

# Appendices

## COMETARY APPARITIONS: 1990 - 2010

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### 1. Chronological Listing of Periodic Comet Elements, 1990 - 2010

Table A1 lists osculating orbital elements (chronologically by perihelion passage time) for all periodic comets expected to arrive at perihelion during the 1990 - 2010 interval. Following the name of the comet, the successive columns list the comet's perihelion passage time (E.T.), the argument of perihelion, the longitude of the ascending node, the inclination, the perihelion distance (AU), and the eccentricity. While not given, the epoch of osculation in each case is the Julian date (less 0.5) nearest to the perihelion passage time that is evenly divisible by 40. The three angular elements (Peri., Node, Incl.) are referred to the ecliptic plane and the mean equinox of 1950.0. In the final column are letter codes designating the relative accuracy of the orbital elements.

- A Highest accuracy. Observations from three or more apparitions have been fitted and nongravitational effects have been included in the computations if appropriate. If nongravitational effects exist, they are nearly time-independent.
- B Observations from three or more apparitions have been fitted with the inclusion of nongravitational effects. While these effects vary with time, no attempt has been made to model the time dependences.
- C The orbit is based upon observations from only two apparitions and no attempt has been made to include nongravitational effects.
- D The orbit is based upon observations from only one apparition and no attempt has been made to include nongravitational effects.

- E Same as D above except a close Jupiter approach occurred, further degrading the errors in the listed orbital elements.

The accuracy of the "A" orbits listed in the early portion of Table A1 should be less than, or on the order of, 0.1 day in perihelion passage (the most uncertain orbital element). The corresponding accuracy for "D" and "E" orbits could be the better part of a day. For a given comet, the orbits toward the end of Table A1 are extrapolated further and hence are less accurate than earlier orbits; for "D" and "E" orbits, the perihelion passage time errors could reach a few days near the end of the table.

## 2. Observing Conditions for the Periodic Comets from 1990 to 2010

The following plots, presented alphabetically, allow the user to easily determine the Earth-based viewing conditions of a particular cometary apparition. These plots were drawn in a rotating coordinate system so that the Sun-Earth line is fixed for each apparition. A comet's (often peculiar) apparent motion on the sky is represented from 150 days before perihelion (-150) to 150 days after perihelion (+150). Small circles are drawn every 30 days along the comet's path, with the perihelion circle filled in. For each plot, the Sun is in the center, with the Earth's fixed location denoted with an "E" for the various years of the comet's perihelion passages. The sign of the ram's horn represents the location of the vernal equinox, but only for the times of the comet's perihelion. The position of the Earth at the vernal equinox direction (at 3 o'clock) corresponds approximately to September 21. Likewise the Earth's positions at 12, 9, and 6 o'clock correspond to about December 21, March 21, and June 21.

As an example, consider the first plot for the 1991, 1999, and 2007 apparitions of comet Arend. Just from the plot itself, one can say that the 1991 perihelion time is late May and the viewing conditions are dreadful around perihelion, since the comet is near solar conjunction. However, the viewing conditions for the 2007 apparition are about as good as they can be, with the comet reaching opposition and perihelion nearly simultaneously in early November. From the plot alone, the perihelion distance can be estimated as 2 AU, and good solar elongation angles exist for the entire interval from 150 days before perihelion to 150 days after perihelion.

Because these plots are ecliptic plane projections, the plots for two highly inclined comets (Tuttle, Hartley-Iras) are misleading and have been omitted. A Jupiter close approach of comet Kowal 2 in March 2007 will make significant changes in this comet's orbit. Hence, there are separate plots for this comet before and after 2007. There are also two separate plots for comet Schwassmann-Wachmann 2 because of orbital changes during the Jupiter close approach in March 1992.

Comet	T	Peri	Node	Incl.	q	e	Code
Kopff	1990 01 20.3725	162.8291	120.2891	4.7205	1.585125	0.542991	A
Tuttle-Giacobini-Kresak	1990 02 08.2082	61.5842	140.8769	9.2300	1.067981	0.655763	A
Sanguin	1990 04 02.1976	162.8380	181.8139	18.7221	1.813632	0.663210	C
Russell 3	1990 05 17.8860	353.2243	248.0158	14.0875	2.517249	0.343269	C
Schwassmann-Wachmann 3	1990 05 19.3431	198.7706	69.2713	11.4110	0.936273	0.694015	A
Peters-Hartley	1990 06 21.6005	338.3133	259.3949	29.8326	1.625775	0.597750	D
Russell 4	1990 07 06.8304	92.9874	70.3963	6.1896	2.222186	0.366319	D
Tritton	1990 07 08.5749	147.7416	299.9536	7.0465	1.435695	0.580754	D
Honda-Mrkos-Pajdusakova	1990 09 12.7771	325.7354	88.6612	4.2246	0.541253	0.821884	A
Encke	1990 10 28.5450	186.2444	334.0410	11.9391	0.330886	0.850220	A
Johnson	1990 11 18.9631	208.2766	116.6736	13.6645	2.312561	0.366148	A
Kearns-Kwee	1990 11 22.6078	131.8347	315.0276	9.0071	2.215383	0.486628	A
Wild 2	1990 12 16.9253	41.5729	135.5763	3.2494	1.578058	0.540983	A
Taylor	1990 12 28.9296	355.5779	108.1833	20.5536	1.950364	0.465565	C
Russell 1	1991 01 04.5376	333.7406	225.8095	17.7562	2.174937	0.438361	C
Swift-Gehrels	1991 02 22.6774	84.8478	313.7178	9.2500	1.355116	0.691610	C
Wolf-Harrington	1991 04 04.8292	186.9747	254.1712	18.4730	1.607836	0.539050	A
Haneda-Campos	1991 04 09.5407	305.4469	67.1606	4.9324	1.224680	0.640280	D
van Biesbroeck	1991 04 24.7126	134.1475	148.4399	6.6195	2.400909	0.552661	A
Hartley 1	1991 04 28.7521	179.4713	38.3006	25.5651	1.795450	0.451536	D
Arend	1991 05 26.0220	47.0686	355.4964	19.9289	1.850061	0.537033	A
Harrington-Abell	1991 07 06.9277	138.6754	336.6354	10.1766	1.774389	0.540439	A
Kowal-Mrkos	1991 07 18.8361	315.8743	244.8049	5.3206	2.669622	0.394069	E
Machholz	1991 07 22.0127	14.5291	93.8227	60.1470	0.125548	0.958369	D
Takamizawa	1991 08 18.4266	147.6443	124.2507	9.4838	1.589706	0.574664	D
Tsuchinshan 1	1991 08 30.5315	22.7558	96.1846	10.5032	1.497517	0.576321	A
Hartley 2	1991 09 17.2624	174.9530	226.0631	9.2546	0.952535	0.720142	D
Wirtanen	1991 09 20.6842	356.1465	81.6136	11.6825	1.083283	0.652255	A
Arend-Rigaux	1991 10 02.7180	329.0588	121.4520	17.8877	1.437822	0.600052	A
Faye	1991 11 16.1937	203.9538	198.8801	9.0909	1.593385	0.578184	A
Shoemaker 1	1991 12 18.6962	18.7849	339.2485	26.2365	1.985828	0.470388	D
Kowal 2	1991 12 28.4311	189.6497	247.0161	15.8350	1.499590	0.567595	D
Chernykh	1992 01 27.8217	263.1970	129.7458	5.0824	2.356322	0.593758	D
Giacobini-Zinner	1992 04 13.2279	172.5210	194.6822	31.8280	1.034003	0.706489	B
Tsuchinshan 2	1992 05 20.0936	203.1607	287.5937	6.7151	1.782157	0.504409	A
Kowal 1	1992 06 12.8814	181.2877	28.0594	4.3535	4.673356	0.234413	D
Grigg-Skjellerup	1992 07 22.1375	359.2759	212.6316	21.1042	0.994689	0.664325	A
Smirnova-Chernykh	1992 08 05.9350	88.9384	76.8382	6.6282	3.572144	0.147314	C
Shoemaker 2	1992 08 06.8754	317.6267	54.7489	21.5489	1.327099	0.664641	D
du Toit-Hartley	1992 08 27.6148	251.5652	308.5623	2.9381	1.197161	0.601614	A
Wolf	1992 08 28.1290	162.2923	203.4405	27.4834	2.427704	0.405599	A
Daniel	1992 09 01.6709	10.9917	68.3700	20.1340	1.649451	0.551964	A
Schuster	1992 09 06.3881	355.7183	49.9189	20.1303	1.539236	0.589521	D
Giclas	1992 09 13.0919	276.4405	111.8726	7.2865	1.846795	0.493212	C
Singer-Brewster	1992 10 28.1526	46.6738	191.9042	9.1990	2.026714	0.413900	D

