3417	23.99	347.58	254.36	3.8868	7.66	0.09
1942 Jan. 10.0	1945 Jan. 16.37	2.4306	0.3659	19.85	347.77	253.49	3.8333	7.51	0.14
1942 Feb. 9.0	1945 Jan. 20.78	2.4494	0.3625	17.22	348.67	252.47	3.8421	7.53	0.22
1942 Mar. 11.0	1945 Jan. 29.47	2.4799	0.3567	16.09	349.35	251.77	3.8548	7.57	0.30
1945 Feb. 26.0	1945 Feb. 26.14	2.5641	0.3367	14.05	353.20	248.45	3.8656	7.60	5.18
1952 Oct. 11.0	1952 Oct. 10.45	2.5752	0.3354	14.04	353.34	248.38	3.8747	7.63	7.46
1960 May 19.0	1960 May 18.75	2.5626	0.3374	14.05	353.20	248.37	3.8673	7.61	3.11
1967 Dec. 4.0	1967 Dec. 3.54	2.5069	0.3447	14.09	353.42	248.13	3.8256	7.48	6.21
1975 June 6.0	1975 June 5.79	2.5095	0.3443	14.09	353.83	248.04	3.8274	7.49	6.72
1982 Dec. 17.0	1982 Nov. 23.16	2.5104	0.3443	14.10	353.44	248.00	3.8288	7.49	2.91
1990 May 17.0	1990 May 17.23	2.5173	0.3431	14.09	353.21	248.02	3.8324	7.50	7.18
1997 Nov. 18.0	1997 Nov. 17.90	2.5101	0.3440	14.10	353.45	247.95	3.8262	7.48	5.37
2005 June 25.0	2005 June 25.24	2.6028	0.3306	14.10	354.74	247.17	3.8880	7.67	3.95
2013 Feb. 28.0	2013 Feb. 27.46	2.6177	0.3288	14.08	354.68	247.14	3.9000	7.70	7.63
2020 Nov. 8.0	2020 Nov. 7.50	2.6051	0.3304	14.09	354.84	247.10	3.8902	7.67	4.40
2024 Jan. 11.0	2020 Nov. 5.68	2.6018	0.3332	15.50	358.69	242.97	3.9021	7.71	0.53
2024 Feb. 10.0	2020 Nov. 1.15	2.6171	0.3305	15.75	358.95	242.68	3.9091	7.73	0.49
2024 Mar. 1.0	2020 Oct. 27.82	2.6317	0.3279	15.93	359.11	242.50	3.9158	7.75	0.47
2024 Apr. 10.0	2020 Oct. 15.31	2.6733	0.3207	16.28	359.32	242.22	3.9355	7.81	0.44
2024 May 10.0	2020 Oct. 2.41	2.7151	0.3136	16.50	359.38	242.08	3.9556	7.87	0.44
2924 June 11.0	2020 Sep. 16.08	2.7664	0.3050	16.67	359.31	242.00	3.9805	7.94	0.45
2024 July 14.0	2020 Aug. 29.02	2.8210	0.2960	16.76	359.13	241.96	4.0073	8.02	0.47
2024 Aug. 13.0	2020 Aug. 12.91	2.8677	0.2885	16.77	358.91	241.96	4.0305	8.09	0.50
2024 Sep. 12.0	2028 Sep. 23.41	2.9093	0.2819	16.75	358.67	241.96	4.0513	8.15	0.54
2024 Oct. 12.0	2028 Sep. 29.93	2.9449	0.2763	16.70	358.42	241.96	4.0692	8.21	0.58
2024 Nov. 16.0	2028 Oct. 5.86	2.9794	0.2710	16.62	358.15	241.94	4.0868	8.26	0.64
2024 Dec. 16.0	2028 Oct. 9.73	3.0036	0.2673	16.56	357.94	241.92	4.0992	8.30	0.70
2025 Jan. 25.0	2028 Oct. 13.57	3.0296	0.2634	16.47	357.69	241.88	4.1128	8.34	0.77
2028 Jan. 18.0	2028 Oct. 22.86	3.1488	0.2455	15.86	357.06	240.15	4.1731	8.53	2.67

TABLE III

Osculating orbits (1950.0) for the second starting orbit

T_0	T	q	e	i	ω	Ω
1939 Jan. 19.0	1939 Jan. 18.85	3.0657	0.2904	14°.92	38°.96	257°.44
1982 Dec. 17.0	1982 Nov. 22.97	2.5102	0.3439	14.10	353.39	248.00
2028 Jan. 18.0	2028 Oct. 8.70	3.1958	0.2375	15.98	356.00	239.88

