```
JPL/HORIZONS                    103P/Hartley 2              2010-Sep-13 11:21:36
Rec #:900844          Soln.date: 2010-Sep-08_22:09:38   # obs: 1721 (1997-2010)

FK5/J2000.0 helio. ecliptic osc. elements (AU, DAYS, DEG, period=Julian yrs):

  EPOCH=  2454179.5 != 2007-Mar-20.0000000 (CT)   Residual RMS= .59218
    EC= .6954407870491051  QR= 1.055939352573553  TP= 2453140.644676941
    OM= 219.7768134530225  W= 181.2914244208019   IN= 13.63163550116112
    A= 3.467106912782197   MA= 158.60186594728    ADIST= 5.87827447299084
    PER= 6.4559335724536   N= .15266983           ANGMOM= .023016657
    DAN= 5.87487           DDN= 1.05605           L= 41.0318716
    B= -.3043369                                  TP= 2004-May-15.1446769

Physical & non-grav parameters (KM, SEC; A1,A2,A3=AU/d^2; DT=days):
    GM= n.a.               RAD= .800              A1= 1.809119E-9
    A2= -3.141845D-11      A3= 4.898911D-10       DT= 35.88793
    M1= 14.1               M2= 17.1               k1= 8.
    k2= 5.                 PHCOF= .030



COMET comments
1: soln ref.= JPL#57, data arc: 1997-May-02 to 2010-Sep-07
2: k1=8., k2=5., phase coef.=0.03;

*******************************************************************************
Ephemeris / WWW_USER Mon Sep 13 11:21:37 2010  Pasadena, USA     / Horizons
*******************************************************************************
Target body name: 103P/Hartley 2                  {source: JPL#57}
Center body name: Earth (399)                     {source: DE405}
Center-site name: GEOCENTRIC
*******************************************************************************
Start time      : A.D. 2010-Sep-13 00:00:00.0000 UT
Stop  time      : A.D. 2010-Oct-13 00:00:00.0000 UT
Step-size       : 1440 minutes
*******************************************************************************
Target pole/equ : No model available
Target radii    : 0.8 km
Center geodetic : 0.00000000,0.00000000,0.0000000 {E-lon(deg),Lat(deg),Alt(km)}
Center cylindric: 0.00000000,0.00000000,0.0000000 {E-lon(deg),Dxy(km),Dz(km)}
Center pole/equ : High-precision EOP model        {East-longitude +}
Center radii    : 6378.1 x 6378.1 x 6356.8 km     {Equator, meridian, pole}
Target primary  : Sun                             {source: DE405}
Interfering body: MOON (Req= 1737.400) km         {source: DE405}
Deflecting body : Sun, EARTH                      {source: DE405}
Deflecting GMs  : 1.3271E+11, 3.9860E+05 km^3/s^2
Small perturbers: Ceres, Pallas, Vesta            {source: SB405-CPV-2}
Small body GMs  : 6.32E+01, 1.43E+01, 1.78E+01 km^3/s^2
Atmos refraction: NO (AIRLESS)
RA format       : HMS
Time format     : CAL
EOP file        : eop.100910.p101202
EOP coverage    : DATA-BASED 1962-JAN-20 TO 2010-SEP-10. PREDICTS-> 2010-DEC-01
Units conversion: 1 AU= 149597870.691 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 )
*******************************************************************************
Initial FK5/J2000.0 heliocentric ecliptic osculating elements (AU, DAYS, DEG):
  EPOCH=  2454179.5 != 2007-Mar-20.0000000 (CT)   Residual RMS= .59218
    EC= .6954407870491051  QR= 1.055939352573553  TP= 2453140.644676941
    OM= 219.7768134530225  W= 181.2914244208019   IN= 13.63163550116112
Comet physical & dynamic parameters (KM, SEC; A1,A2,A3=AU/d^2; DT=days):
    GM= n.a.               RAD= .800              A1= 1.809119E-9
    A2= -3.141845D-11      A3= 4.898911D-10       DT= 35.88793
    M1= 14.1               M2= 17.1               k1= 8.
    k2= 5.                 PHCOF= .030
```

```
*******************************************************************************************
****************
 Date__(UT)__HR:MN     R.A._(ICRF/J2000.0)_DEC  T-mag  N-mag            delta      deldot
S-O-T /r    S-T-O
*******************************************************************************************
****************
$$SOE
 2010-Sep-13 00:00     23 09 43.07 +44 21 02.2  12.20  16.07 0.30012814174061 -12.5647178
131.5787 /T  37.8713
 2010-Sep-14 00:00     23 12 06.46 +44 55 25.5  12.12  16.01 0.29291362486027 -12.4181654
131.3722 /T  38.2444
 2010-Sep-15 00:00     23 14 40.77 +45 30 10.9  12.05  15.96 0.28578365764722 -12.2718846
131.1626 /T  38.6214
 2010-Sep-16 00:00     23 17 27.03 +46 05 18.5  11.98  15.90 0.27873819218646 -12.1254895
130.9504 /T  39.0018
 2010-Sep-17 00:00     23 20 26.38 +46 40 48.2  11.91  15.85 0.27177741995612 -11.9785380
130.7364 /T  39.3850
 2010-Sep-18 00:00     23 23 40.08 +47 16 39.4  11.83  15.79 0.26490180305593 -11.8305353
130.5212 /T  39.7703
 2010-Sep-19 00:00     23 27 09.52 +47 52 51.1  11.76  15.74 0.25811210435514 -11.6809345
130.3055 /T  40.1572
 2010-Sep-20 00:00     23 30 56.24 +48 29 21.6  11.68  15.68 0.25140941831321 -11.5291339
130.0900 /T  40.5450
 2010-Sep-21 00:00     23 35 01.91 +49 06 08.5  11.61  15.62 0.24479520377223 -11.3744725
129.8753 /T  40.9330
 2010-Sep-22 00:00     23 39 28.41 +49 43 08.4  11.53  15.57 0.23827131954808 -11.2162254
129.6621 /T  41.3206
 2010-Sep-23 00:00     23 44 17.78 +50 20 16.8  11.46  15.51 0.23184006326881 -11.0535971
129.4508 /T  41.7071
 2010-Sep-24 00:00     23 49 32.28 +50 57 27.7  11.38  15.45 0.22550421363525 -10.8857160
129.2421 /T  42.0918
 2010-Sep-25 00:00     23 55 14.37 +51 34 33.2  11.30  15.39 0.21926707611320 -10.7116288
129.0364 /T  42.4740
 2010-Sep-26 00:00     00 01 26.73 +52 11 23.5  11.22  15.33 0.21313253199712 -10.5302939
128.8342 /T  42.8532
 2010-Sep-27 00:00     00 08 12.24 +52 47 45.9  11.15  15.27 0.20710509077896 -10.3405765
128.6357 /T  43.2288
 2010-Sep-28 00:00     00 15 34.00 +53 23 24.7  11.07  15.21 0.20118994575555 -10.1412425
128.4411 /T  43.6003
 2010-Sep-29 00:00     00 23 35.24 +53 58 00.4  10.99  15.15 0.19539303273070  -9.9309539
128.2506 /L  43.9673
 2010-Sep-30 00:00     00 32 19.29 +54 31 09.1  10.91  15.08 0.18972109141799  -9.7082643
128.0639 /L  44.3295
 2010-Oct-01 00:00     00 41 49.44 +55 02 21.8  10.83  15.02 0.18418172863137  -9.4716172
127.8807 /L  44.6867
 2010-Oct-02 00:00     00 52 08.84 +55 31 03.7  10.75  14.96 0.17878348148423  -9.2193481
127.7004 /L  45.0391
 2010-Oct-03 00:00     01 03 20.22 +55 56 33.7  10.68  14.89 0.17353587757621  -8.9496934
127.5220 /L  45.3868
 2010-Oct-04 00:00     01 15 25.65 +56 18 03.8  10.60  14.83 0.16844948762333  -8.6608080
127.3444 /L  45.7306
 2010-Oct-05 00:00     01 28 26.20 +56 34 39.3  10.52  14.77 0.16353596449556  -8.3507950
127.1658 /L  46.0713
 2010-Oct-06 00:00     01 42 21.53 +56 45 18.9  10.44  14.71 0.15880806170879  -8.0177472
126.9839 /L  46.4102
 2010-Oct-07 00:00     01 57 09.49 +56 48 56.1  10.37  14.65 0.15427962456719  -7.6597998
126.7961 /L  46.7492
 2010-Oct-08 00:00     02 12 45.76 +56 44 20.7  10.30  14.59 0.14996554817692  -7.2751924
126.5991 /L  47.0905
 2010-Oct-09 00:00     02 29 03.68 +56 30 22.5  10.23  14.53 0.14588169726262  -6.8623392
126.3891 /L  47.4368
 2010-Oct-10 00:00     02 45 54.20 +56 05 54.1  10.16  14.48 0.14204478164276  -6.4199136
126.1617 /L  47.7914
 2010-Oct-11 00:00     03 03 06.21 +55 29 55.8  10.09  14.43 0.13847217840719  -5.9469488
125.9120 /L  48.1579
 2010-Oct-12 00:00     03 20 27.13 +54 41 40.2  10.03  14.38 0.13518168941468  -5.4429609
125.6351 /L  48.5400
 2010-Oct-13 00:00     03 37 43.78 +53 40 36.0   9.97  14.34 0.13219122341406  -4.9080859
125.3258 /L  48.9418
$$EOE
*******************************************************************************************
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Column meaning:
```