Comet	T	Peri	Node	Incl.	q	e	Code
Ciffreo	1993 01 22.5504	358.0191	53.0341	13.0856	1.708788	0.543105	D
Howell	1993 02 27.0516	234.9864	56.8280	4.3837	1.408920	0.552162	A
Schaumasse	1993 03 03.6470	57.4376	80.3821	11.8446	1.202173	0.704806	B
Forbes	1993 03 14.5868	310.5492	333.7526	7.1527	1.446635	0.568092	A
Holmes	1993 04 10.7345	23.2337	327.3390	19.1647	2.176763	0.410411	A
Vaisala 1	1993 04 29.1570	47.3600	134.3990	11.6014	1.783030	0.634709	A
Wiseman-Skiff	1993 06 04.5580	171.9208	270.9395	18.1851	1.509130	0.567864	D
Lovas 2	1993 06 07.5831	71.6226	282.7660	1.5253	1.462700	0.591539	D
Slaughter-Burnham	1993 06 22.1657	44.0784	345.7450	8.1492	2.542748	0.503623	C
Urata-Niijima	1993 07 13.2654	21.4720	31.2229	24.2086	1.456627	0.587835	D
Ashbrook-Jackson	1993 07 14.0510	348.6858	1.9706	12.4944	2.316283	0.394904	A
Gehrels 3	1993 07 25.4311	231.8790	242.3328	1.1025	3.426998	0.150749	C
Neujmin 3	1993 11 13.1573	146.9839	149.7675	3.9929	2.001542	0.586002	A
van Houten	1993 11 14.6334	37.9557	0.3862	7.2377	4.154853	0.368103	D
Shajn-Schaldach	1993 11 15.9895	216.5464	166.2034	6.0837	2.344551	0.387678	B
West-Kohoutek-Ikemura	1993 12 25.3058	359.9618	83.4809	30.5412	1.576806	0.543265	A
Schwassmann-Wachmann 2	1994 01 23.8986	358.1440	125.6223	3.7572	2.070268	0.398744	B
Encke	1994 02 09.4584	186.2805	334.0204	11.9344	0.330912	0.850211	A
Kojima	1994 02 17.9950	348.3869	154.2540	0.8841	2.399068	0.392645	A
Tempel 2	1994 03 16.8162	194.8570	117.5760	11.9783	1.483536	0.522447	A
Maury	1994 03 19.4103	119.7740	176.1322	11.6969	2.028007	0.522232	D
Hartley 3	1994 05 20.3786	168.5198	287.1459	11.6915	2.461890	0.316748	D
Tuttle	1994 06 26.9686	206.7136	269.8462	54.6906	0.997951	0.824078	A
Bus	1994 06 28.1143	24.4274	181.5014	2.5794	2.182989	0.374676	C
Reinmuth 2	1994 06 29.6894	45.9233	295.4269	6.9786	1.893066	0.464095	A
Kohoutek	1994 06 29.9314	175.8624	268.9252	5.9068	1.784643	0.496309	A
Tempel 1	1994 07 03.3078	178.8678	68.3199	10.5501	1.494152	0.520223	A
Wild 3	1994 07 21.2035	179.2453	71.9502	15.4517	2.299509	0.366064	D
Harrington	1994 08 23.2527	233.4169	118.5996	8.6595	1.571901	0.561336	A
Brooks 2	1994 09 01.0882	197.9897	176.2464	5.5481	1.843340	0.490731	B
Russell 2	1994 10 24.6428	249.4470	41.7185	12.0175	2.279217	0.398865	D
Borrelly	1994 11 01.4975	353.3445	74.7365	30.2696	1.365107	0.622806	A
Whipple	1994 12 22.3751	201.8797	181.7931	9.9337	3.093824	0.258716	A
de Vico-Swift	1995 01 20.8140	1.0524	358.8990	5.9899	2.129360	0.433175	D
Finlay	1995 05 05.0335	323.4686	41.4189	3.6692	1.035556	0.710302	A
Clark	1995 05 31.2677	208.7959	59.0632	9.5024	1.552498	0.502069	A
d'Arrest	1995 07 27.3620	178.0388	138.2998	19.5285	1.345869	0.614040	B
Tuttle-Giacobini-Kresak	1995 07 28.6423	61.6814	140.8212	9.2303	1.065197	0.656420	A
Reinmuth 1	1995 09 03.3151	13.2504	119.0813	8.1329	1.873622	0.502486	A
Schwassmann-Wachmann 3	1995 09 22.7987	198.7346	69.2820	11.4221	0.932758	0.694830	A
Jackson-Neujmin	1995 10 06.6032	200.3395	160.0265	13.4842	1.381124	0.661429	A
Longmore	1995 10 09.3253	195.7931	14.9622	24.4038	2.398973	0.343059	A
Honda-Mrkos-Pajdusakova	1995 12 26.2279	326.0051	88.5071	4.2532	0.532040	0.824251	A
Pons-Winnecke	1996 01 02.4617	172.2965	92.7455	22.3023	1.255892	0.634425	A
Churyumov-Gerasimenko	1996 01 17.6571	11.3439	50.3504	7.1096	1.300034	0.630205	A

Comet	T	Peri	Node	Incl.	q	e	Code
duToit-Neujmin-Delporte	1996 03 05.6444	115.2369	188.2657	2.8510	1.719717	0.500761	A
Mueller	1996 04 25.3622	29.9236	3.8681	8.7892	2.739528	0.337460	D
Denning-Fujikawa	1996 06 02.0972	337.5619	35.7224	9.1305	0.789729	0.817917	D
Comas Sola	1996 06 10.4501	45.7406	60.1972	12.9140	1.846362	0.567790	B
Kopff	1996 07 02.1840	162.7631	120.2823	4.7245	1.579523	0.544079	A
Parker-Hartley	1996 07 07.0559	181.1741	243.3830	5.1922	3.044213	0.292763	D
Gunn	1996 07 24.4345	196.7873	67.8553	10.3780	2.461920	0.316318	A
Machholz	1996 10 15.1298	14.5789	93.8372	60.0751	0.124719	0.958637	D
IRAS	1996 10 31.5938	356.8871	357.0032	45.9564	1.702754	0.696648	D
Helin-Roman-Crockett	1996 11 01.4475	10.1109	91.3703	4.2309	3.489729	0.138739	D
Tritton	1996 11 05.0126	147.6286	299.9723	7.0454	1.436363	0.580612	D
Russell 4	1997 02 03.4994	93.2144	70.3285	6.1863	2.229251	0.365105	D
Wirtanen	1997 03 14.3373	356.3186	81.5259	11.7231	1.063724	0.656766	A
Helin-Roman-Alu 1	1997 03 27.7802	215.1302	72.8058	9.7419	3.716630	0.175389	D
Hartley 1	1997 04 02.9011	179.6478	38.2568	25.5652	1.795226	0.451559	D
Boethin	1997 04 17.7622	22.3089	13.7401	4.8708	1.158197	0.774358	C
Wild 2	1997 05 06.6533	41.6992	135.5280	3.2481	1.582620	0.540225	A
Encke	1997 05 23.5778	186.2813	334.0133	11.9237	0.331391	0.850013	A
Gehrels 2	1997 08 07.0814	192.8027	209.8968	6.2631	2.000342	0.463570	C
Haneda-Campos	1997 08 15.7955	306.9793	65.9821	4.9452	1.266977	0.631975	D
Grigg-Skjellerup	1997 08 30.3029	359.3425	212.6004	21.0920	0.996810	0.663806	A
Wolf-Harrington	1997 09 29.2332	187.1545	254.0376	18.5113	1.581824	0.543981	A
Johnson	1997 10 31.8500	207.9684	116.6779	13.6678	2.308307	0.367259	A
du Toit-Hartley	1997 11 14.5252	251.7082	308.4477	2.9348	1.200685	0.600768	A
Russell 3	1997 11 19.1698	353.4603	247.9458	14.0974	2.510067	0.344088	D
Shoemaker-Holt 1	1997 11 21.1651	210.2720	213.7750	4.3667	3.047027	0.321381	D
Taylor	1997 12 12.3665	355.3991	108.1716	20.5489	1.948005	0.465939	C
Hartley 2	1998 01 07.5715	180.9909	219.2042	13.5433	1.034350	0.700403	D
Tempel-Tuttle	1998 02 28.0110	172.5238	234.5826	162.4915	0.976538	0.905509	A
Tsuchinshan 1	1998 04 18.9417	22.7333	96.1465	10.4970	1.495869	0.576598	A
Klemola	1998 05 01.6776	154.5425	174.8446	11.0952	1.754500	0.641322	C
Kowal 2	1998 05 08.8438	194.1236	242.9870	14.5111	1.349210	0.599686	D
Arend-Rigaux	1998 07 12.5982	330.5448	121.0468	18.2944	1.368582	0.611544	A
Peters-Hartley	1998 08 07.7030	338.4184	259.2974	29.8542	1.623906	0.597849	D
Russell 1	1998 08 26.1055	333.9019	225.7244	17.7501	2.182451	0.437500	C
Howell	1998 09 28.3957	235.1268	56.7690	4.3827	1.405951	0.552774	A
Lovas 1	1998 10 14.5843	74.5002	339.3159	12.2304	1.691776	0.613141	D
Takamizawa	1998 11 09.6768	147.7681	124.1776	9.4946	1.585128	0.575292	D
Kowal-Vavrova	1998 11 15.2018	18.9649	201.5408	4.3505	2.577260	0.586659	D
Giacobini-Zinner	1998 11 21.3135	172.5468	194.6963	31.8648	1.033712	0.706481	B
Harrington-Abell	1999 01 27.8709	138.9114	336.5792	10.2124	1.755990	0.542911	A
Tsuchinshan 2	1999 03 08.2134	203.2495	287.4509	6.7139	1.770381	0.506364	A
Shoemaker 1	1999 03 17.9317	18.6966	339.2711	26.2547	1.979472	0.471559	D
Singer-Brewster	1999 04 08.2653	46.8313	191.8332	9.1940	2.032443	0.412890	D
Bowell-Skiff	1999 04 27.5820	173.0860	342.7460	3.8316	1.972346	0.691096	D

