```
*******************************************************************************
JPL/HORIZONS                  Panther (C/1980 Y2)           2018-Nov-17 18:49:59
Rec #:  901890 (+COV) Soln.date: 2014-Jun-13_19:42:24    # obs: 192 (1980-1981)

IAU76/J2000 helio. ecliptic osc. elements (au, days, deg., period=Julian yrs):

  EPOCH=  2444661.5 ! 1981-Feb-26.0000000 (TDB)    RMSW= n.a.
   EC= .9986877014790708   QR= 1.657195787327603   TP= 2444631.8180054906
   OM= 332.0004867123912   W= 105.5986482880437    IN= 82.64631802621146
   A= 1262.819214452988    MA= .00065190660668468  ADIST= 2523.981233118649
   PER= 44876.604172089    N= 2.1963E-5            ANGMOM= .031306954
   DAN= 4.52825            DDN= 2.61104            L= 127.3707257
   B= 72.7938829           MOID= 1.18025994        TP= 1981-Jan-27.3180054906

Comet physical (GM= km^3/s^2; RAD= km):
   GM= n.a.                RAD= n.a.
   M1=  6.1      M2=  n.a.     k1=  9.     k2= n.a.     PHCOF= n.a.

COMET comments
1: soln ref.= JPL#10, data arc: 1980-10-09 to 1981-06-04
2: k1=9.;
*******************************************************************************


*******************************************************************************
Ephemeris / WWW_USER Sat Nov 17 18:49:59 2018 Pasadena, USA      / Horizons
*******************************************************************************
Target body name: Panther (C/1980 Y2)             {source: JPL#10}
Center body name: Earth (399)                     {source: DE431}
Center-site name: Chelmsford
*******************************************************************************
Start time      : A.D. 1981-Jan-01 00:00:00.0000 UT
Stop  time      : A.D. 1981-Oct-10 00:00:00.0000 UT
Step-size       : 7200 minutes
*******************************************************************************
Target pole/equ : No model available
Target radii    : (unavailable)
Center geodetic : 0.49540000,51.7447857,0.0231792 {E-lon(deg),Lat(deg),Alt(km)}
Center cylindric: 0.49540000,3957.31247,4985.2892 {E-lon(deg),Dxy(km),Dz(km)}
Center pole/equ : High-precision EOP model        {East-longitude positive}
Center radii    : 6378.1 x 6378.1 x 6356.8 km     {Equator, meridian, pole}
Target primary  : Sun
Vis. interferer : MOON (R_eq= 1737.400) km        {source: DE431}
Rel. light bend : Sun, EARTH                      {source: DE431}
Rel. lght bnd GM: 1.3271E+11, 3.9860E+05 km^3/s^2
```

```
Small-body perts: Yes                              {source: SB431-N16}
Atmos refraction: NO (AIRLESS)
RA format       : HMS
Time format     : CAL
EOP file        : eop.181116.p190207
EOP coverage    : DATA-BASED 1962-JAN-20 TO 2018-NOV-16. PREDICTS-> 2019-FEB-06
Units conversion: 1 au= 149597870.700 km, c= 299792.458 km/s, 1 day= 86400.0 s
Table cut-offs 1: Elevation (-90.0deg=NO ),Airmass (>38.000=NO), Daylight (NO )
Table cut-offs 2: Solar elongation (  0.0,180.0=NO ),Local Hour Angle( 0.0=NO )
Table cut-offs 3: RA/DEC angular rate (     0.0=NO )
*******************************************************************************
Initial IAU76/J2000 heliocentric ecliptic osculating elements (au, days, deg.):
  EPOCH=  2444661.5 ! 1981-Feb-26.0000000 (TDB)    RMSW= n.a.
   EC= .9986877014790708   QR= 1.657195787327603   TP= 2444631.8180054906
   OM= 332.0004867123912   W= 105.5986482880437    IN= 82.64631802621146
  Equivalent ICRF heliocentric equatorial cartesian coordinates (au, au/d):
   X=-7.705990419896599E-01  Y= 9.309851801223068E-03  Z= 1.519461300156113E+00
  VX=-1.537015324273420E-02 VY= 9.566296073007931E-03 VZ=-4.402419839956707E-03
Comet physical (GM= km^3/s^2; RAD= km):
   GM= n.a.                RAD= n.a.
   M1=  6.1      M2=  n.a.     k1=  9.     k2= n.a.     PHCOF= n.a.
*******************************************************************************
```