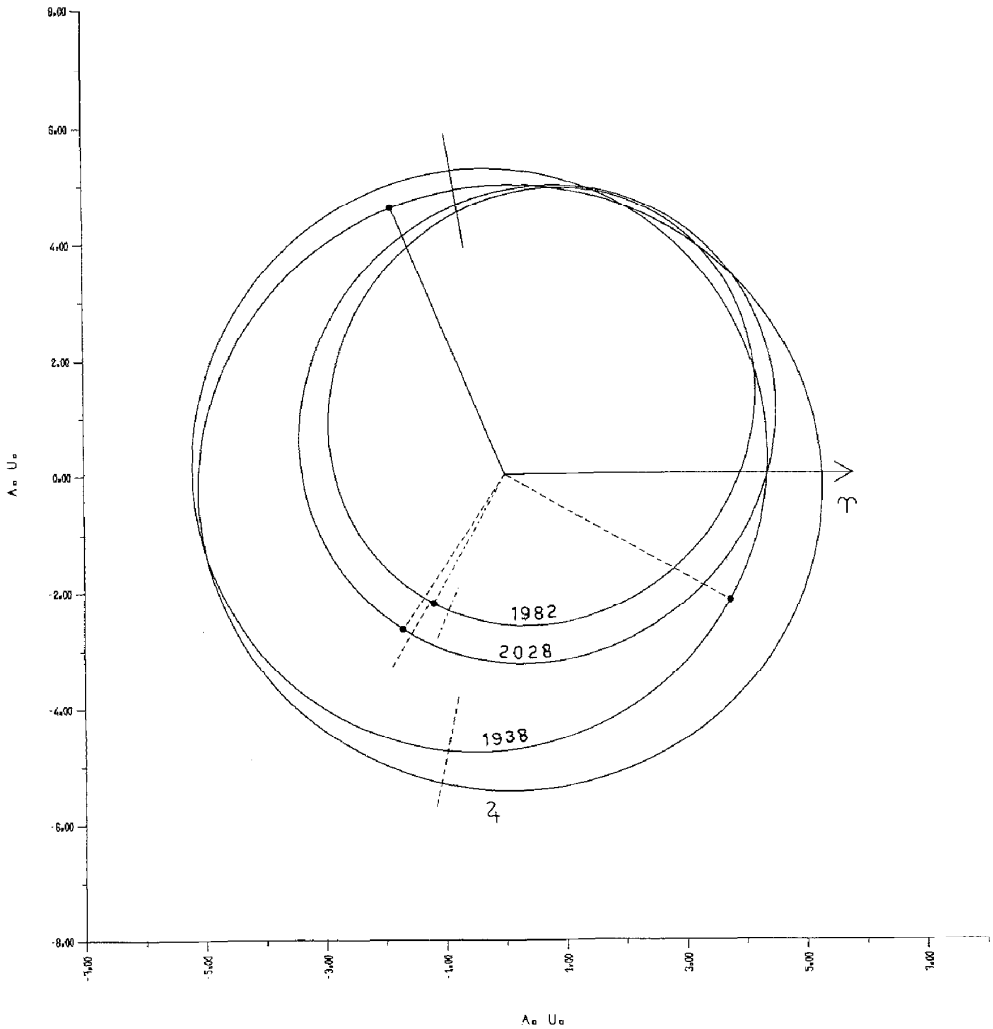

Fig. 1. The projected orbits of P/Russel 3. Dots, perihelia.

orbit, (see Table II), is rather interesting: in fact, it resembles – apart from the spatial orientation – the Jupiter orbit. The next return of this comet will allow us to better investigate the past evolution of this orbit, for at that time we shall have more precise elements.

Repeating the integration with Marsden's elements (1938c) as osculating orbit, the date of the encounter shifts by 9 days to November 25, 1941, and the minimum distance decreases to 0.053 AU. In spite of a deeper penetration in Jupiter's sphere of influence, the effects on the orbital elements are less dramatic than before. This time the comet period which precedes the close approach is about 9 yr, and the eccentricity 0.29. In

Table III we have listed the assumed starting orbit and the osculating orbits, computed during this new integration, before the 1941 and after the 2024 close encounters.

The next close approach with Jupiter will occur on May 9, 2024 when the minimum distance will be 0.403 AU. This time the period and the perihelion distance increase to 8.5 yr and to 3.15 AU, respectively. The eccentricity instead decreases to 0.25, while the lines of the apsides and of the nodes suffer minimal changes. Again in this case Table II lists all the relevant orbital elements.

The forward integration for the second initial orbit furnishes very similar results with respect to the next close encounter of May 21, 2024, and only slight changes can be found in the elements.

We have projected on the ecliptic the comet orbit before the 1941 and after the 2024 encounters, as well as its actual orbit and the Jupiter orbit, and have plotted them in Figure 1, where we have also drawn perihelion and nodal lines.

To conclude, it seems, as can be seen immediately from Figure 1, that the orbit of comet P/Russel 3 is such that encounters with Jupiter might have been and could be frequent, since the comet aphelion is very close to the Jupiter orbit. The next return of the comet P/Russel 3 and its consequent better orbit will allow us to learn more about its past history.

References

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