Comet	T	Peri	Node	Incl.	q	e	Code
Forbes	1999 05 03.8631	310.7134	333.6631	7.1562	1.445799	0.568153	A
Faye	1999 05 06.1370	204.9912	198.6242	9.0545	1.656975	0.568266	A
Arend	1999 08 03.7443	48.9920	354.6846	19.1726	1.916700	0.530350	A
Giclas	1999 08 25.1321	276.3741	111.8350	7.2847	1.845831	0.493641	C
Tempel 2	1999 09 08.4247	194.9972	117.5388	11.9798	1.481679	0.522818	A
Kearns-Kwee	1999 09 16.1682	127.4613	312.3086	9.3479	2.339244	0.476525	A
Schuster	1999 12 16.1838	355.8461	49.9063	20.1352	1.549727	0.587919	D
Wild 1	1999 12 27.3961	167.9950	357.8285	19.9275	1.960834	0.649735	C
Tempel 1	2000 01 02.6070	178.8782	68.3007	10.5396	1.500049	0.518952	A
Wiseman-Skiff	2000 01 12.1896	172.8341	270.3544	18.2901	1.569238	0.556572	D
Urata-Nijima	2000 03 03.7705	21.4475	31.2542	24.1993	1.457867	0.587738	D
Lovas 2	2000 03 14.1183	71.7848	282.6443	1.5272	1.454006	0.592928	D
Ciffreo	2000 04 17.3662	358.0268	53.0461	13.0883	1.713384	0.542558	D
Swift-Gehrels	2000 04 21.5815	92.4470	305.4106	8.4337	1.338822	0.694617	C
Holmes	2000 05 11.7935	23.3595	327.3030	19.1822	2.165496	0.412017	A
West-Kohoutek-Ikemura	2000 06 01.0831	0.0567	83.4381	30.5000	1.595875	0.539819	A
Shoemaker 2	2000 06 15.5333	317.7456	54.6782	21.5932	1.319000	0.665818	D
Daniel	2000 06 23.6395	18.9797	65.8960	22.4079	2.157498	0.463555	A
Encke	2000 09 09.6420	186.4923	333.8922	11.7498	0.339533	0.846897	A
Kojima	2000 09 14.8379	1.9167	118.6470	6.6030	2.003289	0.454488	A
Kowal-Mrkos	2000 10 26.8176	316.0568	244.6563	5.3185	2.684845	0.393330	E
Wolf	2000 11 21.0655	162.3697	203.4163	27.5284	2.412632	0.407149	A
Clark	2000 12 02.7390	208.7882	59.0325	9.4926	1.559087	0.500658	A
Bus	2000 12 29.9628	24.1767	181.4868	2.5806	2.180776	0.375076	C
Ashbrook-Jackson	2001 01 06.4838	348.8806	1.9072	12.5069	2.305361	0.396092	A
Tuttle-Giacobini-Kresak	2001 01 06.5758	62.1863	140.4301	9.2307	1.052179	0.659314	A
Smirnova-Chernykh	2001 01 15.6642	86.5975	76.5136	6.6513	3.545787	0.148327	C
Schwassmann-Wachmann 3	2001 01 27.2327	198.7432	69.2558	11.4043	0.937347	0.693786	A
Reinmuth 2	2001 02 20.0189	46.1486	295.3260	6.9780	1.889724	0.464510	A
Kohoutek	2001 02 27.3738	175.7528	268.9218	5.9095	1.787280	0.496161	A
Hartley 3	2001 03 20.7742	168.0300	287.0159	11.6846	2.479136	0.314359	D
Honda-Mrkos-Pajdusakova	2001 03 30.3292	326.0842	88.4331	4.2604	0.528402	0.825101	A
Schaumasse	2001 05 02.1017	57.8294	79.1577	11.7498	1.205017	0.704830	B
Shajn-Schaldach	2001 05 09.1411	216.6328	166.1924	6.0907	2.330098	0.389490	B
Harrington	2001 06 05.9424	233.5647	118.5175	8.6600	1.568142	0.561845	A
Wild 3	2001 06 18.5367	179.1369	71.9371	15.4373	2.310332	0.364456	D
Brooks 2	2001 07 19.8487	198.1074	176.2141	5.5549	1.834899	0.491929	B
Gehrels 3	2001 09 03.0644	228.2411	238.6989	1.1299	3.626642	0.125672	C
Borrelly	2001 09 14.7363	353.3610	74.7375	30.3235	1.358185	0.623898	A
Helin	2001 09 26.3497	215.3679	142.8805	4.7227	2.530729	0.565755	D
Machholz	2002 01 08.7226	14.5734	93.9136	60.1876	0.124105	0.958812	D
Schwassmann-Wachmann 2	2002 01 18.5521	18.3357	113.5618	4.5521	3.408851	0.195241	B
d'Arrest	2002 02 03.6742	178.1051	138.2554	19.5022	1.352823	0.612805	B
Finlay	2002 02 07.1652	323.5632	41.3405	3.6701	1.034100	0.710510	A
Russell 2	2002 03 19.7904	249.4961	41.6644	12.0037	2.292839	0.397105	D

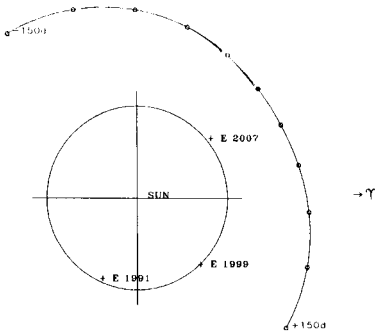
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de Vico-Swift	2002 05 07.1575	1.2625	358.8137	5.9879	2.127853	0.433291	D
Pons-Winnecke	2002 05 15.7369	172.2755	92.7679	22.2857	1.258149	0.634078	A
Gehrels 1	2002 06 23.0110	28.1835	12.8424	9.6104	2.965523	0.508859	C
duToit-Neujmin-Delporte	2002 07 31.0697	115.2692	188.2080	2.8498	1.729537	0.499095	A
Churyumov-Gerasimenko	2002 08 18.3116	11.4090	50.3128	7.1167	1.292340	0.631528	A
Wirtanen	2002 08 27.0749	356.3725	81.4946	11.7387	1.058726	0.657860	A
Longmore	2002 09 04.7375	196.4441	14.2826	24.3972	2.309550	0.358190	A
Sanguin	2002 09 23.0553	163.0526	181.6489	18.7709	1.807428	0.663372	C
Grigg-Skjellerup	2002 11 29.7167	1.6337	211.0321	22.3526	1.117872	0.632710	A
Kopff	2002 12 12.0646	162.6860	120.2977	4.7222	1.583575	0.543302	A
Shoemaker 3	2002 12 15.0242	14.8858	96.6291	6.3877	1.813722	0.726741	D
Reinmuth 1	2002 12 24.3743	13.2462	119.0983	8.1343	1.877526	0.502108	A
Maury	2002 12 27.3149	119.8217	176.0571	11.6850	2.043415	0.520672	D
Neujmin 1	2002 12 27.3619	346.9227	346.3339	14.1794	1.552038	0.775628	A
du Toit-Hartley	2003 02 15.3290	253.1644	307.1767	2.8899	1.229972	0.594100	A
Tritton	2003 03 06.0230	147.7381	299.8862	7.0598	1.428173	0.582079	D
Gunn	2003 05 11.9334	196.3440	67.7541	10.3816	2.445920	0.318682	A
Whipple	2003 07 06.5556	202.2153	181.6965	9.9393	3.088203	0.259098	A
du Toit 1	2003 08 28.2336	257.2429	21.5243	18.6951	1.274280	0.787683	C
Russell 4	2003 08 29.2305	92.8851	70.2972	6.1831	2.231123	0.364849	D
Hartley 1	2003 09 01.4365	187.2461	36.1576	25.5192	2.127536	0.387254	D
Wild 2	2003 09 25.9857	41.6832	135.5130	3.2457	1.590364	0.538794	A
van Biesbroeck	2003 10 09.4879	134.0727	148.3310	6.6160	2.415385	0.551995	A
Encke	2003 12 29.8448	186.5074	333.8797	11.7639	0.338457	0.847339	A
Jackson-Neujmin	2004 01 10.0065	200.4238	159.9241	13.4616	1.388620	0.660472	A
Haneda-Campos	2004 01 10.1738	307.0361	65.9606	4.9417	1.274328	0.630646	D
Vaisala 1	2004 01 22.8598	47.1633	134.0557	11.5438	1.795931	0.633066	A
Wolf-Harrington	2004 03 17.9047	187.2965	253.9758	18.5214	1.578632	0.544599	A
Howell	2004 04 14.0246	236.0753	55.9134	4.3669	1.367082	0.561320	A
Hartley 2	2004 06 12.8306	181.0770	219.1488	13.5255	1.039113	0.699515	D
Schwassmann-Wachmann 1	2004 07 10.8369	48.9835	311.9905	9.3873	5.723567	0.044172	A
Neujmin 3	2004 07 16.2005	147.1332	149.7273	3.9915	2.015078	0.585041	A
Kowal 2	2004 07 19.5411	194.2622	242.9224	14.5073	1.349618	0.599667	D
Mueller	2004 10 01.5148	30.1795	3.7662	8.7802	2.746883	0.336847	D
Johnson	2004 10 11.9694	207.6725	116.6537	13.6616	2.309977	0.366506	A
Gehrels 2	2004 10 27.2197	192.9949	209.8164	6.2581	2.008260	0.462528	C
Taylor	2004 11 30.5357	355.5534	108.1101	20.5652	1.942020	0.466879	C
Tsuchinshan 1	2004 12 07.7363	22.8157	96.1042	10.5041	1.489266	0.577803	A
Helin-Roman-Crockett	2004 12 28.1194	10.5428	91.3187	4.2327	3.473504	0.140294	D
Slaughter-Burnham	2005 01 14.7542	44.0686	345.5723	8.1489	2.534897	0.503930	C
Tempel 2	2005 02 15.0423	195.5328	117.1761	12.0208	1.426862	0.535387	A
Arend-Rigaux	2005 02 24.5616	330.6851	120.9658	18.3058	1.368542	0.611596	A
Comas Sola	2005 04 01.2432	45.8018	60.1193	12.9252	1.833011	0.569238	B
Parker-Hartley	2005 06 19.0914	181.4863	243.2498	5.1940	3.044287	0.292767	D
Denning-Fujikawa	2005 06 23.6817	337.5768	35.7016	9.1115	0.796242	0.817006	D