Date__(UT)__HR:MN		R.A._(ICRF/J2000.0)_DEC	dRA*cosD	d(DEC)/dt	T-mag	N-mag	r	rdot	delta	
$$SOE										
1981-Jan-01 00:00		18 51 43.78 +40 32 47.5	15.75888	42.03353	9.54	n.a.	1.693940107307	-4.7634166	1.88490405623969	-11.8
1981-Jan-06 00:00		18 54 27.32 +42 03 37.1	16.65599	48.82639	9.47	n.a.	1.681428558359	-3.8971797	1.84849340547281	-13.3
1981-Jan-11 00:00		18 57 23.10 +43 48 35.0	17.28217	56.25108	9.39	n.a.	1.671453820598	-3.0072789	1.80822630721167	-14.5
1981-Jan-16 00:00	m	19 00 29.71 +45 48 58.7	17.65470	64.34475	9.32	n.a.	1.664077306329	-2.0986224	1.76472514825399	-15.5
1981-Jan-21 00:00	m	19 03 46.37 +48 06 11.6	17.82092	73.17600	9.26	n.a.	1.659345504978	-1.1766144	1.71875397195862	-16.2
1981-Jan-26 00:00	m	19 07 12.96 +50 41 47.1	17.78322	82.83322	9.19	n.a.	1.657288731387	-0.2470241	1.67120647704644	-16.6
1981-Jan-31 00:00		19 10 49.51 +53 37 25.8	17.49928	93.33999	9.13	n.a.	1.657920286063	0.6841671	1.62312136113968	-16.6
1981-Feb-05 00:00		19 14 35.99 +56 54 45.9	16.92544	104.6237	9.07	n.a.	1.661236079085	1.6109325	1.57570635280115	-16.2
1981-Feb-10 00:00		19 18 32.53 +60 35 08.7	16.04175	116.4761	9.02	n.a.	1.667214742410	2.5273695	1.53034434703949	-15.2
1981-Feb-15 00:00	m	19 22 40.35 +64 39 23.0	14.90825	128.5638	8.98	n.a.	1.675818224577	3.4278622	1.48857629128200	-13.7
1981-Feb-20 00:00	m	19 27 03.84 +69 07 32.3	13.62933	140.4589	8.95	n.a.	1.686992829488	4.3072240	1.45205554186000	-11.6
1981-Feb-25 00:00	m	19 31 54.06 +73 58 40.0	12.37087	151.5664	8.94	n.a.	1.700670634657	5.1608162	1.42249170869234	-8.8
1981-Mar-02 00:00		19 37 43.98 +79 10 27.9	11.67129	161.1024	8.95	n.a.	1.716771207423	5.9846341	1.40157298288036	-5.6
1981-Mar-07 00:00		19 47 24.36 +84 38 57.3	14.42099	168.0451	8.97	n.a.	1.735203527069	6.7753615	1.39084981556741	-1.8
1981-Mar-12 00:00	m	05 08 22.83 +89 35 25.1	135.2159	-107.539	9.02	n.a.	1.755868017100	7.5303918	1.39158994008365	2.3
1981-Mar-17 00:00	m	07 35 36.20 +83 55 32.9	12.84900	-172.993	9.09	n.a.	1.778658595695	8.2478188	1.40464952817931	6.7
1981-Mar-22 00:00	m	07 44 34.54 +78 13 01.5	11.23822	-170.466	9.18	n.a.	1.803464662501	8.9264036	1.43041338656132	11.1
1981-Mar-27 00:00		07 50 32.62 +72 38 55.5	12.74990	-164.781	9.30	n.a.	1.830172956642	9.5655207	1.46878811094485	15.5
1981-Apr-01 00:00		07 55 46.11 +67 18 39.4	14.96363	-156.728	9.43	n.a.	1.858669238217	10.1650915	1.51923843127119	19.5
1981-Apr-06 00:00		08 00 43.62 +62 16 08.3	17.33110	-147.087	9.58	n.a.	1.888839762723	10.7255105	1.58086180911169	23.2

