


# Data from the ULYSSES FINAL ARCHIVE

Open



ulysses\_daily\_heliocentric\_data\_1990-2009.txt

~/Pul-Fun/Ulysses/Trajectory/trajectory\_data


lat: Sun Mean Equator and Equinox of 1950

RA and DEC: Earth Mean Orbit and Equinox of 1950

long: long of Ulysses wrt Earth in Sun Mean Equator and Equinox of 1950

YYYY	MM	DD	YYYY	DOY	JD	HH	MM	SS	ESP	SPE	SEP	R	R	dR	V	lat	RA	DEC	long
[UTC]									[deg]	[deg]	[deg]	[AU]	[km]	[km/s]	[km/s]	[deg]	[deg]	[deg]	[deg]
1990	10	07	1990	280	2448171.5	00	00	00	0.08	97.86	82.06	0.999	149497071.034	-2.512	41.092	6.35	12.98	0.01	0.08
1990	10	08	1990	281	2448172.5	00	00	00	0.45	98.57	80.97	0.998	149301115.851	-2.035	40.987	6.32	14.34	0.06	0.46
1990	10	09	1990	282	2448173.5	00	00	00	0.83	97.43	81.74	0.997	149145073.980	-1.577	40.996	6.28	15.70	0.10	0.83
1990	10	10	1990	283	2448174.5	00	00	00	1.20	96.17	82.63	0.996	149028578.950	-1.119	41.008	6.24	17.06	0.15	1.21
1990	10	11	1990	284	2448175.5	00	00	00	1.58	94.86	83.56	0.996	148951687.780	-0.661	41.017	6.20	18.42	0.20	1.59
1990	10	12	1990	285	2448176.5	00	00	00	1.96	93.54	84.50	0.995	148914448.678	-0.201	41.020	6.15	19.78	0.24	1.96
1990	10	13	1990	286	2448177.5	00	00	00	2.33	92.21	85.46	0.995	148916887.222	0.258	41.019	6.10	21.14	0.29	2.34
1990	10	14	1990	287	2448178.5	00	00	00	2.71	90.88	86.42	0.996	148958991.852	0.717	41.012	6.05	22.51	0.34	2.72
1990	10	15	1990	288	2448179.5	00	00	00	3.09	89.56	87.38	0.996	148901696.482	1.186	41.005	6.00	23.87	0.39	3.09
1990	10	16	1990	289	2448180.5	00	00	00	3.47	88.24	88.34	0.996	148844401.112	1.655	40.998	5.95	25.23	0.44	3.47
1990	10	17	1990	290	2448181.5	00	00	00	3.85	86.92	89.29	0.996	148787105.742	2.124	40.991	5.90	26.59	0.49	3.85
1990	10	18	1990	291	2448182.5	00	00	00	4.23	85.60	90.25	0.996	148729810.372	2.593	40.984	5.85	27.95	0.54	4.23
1990	10	19	1990	292	2448183.5	00	00	00	4.61	84.28	91.20	0.996	148672515.002	3.062	40.977	5.80	29.31	0.59	4.61
1990	10	20	1990	293	2448184.5	00	00	00	4.99	82.96	92.16	0.996	148615219.632	3.531	40.970	5.75	30.67	0.64	4.99
1990	10	21	1990	294	2448185.5	00	00	00	5.37	81.64	93.11	0.996	148557924.262	4.000	40.963	5.70	32.03	0.69	5.37
1990	10	22	1990	295	2448186.5	00	00	00	5.75	80.32	94.07	0.996	148500628.892	4.469	40.956	5.65	33.39	0.74	5.75
1990	10	23	1990	296	2448187.5	00	00	00	6.13	79.00	95.02	0.996	148443333.522	4.938	40.949	5.60	34.75	0.79	6.13
1990	10	24	1990	297	2448188.5	00	00	00	6.51	77.68	95.98	0.996	148386038.152	5.407	40.942	5.55	36.11	0.84	6.51
1990	10	25	1990	298	2448189.5	00	00	00	6.89	76.36	96.93	0.996	148328742.782	5.876	40.935	5.50	37.47	0.89	6.89
1990	10	26	1990	299	2448190.5	00	00	00	7.27	75.04	97.89	0.996	148271447.412	6.345	40.928	5.45	38.83	0.94	7.27
1990	10	27	1990	300	2448191.5	00	00	00	7.65	73.72	98.84	0.996	148214152.042	6.814	40.921	5.40	40.19	0.99	7.65
1990	10	28	1990	301	2448192.5	00	00	00	8.03	72.40	99.80	0.996	148156856.672	7.283	40.914	5.35	41.55	1.04	8.03
1990	10	29	1990	302	2448193.5	00	00	00	8.41	71.08	100.75	0.996	148099561.302	7.752	40.907	5.30	42.91	1.09	8.41
1990	10	30	1990	303	2448194.5	00	00	00	8.79	69.76	101.71	0.996	148042265.932	8.221	40.900	5.25	44.27	1.14	8.79
1990	10	31	1990	304	2448195.5	00	00	00	9.17	68.44	102.66	0.996	147984970.562	8.690	40.893	5.20	45.63	1.19	9.17
1990	11	01	1990	305	2448196.5	00	00	00	9.55	67.12	103.62	0.996	147927675.192	9.159	40.886	5.15	46.99	1.24	9.55