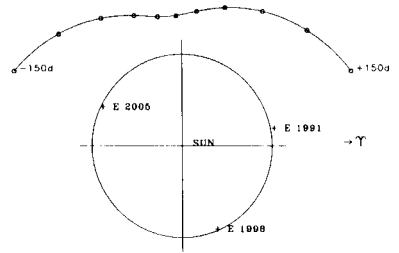
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Russell 3	2005 06 26.7384	354.7361	247.1704	14.0942	2.601985	0.330766	D
Hartley-IRAS	2005 06 26.8446	47.0771	0.6985	95.6906	1.275190	0.835164	D
Giacobini-Zinner	2005 07 02.7788	172.5453	194.7286	31.8168	1.037893	0.705695	B
Tempel 1	2005 07 05.2996	178.8060	68.2716	10.5283	1.506168	0.517489	A
Forbes	2005 07 31.8555	329.2908	314.3585	8.9606	1.572013	0.541397	A
Singer-Brewster	2005 09 14.0228	46.6752	191.7602	9.1860	2.041233	0.411068	D
Helin-Roman-Alu 1	2005 12 20.2010	222.7013	58.2282	8.7034	3.037075	0.255504	D
Tsuchinshan 2	2005 12 24.1034	203.4196	287.3755	6.7158	1.766378	0.507127	A
Chernykh	2005 12 29.6910	263.1305	129.6148	5.0844	2.350589	0.593977	D
Takamizawa	2006 03 10.7820	157.8227	114.1809	10.5445	1.663781	0.562120	D
Russell 1	2006 04 08.1562	333.7885	225.7059	17.7728	2.172077	0.438902	C
Schwassmann-Wachmann 3	2006 06 06.2466	198.7749	69.2307	11.3931	0.939132	0.693208	A
Clark	2006 06 08.3056	208.6957	58.9932	9.4853	1.562006	0.499939	A
Shoemaker 1	2006 06 08.6744	18.5770	339.2408	26.2468	1.973637	0.472315	D
Tuttle-Giacobini-Kresak	2006 06 10.6467	62.2122	140.4099	9.2344	1.047704	0.660377	A
Honda-Mrkos-Pajdusakova	2006 06 30.3789	326.0720	88.4610	4.2581	0.530231	0.824512	A
Giclas	2006 08 07.4579	276.2837	111.8194	7.2840	1.851721	0.492417	C
Harrington-Abell	2006 08 14.7638	139.0977	336.4692	10.2144	1.757118	0.542856	A
Wiseman-Skiff	2006 09 13.8275	172.9133	270.3277	18.2648	1.577398	0.555173	D
Peters-Hartley	2006 09 20.2033	338.6308	259.1689	29.8957	1.633891	0.595961	D
Urata-Nijima	2006 10 28.6654	21.4375	31.2383	24.1620	1.464704	0.586452	D
Faye	2006 11 15.5028	205.0327	198.5935	9.0370	1.667312	0.566706	A
West-Kohoutek-Ikemura	2006 11 19.4449	0.1086	83.4207	30.4592	1.603450	0.538446	A
Lovas 2	2006 11 27.2638	76.6927	278.1922	1.5471	1.399811	0.602798	D
Schuster	2007 04 02.1631	355.8172	49.9293	20.1078	1.556144	0.586799	D
Machholz	2007 04 04.7534	14.6109	93.8559	59.9561	0.124618	0.958686	D
Encke	2007 04 19.2633	186.5313	333.8638	11.7486	0.339263	0.847039	A
Holmes	2007 05 04.4600	24.2703	326.1608	19.1078	2.053220	0.432415	A
Kowal 1	2007 05 16.8927	179.7727	27.5755	4.2941	4.724052	0.228040	D
Shoemaker-Holt 1	2007 06 15.3564	210.5009	213.6684	4.3604	3.068950	0.319997	D
Bus	2007 07 07.6458	24.2749	181.4673	2.5834	2.173213	0.376477	C
Ciffreo	2007 07 16.5889	357.9603	53.0635	13.0737	1.719189	0.541458	D
Kojima	2007 10 05.9383	2.0612	118.6085	6.5979	2.011905	0.453220	A
Arend	2007 11 01.1454	49.0389	354.6392	19.1483	1.924357	0.529241	A
Kohoutek	2007 11 04.2299	175.6735	268.9219	5.9010	1.795539	0.494616	A
Lovas 1	2007 12 17.9756	74.6753	339.2204	12.2119	1.704712	0.611790	D
Tuttle	2008 01 31.0992	207.5176	269.6411	54.9711	1.027297	0.819872	A
Hartley 3	2008 02 02.5529	167.8924	287.0088	11.6752	2.489295	0.312252	D
Wirtanen	2008 02 02.9836	356.3206	81.4955	11.7398	1.057433	0.658155	A
Reinmuth 2	2008 02 18.3149	58.1229	285.8478	5.9023	2.106381	0.428320	A
Grigg-Skjellerup	2008 03 23.6850	1.7247	210.9985	22.3618	1.116711	0.633002	A
Brooks 2	2008 04 12.6128	219.4686	158.6774	4.2631	1.466490	0.562698	B
Shoemaker 2	2008 04 14.8428	317.7869	52.3826	24.0691	1.416215	0.644346	D
Wild 3	2008 05 19.8980	179.1293	71.9076	15.4465	2.301202	0.365961	D
du Toit-Hartley	2008 05 28.3674	253.3675	307.0451	2.8885	1.230476	0.594000	A

Comet	T	Peri	Node	Incl.	q	e	Code
Harrington	2008 06 19.2483	269.0490	83.2241	5.4305	1.688279	0.544204	A
Finlay	2008 06 22.5126	347.4575	13.1417	6.8084	0.970023	0.721351	A
Daniel	2008 07 20.7260	18.9685	65.8852	22.3733	2.169986	0.461865	A
Borrelly	2008 07 22.3501	353.3645	74.7573	30.3231	1.354757	0.624488	A
d'Arrest	2008 08 15.1038	178.1141	138.2461	19.5194	1.353562	0.612813	B
Shajn-Schaldach	2008 09 06.3097	221.6260	162.4398	6.0154	2.108198	0.426504	B
Pons-Winnecke	2008 09 26.6597	172.3121	92.7408	22.3112	1.253270	0.634901	A
Boethin	2008 12 16.4417	53.6052	342.7321	4.2112	1.147534	0.775275	C
duToit-Neujmin-Delporte	2008 12 25.8054	115.3264	188.1079	2.8532	1.723864	0.500235	A
Klemola	2009 01 20.9925	153.9780	174.6314	11.1506	1.759009	0.640632	C
Ashbrook-Jackson	2009 01 31.9873	357.6871	356.2839	13.0463	2.799161	0.319178	A
Wolf	2009 02 27.2439	158.9943	201.4152	27.9492	2.724130	0.357953	A
Churyumov-Gerasimenko	2009 02 28.3681	12.6572	49.5409	7.0370	1.246519	0.640173	A
Kearns-Kwee	2009 03 07.3931	127.5431	312.3096	9.3369	2.355643	0.475039	A
Kopff	2009 05 25.3525	162.7394	120.2743	4.7273	1.577537	0.544348	A
Swift-Gehrels	2009 06 13.8701	96.3552	299.9949	8.9503	1.377005	0.689534	C
Tritton	2009 06 22.4950	147.8491	299.7853	7.0869	1.414210	0.584745	D
Longmore	2009 07 07.8717	196.6941	14.2223	24.3922	2.310336	0.358112	C
Smirnova-Chernykh	2009 07 30.3916	87.1864	76.4580	6.6463	3.557680	0.147558	C
Schaumasse	2009 08 08.8876	57.9528	79.0440	11.7273	1.213938	0.703602	B
Russell 2	2009 08 13.4891	249.6004	41.5691	12.0076	2.282715	0.398614	D
de Vico-Swift	2009 08 30.9545	1.3302	358.6011	5.9576	2.172421	0.426351	D
Howell	2009 10 14.1099	236.1937	55.8502	4.3662	1.363060	0.562170	A
Gehrels 3	2010 01 12.0811	226.5609	238.5183	1.1289	3.633389	0.122225	C
Kowal-Mrkos	2010 02 22.6640	316.2446	244.5076	5.3215	2.683230	0.393610	E
Wild 2	2010 02 22.8193	41.7258	135.4688	3.2432	1.598056	0.537399	A
Hartley 1	2010 02 23.8608	187.4465	36.1057	25.5098	2.130344	0.386749	D
IRAS	2010 02 26.0121	356.7314	357.0640	45.8258	1.713436	0.696673	D
Gunn	2010 03 02.2497	196.6029	67.6970	10.3838	2.440322	0.319398	A
Russell 4	2010 03 29.7412	92.7880	70.2741	6.1805	2.240246	0.363114	D
Reinmuth 1	2010 04 19.5114	13.1686	119.0944	8.1260	1.884101	0.501037	A
Kowal 2	2010 05 30.5862	326.6168	105.5477	3.1799	1.068849	0.670155	E
Haneda-Campos	2010 06 07.4025	307.0951	65.8812	4.9427	1.278030	0.630004	D
Wolf-Harrington	2010 07 01.7815	191.4933	249.1721	15.9662	1.357576	0.594468	A
Tempel 2	2010 07 04.9120	195.6349	117.1525	12.0254	1.422699	0.536334	A
Encke	2010 08 06.4356	186.5568	333.8597	11.7774	0.335863	0.848338	A
Schwassmann-Wachmann 2	2010 09 29.6413	17.8646	113.5576	4.5491	3.424618	0.192754	B
van Houten	2010 10 16.3176	40.0088	359.8401	7.2747	4.140701	0.362981	D
Hartley 2	2010 11 30.2552	181.3893	219.0513	13.5337	1.058243	0.695826	D