1981-Apr-11 00:00	m	08	05	34.48	+57	33	45.4	19.59573	−136.612	9.74	n.a.	1.920572533989	11.2475680	1.65248388047949	26.5
1981-Apr-16 00:00	m	08	10	21.84	+53	12	28.0	21.64177	−125.980	9.91	n.a.	1.953758332696	11.7323742	1.73280491858570	29.3
1981-Apr-21 00:00	m	08	15	07.13	+49	12	03.1	23.46512	−115.680	10.09	n.a.	1.988291531298	12.1812885	1.82052832597090	31.7
1981-Apr-26 00:00		08	19	51.29	+45	31	31.3	25.08964	−106.012	10.27	n.a.	2.024070713956	12.5958542	1.91440976366361	33.6
1981-May-01 00:00		08	24	35.07	+42	09	26.3	26.54020	−97.1340	10.45	n.a.	2.060999120653	12.9777407	2.01327287933023	35.1
1981-May-06 00:00		08	29	18.95	+39	04	09.4	27.81853	−89.1015	10.63	n.a.	2.098984938963	13.3286958	2.11600373662424	36.3
1981-May-11 00:00	m	08	34	02.90	+36	13	59.4	28.89375	−81.9168	10.80	n.a.	2.137941467294	13.6505042	2.22155871907810	37.1
1981-May-16 00:00	m	08	38	46.51	+33	37	16.2	29.78381	−75.5534	10.98	n.a.	2.177787169245	13.9449548	2.32902487957327	37.6
1981-May-21 00:00	m	08	43	29.54	+31	12	25.1	30.53057	−69.9528	11.15	n.a.	2.218445641045	14.2138119	2.43761832777646	37.9
1981-May-26 00:00	A	08	48	11.93	+28	57	59.3	31.16863	−65.0419	11.32	n.a.	2.259845509880	14.4587941	2.54664522014796	37.9
1981-May-31 00:00	A	08	52	53.71	+26	52	41.2	31.71767	−60.7441	11.48	n.a.	2.301920280239	14.6815596	2.65546669021991	37.8
1981-Jun-05 00:00	A	08	57	34.83	+24	55	22.1	32.16354	−56.9839	11.64	n.a.	2.344608143124	14.8836948	2.76346891949749	37.4
1981-Jun-10 00:00	Am	09	02	14.92	+23	05	02.1	32.48788	−53.6961	11.79	n.a.	2.387851756888	15.0667077	2.87009019838724	36.8
1981-Jun-15 00:00	Am	09	06	53.58	+21	20	48.1	32.71230	−50.8259	11.94	n.a.	2.431598010733	15.2320234	2.97486626718750	36.1
1981-Jun-20 00:00	Am	09	11	30.54	+19	41	53.4	32.86230	−48.3230	12.08	n.a.	2.475797783193	15.3809819	3.07740138680052	35.2
1981-Jun-25 00:00	A	09	16	05.68	+18	07	37.0	32.95682	−46.1429	12.22	n.a.	2.520405698391	15.5148388	3.17733426462982	34.3
1981-Jun-30 00:00	A	09	20	38.94	+16	37	22.9	32.99591	−44.2451	12.36	n.a.	2.565379884313	15.6347659	3.27430662408903	33.2
1981-Jul-05 00:00	A	09	25	10.06	+15	10	39.7	32.95471	−42.5903	12.49	n.a.	2.610681840563	15.7418545	3.36795776409148	31.9