TIME

  Prior to 1962, times are UT1. Dates thereafter are UTC. 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.

  The uniform Coordinate Time scale is used internally. Conversion between CT and the selected non-uniform UT output scale has not been determined for UTC times after the next July or January 1st. The last known leap-second is used over any future interval.

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

 R.A._(ICRF/J2000.0)_DEC =
   J2000.0 astrometric right ascension and declination of target center. Corrected for light-time. Units: HMS (HH MM SS.ff) and DMS (DD MM SS.f)

 T-mag N-mag =
   Comet's approximate apparent visual total magnitude ("T-mag") and nuclear magnitude ("N-mag") by following definitions:
   T-mag = M1 + 5*log10(delta) + k1*log10(r)
   N-mag = M2 + 5*log10(delta) + k2*log10(r) + phcof*beta
Units: none

 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 observer location at print-time. If negative, the target center is behind the Sun. Angular units: DEGREES.

    The '/r' column is a Sun-relative code, output for observing sites with defined rotation models only.

         /T indicates target trails Sun (evening sky)
         /L indicates target leads Sun (morning sky)

    NOTE: The S-O-T solar elongation angle is the total separation in any direction. It does not indicate the angle of Sun leading or trailing.

 S-T-O =
   Sun-Target-Observer (~ PHASE ANGLE) angle: the vertex angle at target center formed by a vector to the apparent center of the Sun and a vector intersecting the observer at print-time. This measurable angle is within 20 arcseconds (0.006 deg) of the reduced PHASE ANGLE at observer's location at print time. The difference is due to down-leg stellar aberration affecting measured target position but not apparent solar illumination direction. When computing phase, Horizons uses the true phase angle, not S-T-O, but the resulting difference in illuminated fraction is less than 0.001%.
   Units: DEGREES

 Computations by ...
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