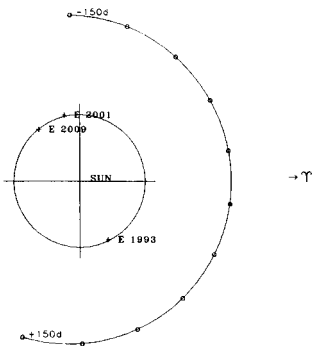
Comet Arend



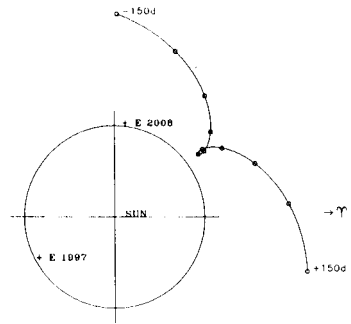
Comet Arend-Rigaux



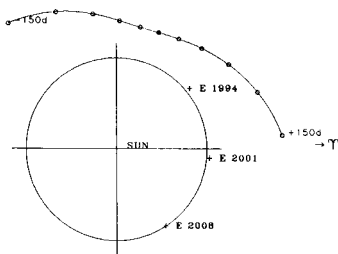
Comet Ashbrook-Jackson



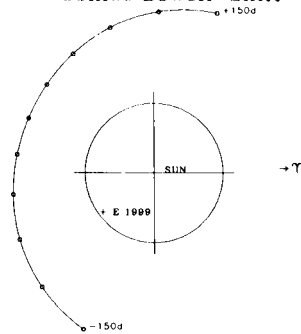
Comet Boethin



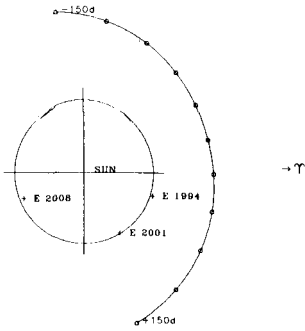
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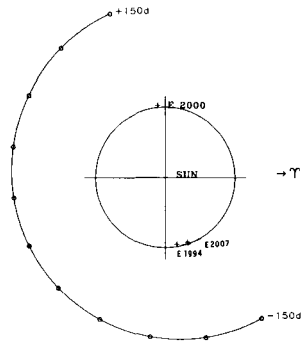
Comet Bowell-Skiff



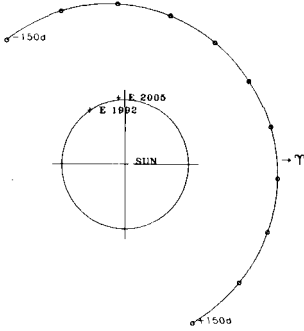
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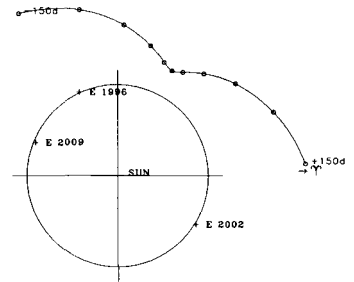
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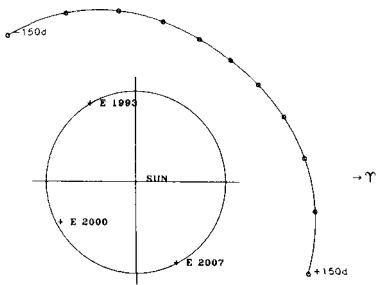
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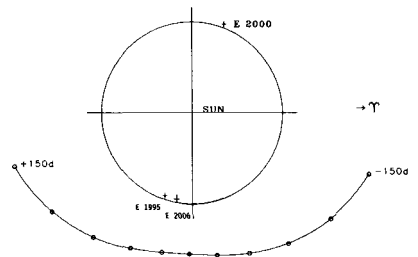
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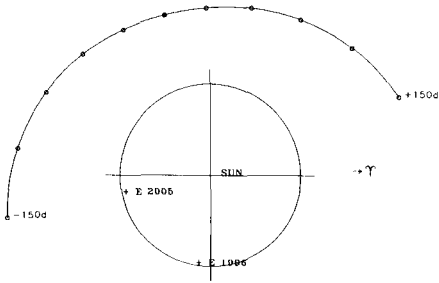
Comet Cifreio



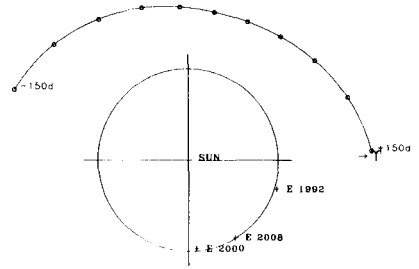
Comet Clark



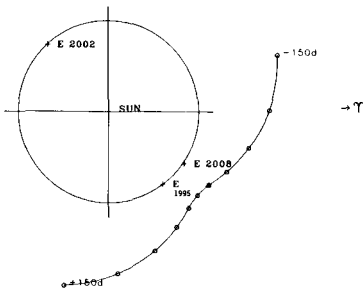
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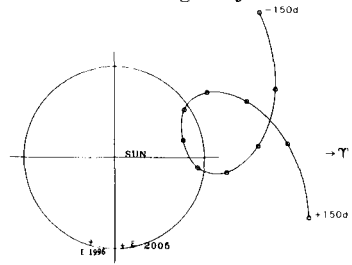
Comet Daniel



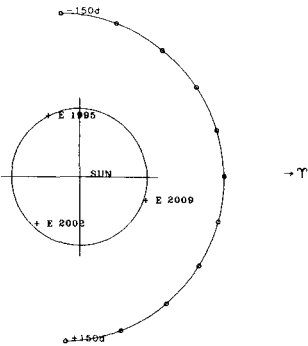
Comet d'Arrest



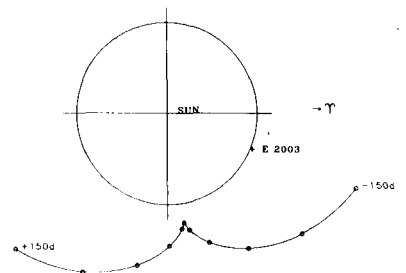
Comet Denning-Fujikawa



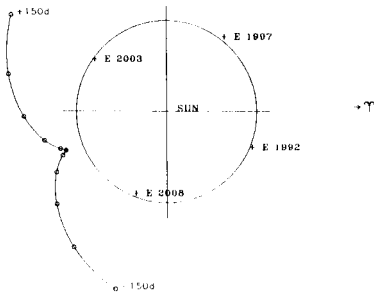
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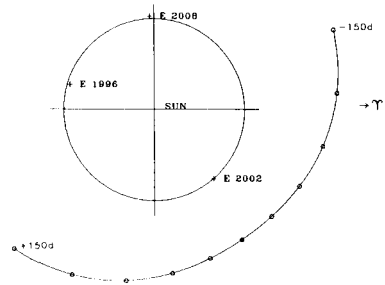
Comet du Toit 1