1981-Jul-10 00:00	Am	09	29	38.63	+13	47	00.7	32.82768	−41.1462	12.61	n.a.	2.656275785557	15.8371169	3.45797869846356	30.6
1981-Jul-15 00:00	Am	09	34	04.26	+12	26	02.2	32.63236	−39.8886	12.73	n.a.	2.702129064994	15.9214922	3.54413055244656	29.2
1981-Jul-20 00:00	Am	09	38	26.70	+11	07	23.3	32.38488	−38.7977	12.85	n.a.	2.748211525733	15.9958486	3.62620985369920	27.8
1981-Jul-25 00:00	m	09	42	45.77	+09	50	45.2	32.09338	−37.8567	12.96	n.a.	2.794495424071	16.0609878	3.70401932183979	26.2
1981-Jul-30 00:00		09	47	01.27	+08	35	51.1	31.74261	−37.0478	13.07	n.a.	2.840955241075	16.1176493	3.77734308694890	24.6
1981-Aug-04 00:00		09	51	12.79	+07	22	26.6	31.31047	−36.3503	13.17	n.a.	2.887567508503	16.1665155	3.84597448887463	23.0
1981-Aug-09 00:00		09	55	19.83	+06	10	19.3	30.80033	−35.7494	13.27	n.a.	2.934310648006	16.2082161	3.90976845595803	21.2
1981-Aug-14 00:00	m	09	59	21.96	+04	59	18.5	30.22468	−35.2360	13.36	n.a.	2.981164825291	16.2433319	3.96863039428729	19.5
1981-Aug-19 00:00	m	10	03	18.85	+03	49	14.2	29.59430	−34.8042	13.45	n.a.	3.028111813173	16.2723968	4.02248643987357	17.7
1981-Aug-24 00:00	m	10	07	10.19	+02	39	56.9	28.90541	−34.4489	13.54	n.a.	3.075134863591	16.2959017	4.07125243051925	15.9
1981-Aug-29 00:00		10	10	55.52	+01	31	18.2	28.13353	−34.1584	13.62	n.a.	3.122218588620	16.3142979	4.11482869963747	14.1
1981-Sep-03 00:00		10	14	34.24	+00	23	11.3	27.26549	−33.9193	13.70	n.a.	3.169348848318	16.3280007	4.15315328282523	12.3
1981-Sep-08 00:00		10	18	05.67	−00	44	29.3	26.30720	−33.7248	13.78	n.a.	3.216512649060	16.3373918	4.18622768018790	10.4
1981-Sep-13 00:00	m	10	21	29.23	−01	51	48.7	25.26719	−33.5718	13.85	n.a.	3.263698052727	16.3428226	4.21409295350174	8.6
1981-Sep-18 00:00	m	10	24	44.38	−02	58	51.8	24.15057	−33.4607	13.91	n.a.	3.310894093534	16.3446161	4.23680276075245	6.8
1981-Sep-23 00:00	m	10	27	50.50	−04	05	43.4	22.93952	−33.3877	13.98	n.a.	3.358090701921	16.3430699	4.25439318927587	5.0
1981-Sep-28 00:00		10	30	46.79	−05	12	27.2	21.60949	−33.3403	14.04	n.a.	3.405278631594	16.3384575	4.26691098878279	3.3
1981-Oct-03 00:00		10	33	32.31	−06	19	05.6	20.15576	−33.3077	14.10	n.a.	3.452449391076	16.3310309	4.27446594284155	1.6
1981-Oct-08 00:00		10	36	06.11	−07	25	39.8	18.58398	−33.2851	14.15	n.a.	3.499595183614	16.3210220	4.27722786004154	−0.0

