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A STUDY OF CHINESE ANCIENT COMETARY RECORDS

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ABSTRACT

From 146 B.C. to A.D. 1760, 363 sets of cometary observations have been recorded in Chinese Ancient Records of Celestial Phenomena. The positions of all recorded comets, or their paths, on the sky are compared. Taking into account the perturbations of all nine planets and using the numerical method of N-body problem, the orbits of well-recorded comets are calculated. Identification of a periodic comet is presented.

Key Words : ancient cometary records - Detemination of orbits - Identification of periodic comets

I. INTRODUCTION

In chinese history, there are a lot of astronomical observation records. *A Compilation of Chinese Ancient Records of Celestial Phenomena* (Zhaung et al, 1988) is a summary of all ancient and medieval astronomical observation records in China. Many obsrvation records of comets are found in this compilation. Some authors have calculated cometary orbits from those records (Ho, 1962; Kiang, 1972; Yeomans, 1977; Chang, 1979; Hasegawa, 1979, 1995; Marsden et al, 1996).

In this study, we reduce the 363 sets of cometary observation records from 146 B.C. to A.D.1760 . The orbital determination of all well-recorded comets have been carried out using the numerical method of N-body problem. Some possible identifications of periodic comets for comet 1106 and comet 1273 are presented.

II. REDUCTION OF OBSERVATION DATA IN CHINESE ANCIENT COMETARY RECORDS

According to the original records, the path of comet's motion in the sky could be drawn on the Huang-Yu Star Map of Song dynasty of China (Pan-Nai, 1989) (see Fig. 1). Thus, the cometary positions, right ascension (α) and declination (δ), are transfered to the mean equator and equinox at the beginning of the year in which the comet appeared.We have reduced 363 sets of original observation records of comets from 146 B.C. to 1760 A.D. , and transfered correlative mean equatorial coordinates.

III. DETERMINATION OF ORBITS

For further researches, we calculated the initial orbits using the Laplace method for 363 sets of original records. The numerical integrations of motion of all recorded comets are performed while taking into account the perturbations of nine planets using the method of the N-body problem. The correlative coordinates of the Sun and planets are derived by the formulas of Celestial Mechnics (Taff, 1985). Especially, there are 24 sets original records that have never been computed in 363 sets of original records (they are also not included in the *Catalogue of Cometary Orbits 1996*) (Mareden et al, 1996). We have determined the orbits of those un-computed older comets, and the results of calculation are presented in Table 1.

IV. IDENTIFICATION OF PERIODIC COMETS

In accordance with above numerical results, the possible, but unconfirmed identifications with periodic comets are suggested for the comet 1106 and comet 1273. They are found by comparing their recorded path. with their computed orbital elements and their ephemerides calculated with the different epoch.

The computed orbital elements for both comet 1106 and comet 1273 are listed in Table 2. We note that their orbits are very similar. Fig. 1 presents the paths of comet 1106 and comet 1273 in the sky, and the paths are connected very well. Using the calculated ephemerides with different epochs, we obtained the calculated paths for both comet 1106 and comet 1273. It is found that the calculated paths consist with original paths. Therefore, the comets 1106 and 1273 could be regarded as the same periodic comet.

The identifications of two periodic comets given here have only some apparitions. We expect that the final confirmation be made by re-observations in the future with the predictions given above, or with historical records of those comet in other countries.

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Table 1. The Results of Orbital Deteminations on 24 Sets Original Records*