1990	11	02	1990	306	2448197.5	00	00	00	9.93	65.80	104.40	0.996	147870379.822	9.628	40.879	5.10	48.35	1.29	9.93
1990	11	03	1990	307	2448198.5	00	00	00	10.31	64.49	105.40	0.996	147813084.452	10.097	40.872	5.05	49.71	1.34	10.31
1990	11	04	1990	308	2448199.5	00	00	00	10.69	63.19	106.50	0.996	147755789.082	10.566	40.865	5.00	51.07	1.39	10.69
1990	11	05	1990	309	2448200.5	00	00	00	11.07	61.90	107.59	0.996	147698493.712	11.035	40.858	4.95	52.43	1.44	11.07
1990	11	06	1990	310	2448201.5	00	00	00	11.45	60.60	108.69	0.996	147641198.342	11.504	40.851	4.90	53.79	1.49	11.45
1990	11	07	1990	311	2448202.5	00	00	00	11.83	59.30	109.79	0.996	147583902.972	11.973	40.844	4.85	55.15	1.54	11.83
1990	11	08	1990	312	2448203.5	00	00	00	12.21	58.00	110.89	0.996	147526607.602	12.442	40.837	4.80	56.51	1.59	12.21
1990	11	09	1990	313	2448204.5	00	00	00	12.59	56.70	111.99	0.996	147469312.232	12.911	40.830	4.75	57.87	1.64	12.59
1990	11	10	1990	314	2448205.5	00	00	00	12.97	55.40	113.09	0.996	147412016.862	13.380	40.823	4.70	59.23	1.69	12.97
1990	11	11	1990	315	2448206.5	00	00	00	13.35	54.10	114.19	0.996	147354721.492	13.849	40.816	4.65	60.59	1.74	13.35
1990	11	12	1990	316	2448207.5	00	00	00	13.73	52.80	115.29	0.996	147297426.122	14.318	40.809	4.60	61.95	1.79	13.73
1990	11	13	1990	317	2448208.5	00	00	00	14.11	51.50	116.39	0.996	147240130.752	14.787	40.802	4.55	63.31	1.84	14.11
1990	11	14	1990	318	2448209.5	00	00	00	14.49	50.20	117.49	0.996	147182835.382	15.256	40.795	4.50	64.67	1.89	14.49
1990	11	15	1990	319	2448210.5	00	00	00	14.87	48.90	118.59	0.996	147125539.012	15.725	40.788	4.45	66.03	1.94	14.87
1990	11	16	1990	320	2448211.5	00	00	00	15.25	47.60	119.69	0.996	147068243.642	16.194	40.781	4.40	67.39	1.99	15.25
1990	11	17	1990	321	2448212.5	00	00	00	15.63	46.30	120.79	0.996	147010948.272	16.663	40.774	4.35	68.75	2.04	15.63
1990	11	18	1990	322	2448213.5	00	00	00	16.01	45.00	121.89	0.996	146953652.902	17.132	40.767	4.30	70.11	2.09	16.01
1990	11	19	1990	323	2448214.5	00	00	00	16.39	43.70	122.99	0.996	146896357.532	17.601	40.760	4.25	71.47	2.14	16.39
1990	11	20	1990	324	2448215.5	00	00	00	16.77	42.40	124.09	0.996	146839062.162	18.070	40.753	4.20	72.83	2.19	16.77
1990	11	21	1990	325	2448216.5	00	00	00	17.15	41.10	125.19	0.996	146781766.792	18.539	40.746	4.15	74.19	2.24	17.15
1990	11	22	1990	326	2448217.5	00	00	00	17.53	39.80	126.29	0.996	146724471.422	19.008	40.739	4.10	75.55	2.29	17.53
1990	11	23	1990	327	2448218.5	00	00	00	17.91	38.50	127.39	0.996	146667176.052	19.477	40.732	4.05	76.91	2.34	17.91
1990	11	24	1990	328	2448219.5	00	00	00	18.29	37.20	128.49	0.996	146609880.682	19.946	40.725	4.00	78.27	2.39	18.29
1990	11	25	1990	329	2448220.5	00	00	00	18.67	35.90	129.59	0.996	146552585.312	20.415	40.718	3.95	79.63	2.44	18.67
1990	11	26	1990	330	2448221.5	00	00	00	19.05	34.60	130.69	0.996	146495289.942	20.884	40.711	3.90	80.99	2.49	19.05
1990	11	27	1990	331	2448222.5	00	00	00	19.43	33.30	131.79	0.996	146437994.572	21.353	40.704	3.85	82.35	2.54	19.43
1990	11	28	1990	332	2448223.5	00	00	00	19.81	32.00	132.89	0.996	146380699.202	21.822	40.697	3.80	83.71	2.59	19.81
1990	11	29	1990	333	2448224.5	00	00	00	20.19	30.70	133.99	0.996	146323403.832	22.291	40.690	3.75	85.07	2.64	20.19
1990	11	30	1990	334	2448225.5	00	00	00	20.57	29.40	135.09	0.996	146266108.462	22.760	40.683	3.70	86.43	2.69	20.57
1990	11	31	1990	335	2448226.5	00	00	00	20.95	28.10	136.19	0.996	146208813.092	23.229	40.676	3.65	87.79	2.74	20.95