$$EOE

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Column meaning:

TIME

Times PRIOR to 1962 are UT1, a mean-solar time closely related to the prior but now-deprecated GMT. Times AFTER 1962 are in UTC, the current

civil or "wall-clock" time-scale. UTC is kept within 0.9 seconds of UT1
by introduction of integer leap-seconds for 1972 and later.

Conversion from the internal TDB timescale to the non-uniform UT time-scale requested for output has not been determined for UTC times after the next July or January 1st. Therefore, the last known leap-second is used as a constant over future intervals.

Time tags refer to the UT time on Earth, regardless of where the observer is located in the solar system. For example, if an observation from the surface of another body has an output time-tag of 12:31:00 UT, it refers to a time-scale conversion from TDB to UT valid at the center of the Earth, not the actual observer location elsewhere in the solar system, where clock rates may differ slightly due to the local spacetime metric and there is no precisely defined or adopted "UT" analog.

Any 'b' symbol in the 1st-column denotes a B.C. date. First-column blank (" ") denotes an A.D. date. Calendar dates prior to 1582-Oct-15 are in the Julian calendar system. Later calendar dates are in the Gregorian system.

NOTE: "n.a." in output means quantity "not available" at the print-time.

SOLAR PRESENCE (OBSERVING SITE)
Time tag is followed by a blank, then a solar-presence symbol:

- '*' Daylight (refracted solar upper-limb on or above apparent horizon)
- 'C' Civil twilight/dawn
- 'N' Nautical twilight/dawn
- 'A' Astronomical twilight/dawn
- ' ' Night OR geocentric ephemeris

LUNAR PRESENCE (OBSERVING SITE)
The solar-presence symbol is immediately followed by a lunar-presence symbol:

- 'm' Refracted upper-limb of Moon on or above apparent horizon
- ' ' Refracted upper-limb of Moon below apparent horizon OR geocentric ephemeris

R.A._(ICRF/J2000.0)_DEC =
Astrometric right ascension and declination of the TARGET CENTER with respect to the observing site in the coordinates of the ICRF/J2000 inertial reference frame. Compensated for down-leg light-time.
Units: RA in hours-minutes-seconds of time (HH MM SS.ff),
DEC in angular degrees-minutes-seconds (DD MM SS.f)

dRA*cosD d(DEC)/dt =
The rate of change of target center apparent RA and DEC (airless). d(RA)/dt is multiplied by the cosine of the declination.
Units: ARCSECONDS PER HOUR

T-mag N-mag =
Comet's approximate apparent visual total magnitude ("T-mag") and nuclear magnitude ("N-mag") by following standard IAU definitions:
T-mag = M1 + 5*log10(delta) + k1*log10(r)
N-mag = M2 + 5*log10(delta) + k2*log10(r) + phcof*beta
Units: MAGNITUDES

r rdot =
Heliocentric range ("r", light-time corrected) and range-rate ("rdot") of the target center at the instant light seen by the observer at print-time would have left the target center (print-time minus down-leg light-time). The Sun-to-target distance traveled by a ray of light emanating from the center of the Sun that reaches the target center point at some instant and is recordable by the observer one down-leg light-time later at print-time.
Units: AU and KM/S

delta deldot =
Range ("delta") and range-rate ("delta-dot") of target center with respect to the observer at the instant light seen by the observer at print-time would have left the target center (print-time minus down-leg light-time); the distance traveled by a light ray emanating from the center of the target and recorded by the observer at print-time. "deldot" is a projection of the velocity vector along this ray, the light-time-corrected line-of-sight from the coordinate center, and indicates relative motion. A positive "deldot" means the target center is moving away from the observer (coordinate center). A negative "deldot" means the target center is moving toward the observer.
Units: AU and KM/S

S-O-T /r =
Sun-Observer-Target angle; target's apparent SOLAR ELONGATION seen from the observer location at print-time. Angular units: DEGREES

The '/r' column indicates the target's apparent position relative to the Sun in the observer's sky, as described below:

For an observing location on the surface of a rotating body (considering its rotational sense):

/T indicates target TRAILS Sun (evening sky; rises and sets AFTER Sun)
/L indicates target LEADS Sun (morning sky; rises and sets BEFORE Sun)

For an observing point NOT on a rotating body (such as a spacecraft), the "leading" and "trailing" condition is defined by the observer's heliocentric orbital motion: if continuing in the observer's current direction of heliocentric motion would encounter the target's apparent longitude first, followed by the Sun's, the target LEADS the Sun as seen by the observer. If the Sun's apparent longitude would be encountered first, followed by the target's, the target TRAILS the Sun.

NOTE: The S-O-T solar elongation angle is numerically the minimum separation angle of the Sun and target in the sky in any direction. It does NOT indicate the amount of separation in the leading or trailing directions, which are defined in the equator of a spherical coordinate system.

Cnst =
  Constellation ID; the 3-letter abbreviation for the name of the constellation containing the target center's astrometric position, as defined by IAU (1930) boundary delineation. See documentation for list of abbreviations.

Computations by ...
    Solar System Dynamics Group, Horizons On-Line Ephemeris System
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    Pasadena, CA 91109 USA
    Information: http://ssd.jpl.nasa.gov/
    Connect : telnet://ssd.jpl.nasa.gov:6775 (via browser)
              telnet ssd.jpl.nasa.gov 6775 (via command-line)
    Author : Jon.D.Giorgini@jpl.nasa.gov

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