Year	T	q	e	ω	Ω	i
39	39 Mar. 01.4	0.98737	0.98721	54.07898	3.00842	18.71765
71	71 June 10.4	0.99172	0.83278	159.20397	14.12984	5.02190
85	85 Feb. 08.4	0.97487	0.79144	103.19198	281.15499	18.26402
126	126 Apr. 06.3	0.98100	0.98222	66.87980	17.49233	24.13997
182	182 July 12.6	0.98396	0.82133	65.84104	284.43068	26.61377
238	238 Aug. 01.6	0.98550	0.98204	55.67655	3.71165	21.61418
423	422 Dec. 23.5	0.97821	0.98061	77.46354	350.90219	31.77956
634	634 Sep. 06.2	0.98499	0.98425	74.04375	0.75204	18.24092
681	681 Sep. 20.4	0.98328	0.98288	84.87823	359.04785	16.11659
821	821 Mar. 10.4	0.98711	0.98755	86.16057	351.69848	16.76175
838	838 Sep. 02.5	0.98292	0.98266	83.28904	358.90972	14.76800
839	839 Feb. 28.2	0.98823	0.81811	111.19195	351.43965	16.41886
975	975 June 20.4	0.95959	0.96821	65.80656	111.99850	13.45350
1003	1003 Apr. 10.6	0.51307	0.42900	165.58964	103.97443	10.27858
1005	1005 Aug. 01.4	0.98265	0.98246	81.18460	4.78212	21.71755
1021	1021 May 01.1	1.10194	0.95389	338.91832	6.98715	12.39542
1106	1106 Apr. 09.6	0.86884	0.97062	314.55216	208.18775	6.55664
1123	1123 Feb. 15.3	0.98134	0.98181	91.37542	353.82825	16.72633
1161	1161 June 27.2	0.98728	0.98481	106.64327	335.04799	15.48275
1273	1273 Apr. 12.3	0.84254	0.97221	315.71322	206.05811	6.65117
1430	1430 Sep. 09.1	0.98299	0.98342	58.08890	34.65840	14.90296
1496	1495 Dec. 21.1	0.98518	0.97831	88.31003	13.07164	5.99337
1502	1502 Dec. 05.2	0.98251	0.96686	355.92253	257.64382	12.74256
1536	1536 Mar. 13.8	0.98610	0.98370	241.42768	211.91450	14.31845

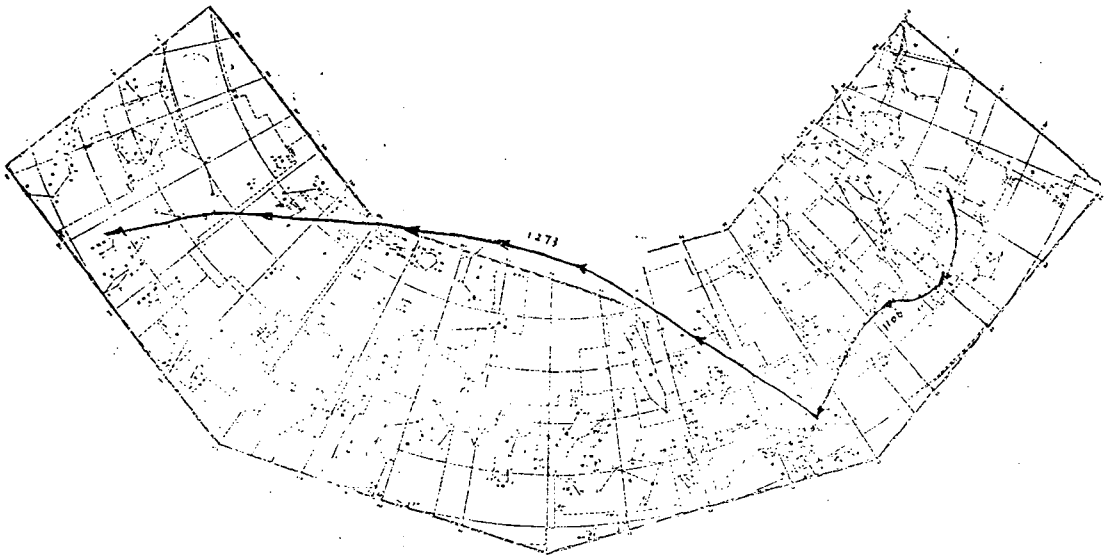

Fig. 1.

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Table 2. Orbital Element for Comets 1106 & 1273 *

Elements	Comet 1106	Comet 1273
Epoch	1106 March 10.5	1273 April 20.6
T	1106 April 09.6	1273 April 13.6
q	0.86884	0.84254
e	0.97060	0.97221
a	29.57249	30.31810
P	160.81702	166.93714
ω	314.55216	315.71322
Ω	208.18775	206.05811
i	6.55664	6.65117

* The successive columns in Table 1 and Table 2 signify:
Year = year of observation records of comets.
T = perihelion time. (in UT). q = perihelion distance (in AU).
e = eccentricity. a = simimajor axis (in AU)
P = revolution period (in years).
ω = argument of perihelion (in degree), equinox 2000.0.
Ω = longitude of the ascending node (in degree), equinox 2000.0.
i = inclination (in degree), equinox 2000.0.
epoch = osculation date of orbital detemination (in UT).