Open



helioc.dat

~/Pul-Fun/Ulysses/Trajectory/trajectory\_data

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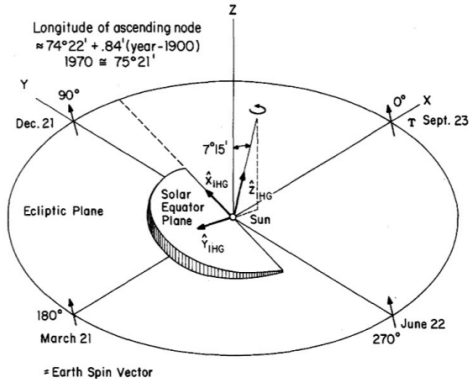
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Sun

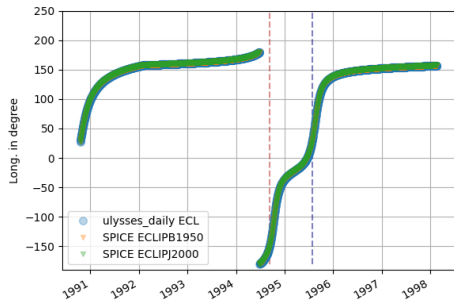
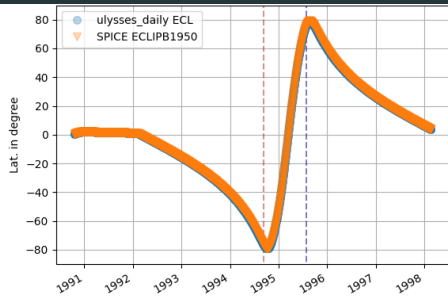
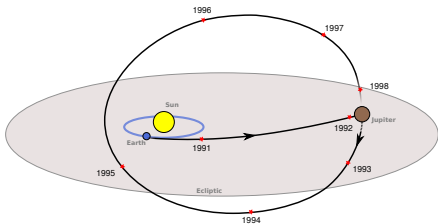
# Coordinate Systems

There seem to be two options for coordinate systems:

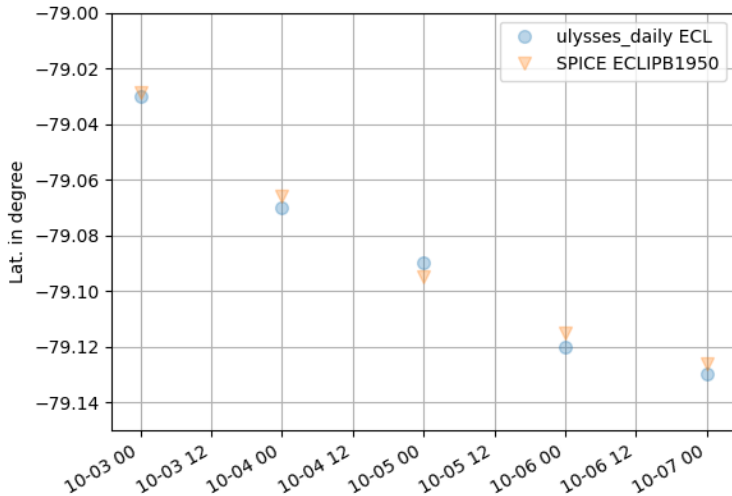
- **Heliocentric Inertial (HCI)** system
- **Heliocentric Aries Ecciptic (HAE)** system