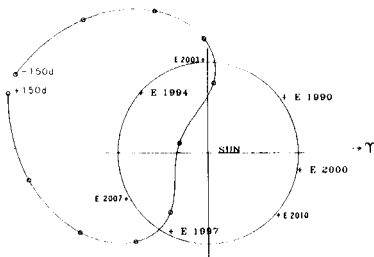
Comet du Toit-Hartley



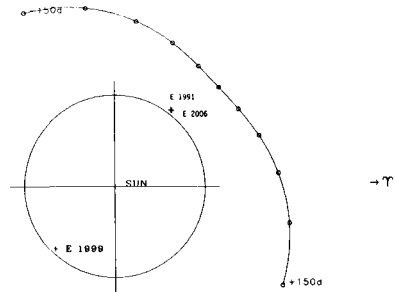
Comet duToit-Neujmin-Delporte



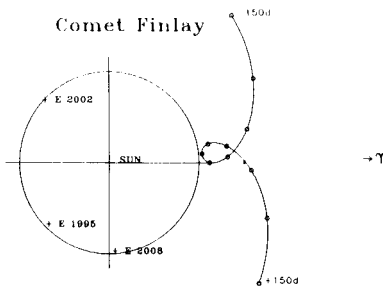
Comet Encke



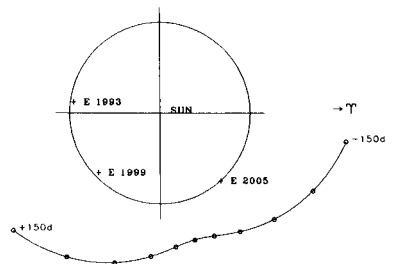
Comet Faye



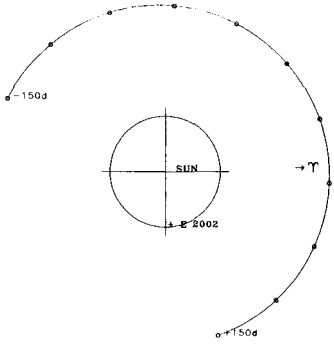
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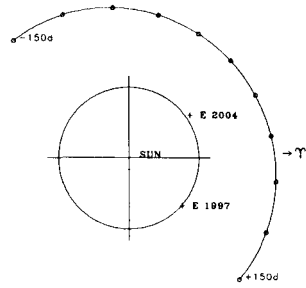
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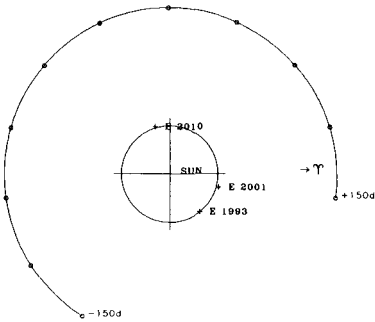
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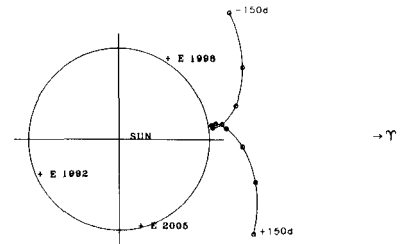
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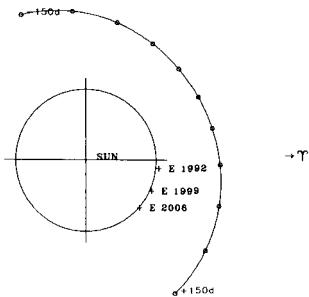
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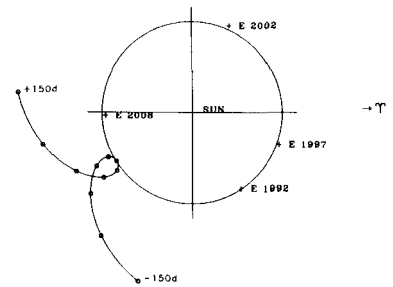
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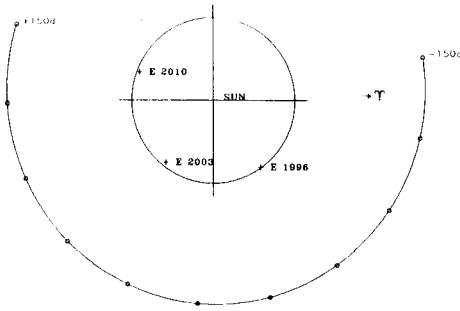
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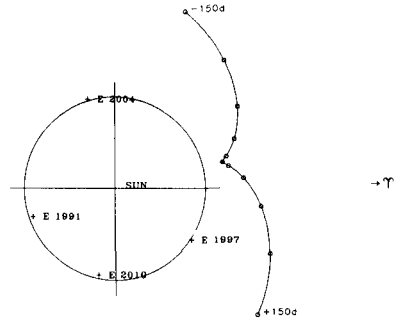
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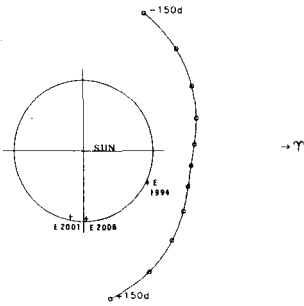
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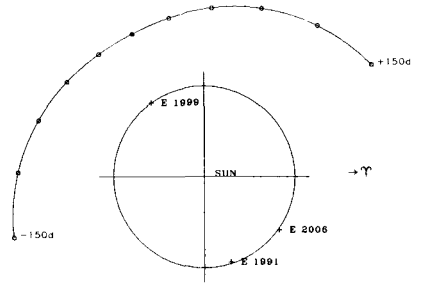
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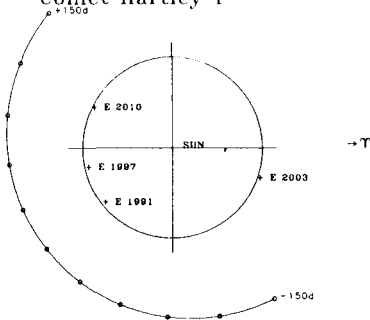
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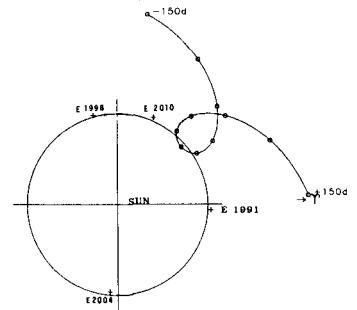
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Comet Hartley 1

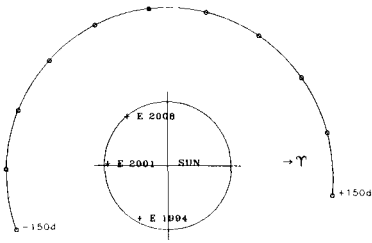


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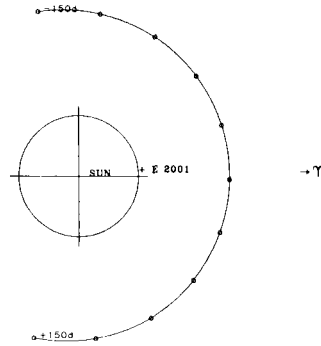




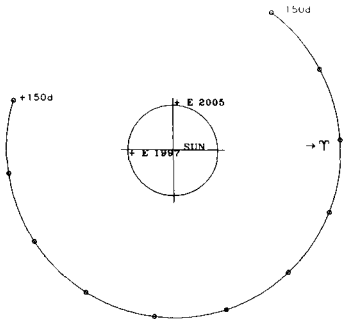
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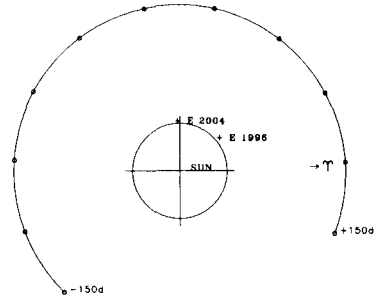
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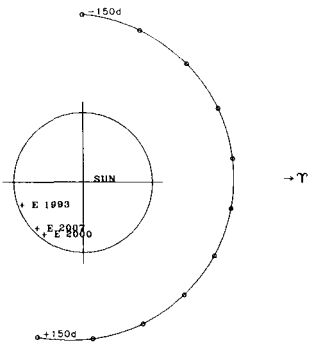
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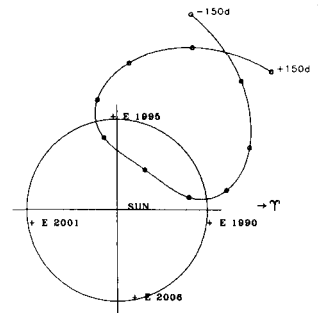
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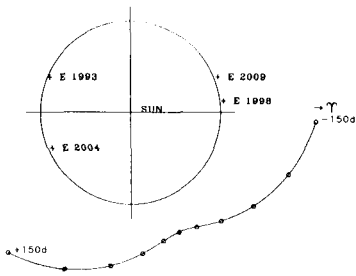
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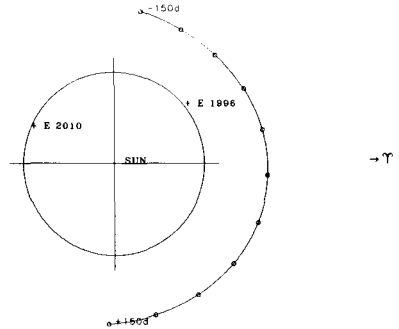
Comet Honda-Mrkos-Pajdušáková



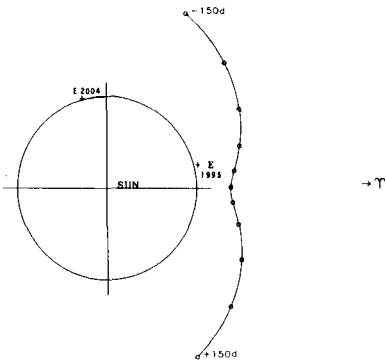
Comet Howell



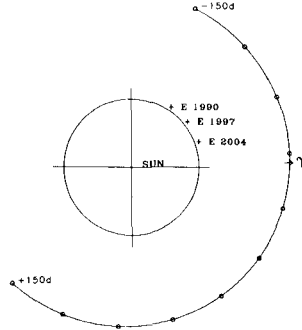
Comet IRAS



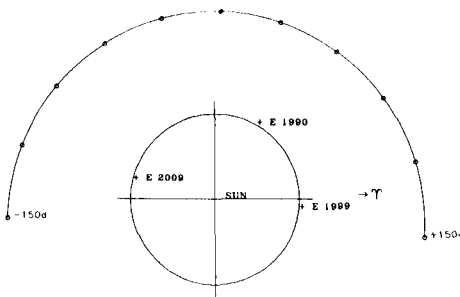
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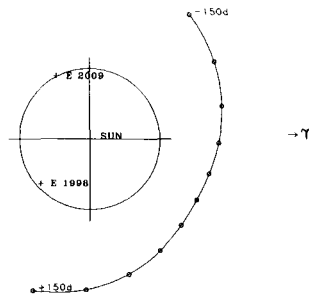
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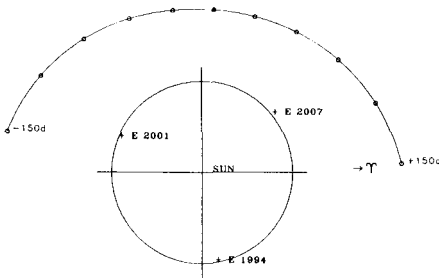
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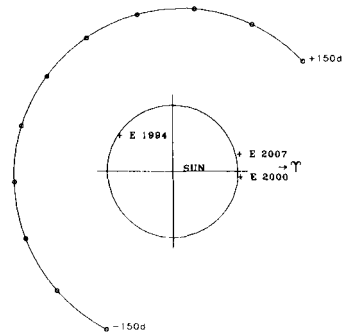
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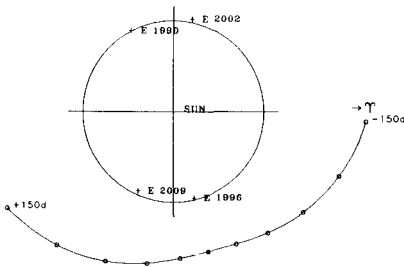
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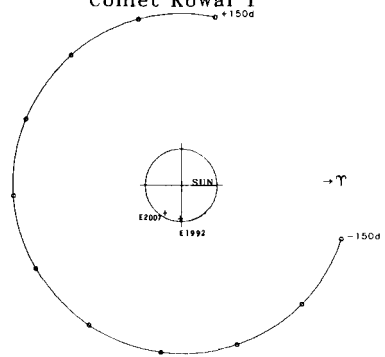
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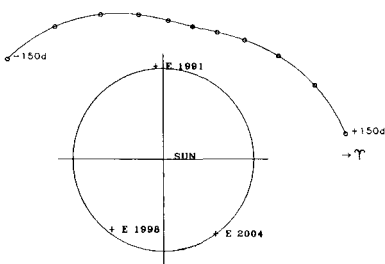
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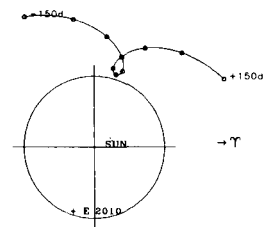
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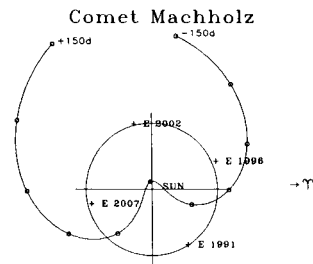
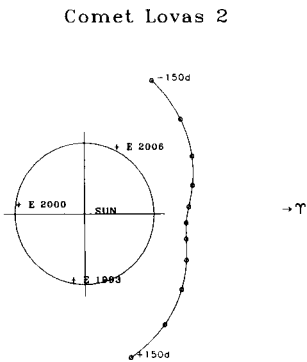
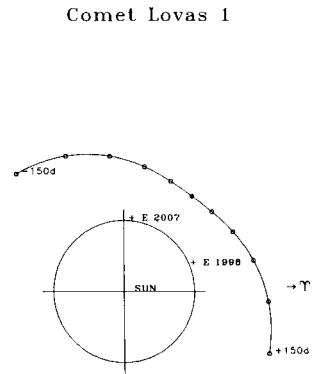
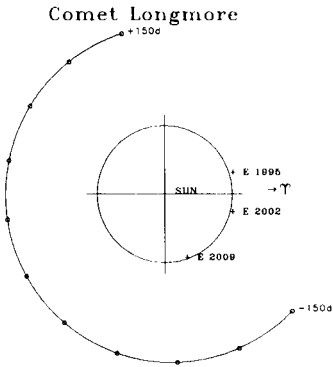
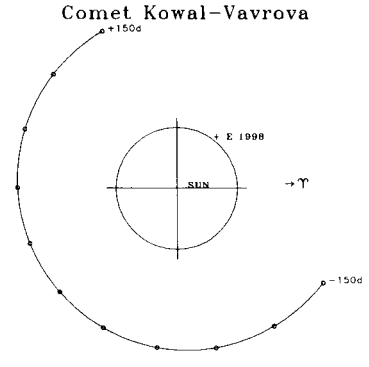
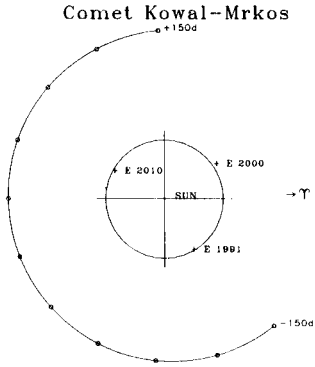


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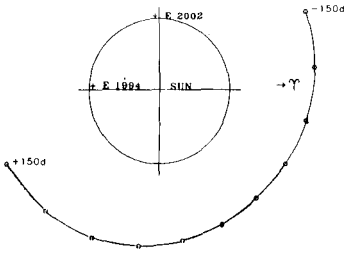


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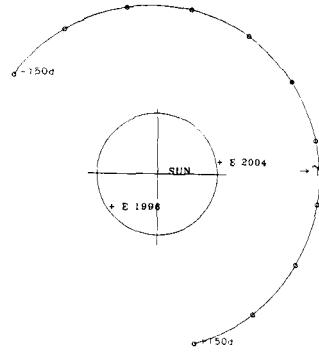




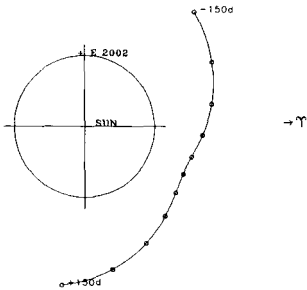
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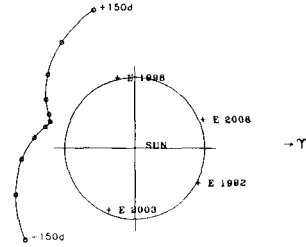
Comet Mueller



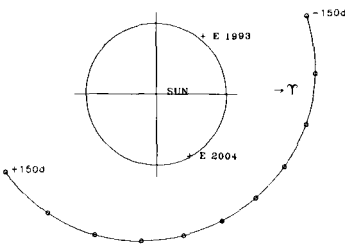
Comet Neujmin 1



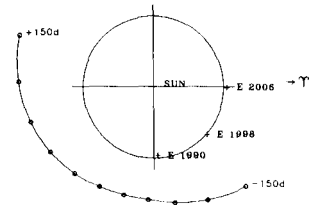
Comet Neujmin 2



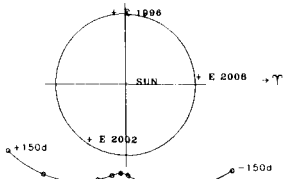
Comet Neujmin 3



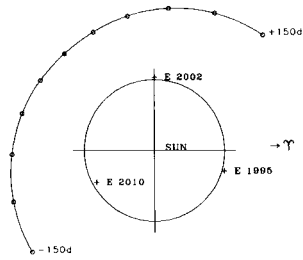
Comet Peters-Hartley



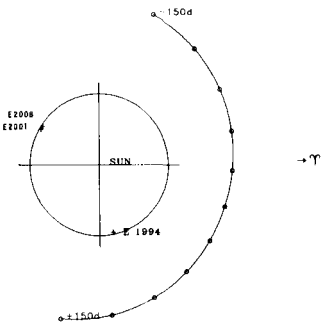
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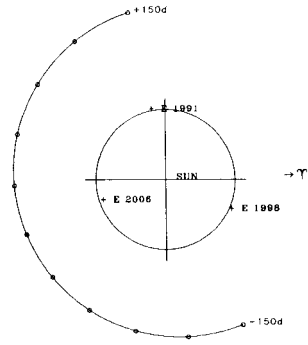
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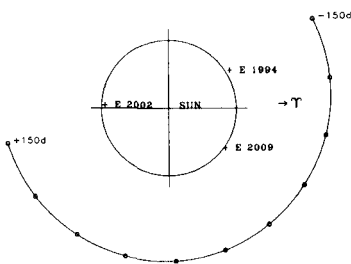
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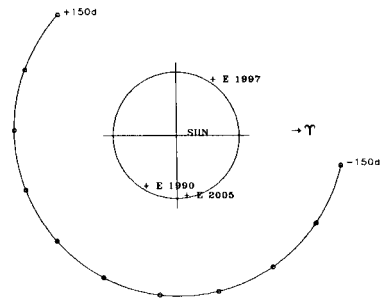
Comet Russell 1



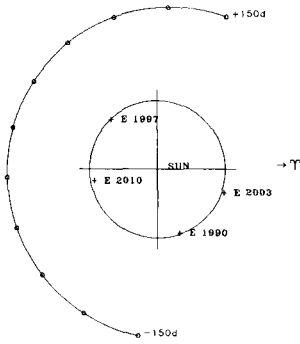
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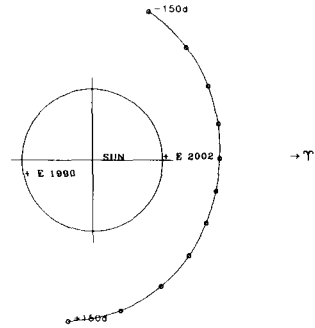
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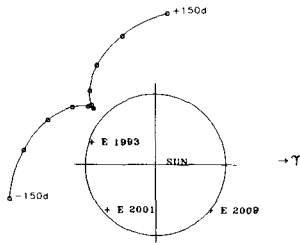
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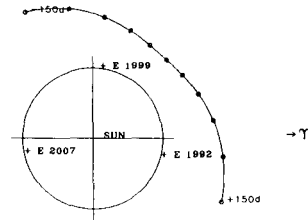
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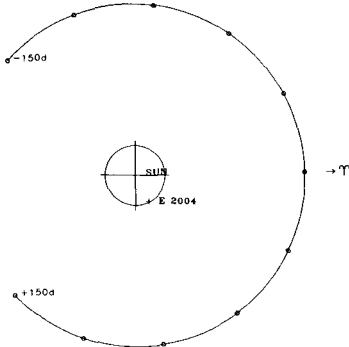
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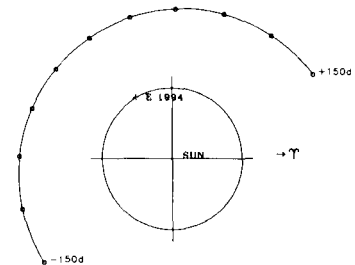
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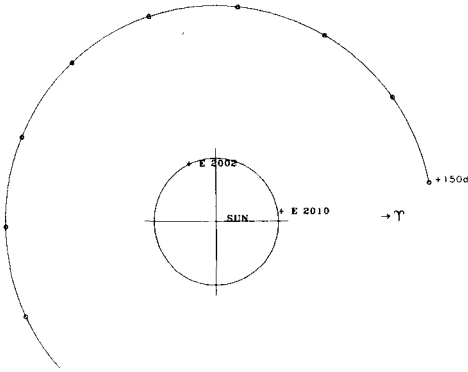
Comet Schwassmann-Wachmann 1



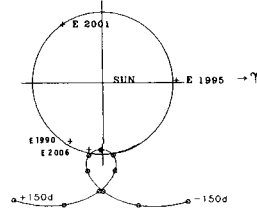
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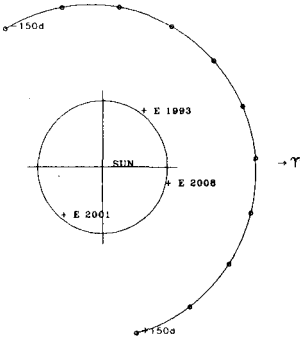
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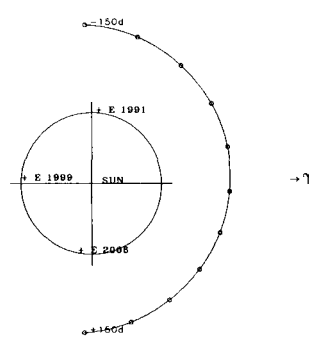
Comet Schwassmann-Wachmann 3



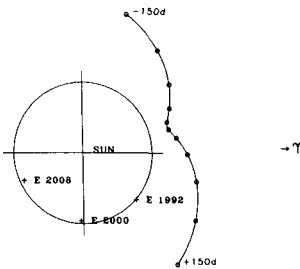
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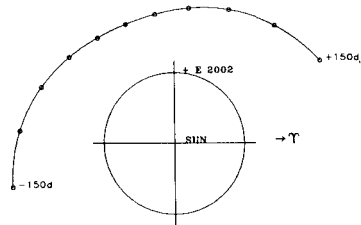
Comet Shoemaker 1



Comet Shoemaker 2

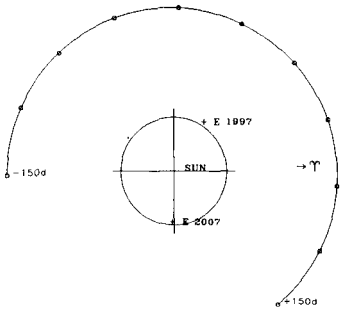


Comet Shoemaker 3

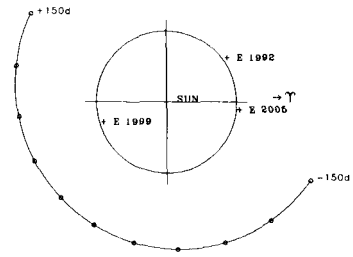




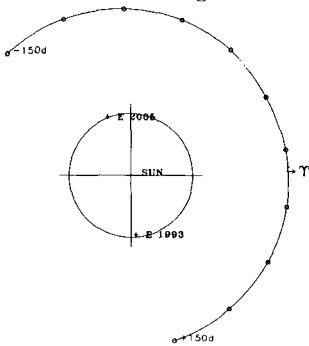
Comet Shoemaker-Holt 1



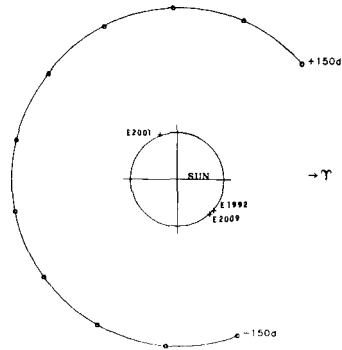
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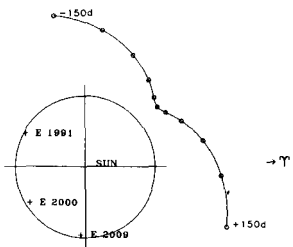
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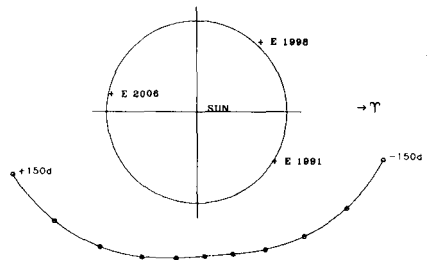
Comet Smirnova-Chernykh



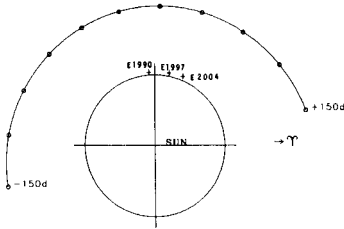
Comet Swift-Gehrels



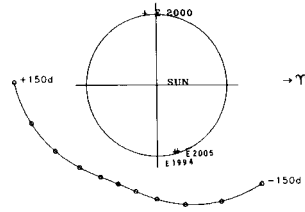
Comet Takamizawa



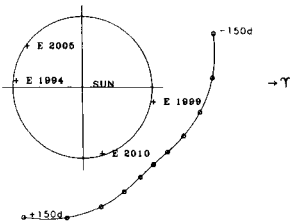
Comet Taylor



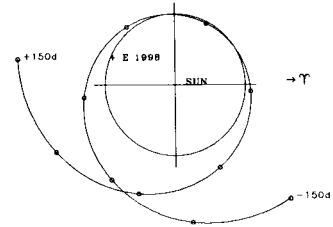
Comet Tempel 1



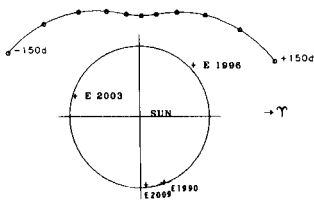
Comet Tempel 2



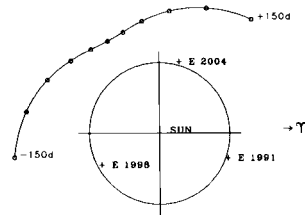
Comet Tempel-Tuttle



Comet Tritton

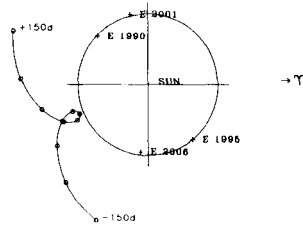
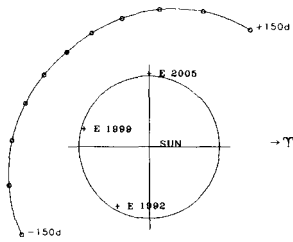


Comet Tsuchinshan 1



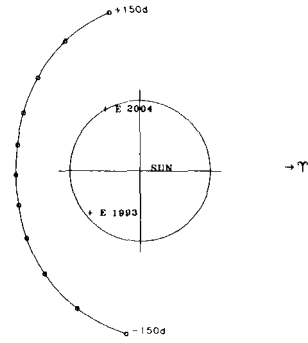
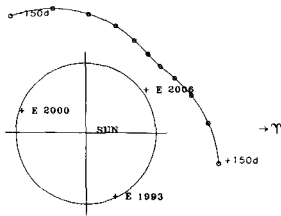
Comet Tsuchinshan 2

Comet Tuttle-Giacobini-Kresák



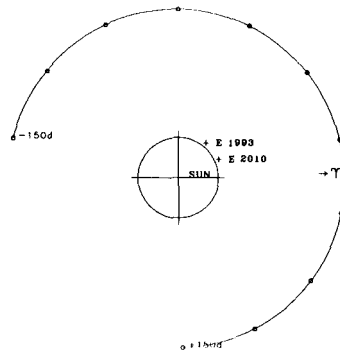
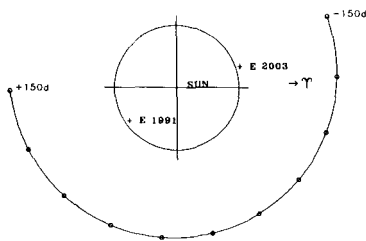
Comet Urata-Niijima

Comet Väisälä 1

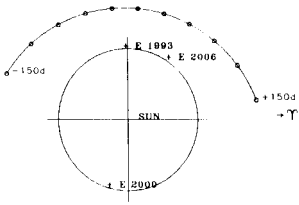


Comet van Biesbroeck

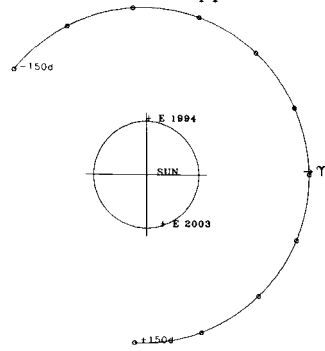
Comet van Houten



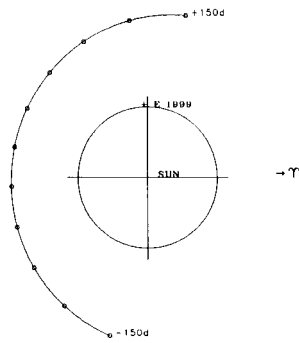
Comet West-Kohoutek-Ikemura



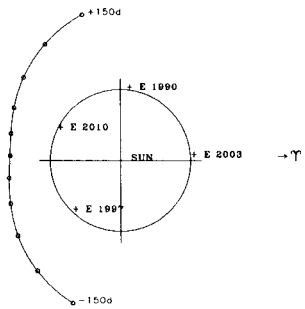
Comet Whipple



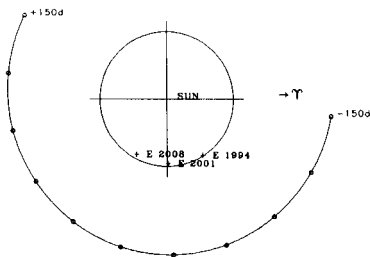
Comet Wild 1



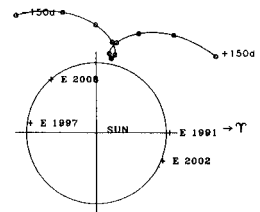
Comet Wild 2



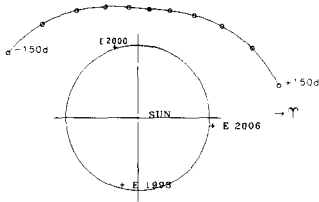
Comet Wild 3



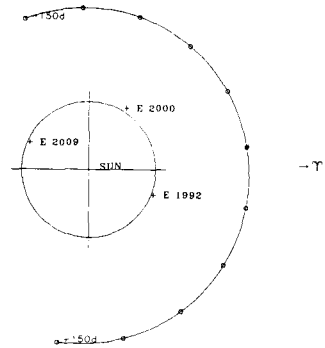
Comet Wirtanen



Comet Wiseman-Skiff



Comet Wolf



Comet Wolf-Harrington