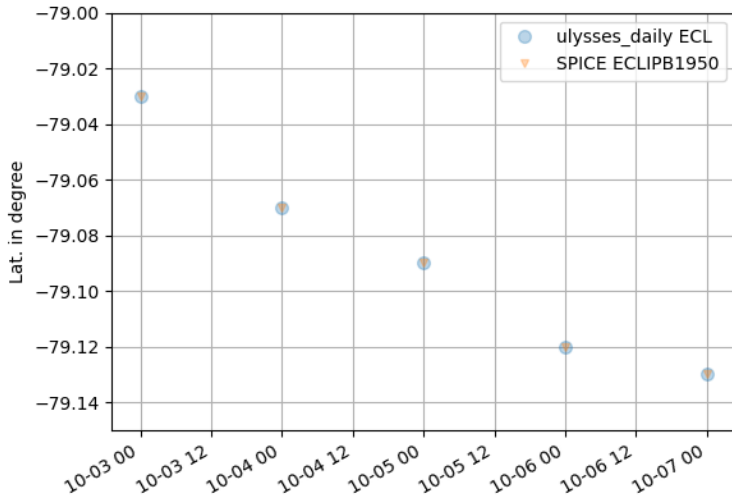
# Ulysses' 1st Orbit



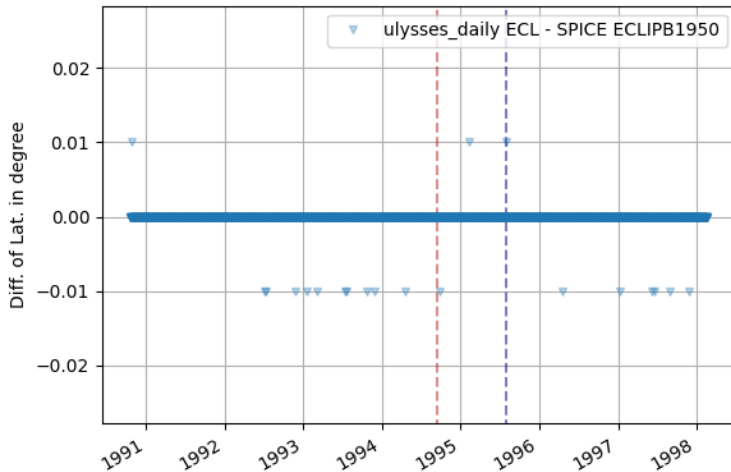
# Ecliptic System – Latitude



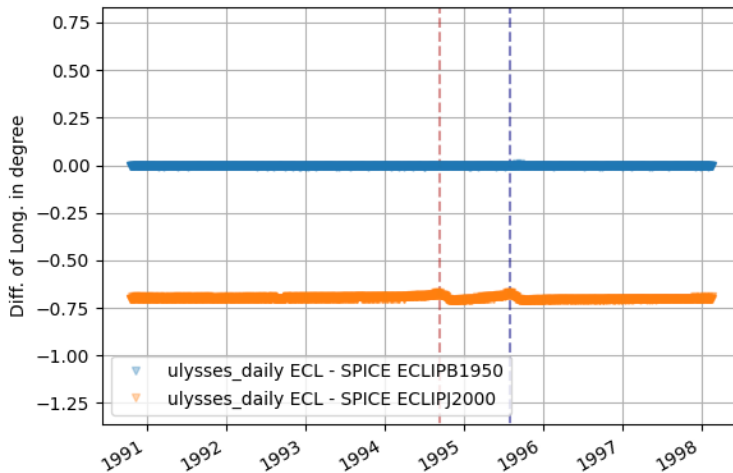
# Ecliptic System – Latitude



# Ecliptic System – Latitude



# Ecliptic System – Longitude



# Equatorial System

628-53, Rev. G Controlled Document

## Ulysses Reference Trajectory Characteristics

Krystyna Kiedron

March 15, 1993



JPL-D-243

Earth - Sun - S/C Angle	deg
Sun - S/C - Earth Angle	deg
Sun - Earth - S/C Angle	deg
Heliocentric Range of S/C	AU
Heliocentric Range Rate	km/sec
Heliocentric Velocity Magnitude	km/sec
Heliographic Latitude of S/C (SMEQ) <sup>a</sup>	deg
Heliocentric Sun Equator Right Ascension <sup>b</sup>	deg
Ecliptic Latitude of S/C Relative to Sun (EMEC) <sup>c</sup>	deg
Solar Longitude With Respect to Earth <sup>d</sup>	deg

<sup>a</sup>SMEQ - Sun mean equator and equinox of 1950

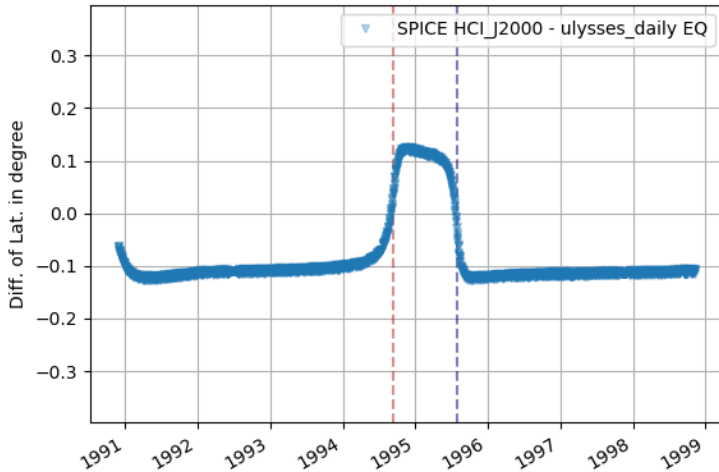
<sup>b</sup>The right ascension of the S/C in the Sun's equatorial plane measured from the ascending node of Earth's orbit plane of 1950

<sup>c</sup>Earth mean ecliptic and equinox of 1950

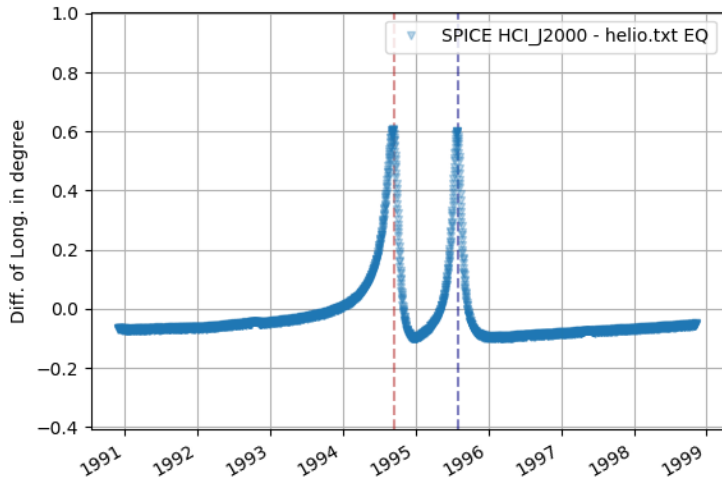
<sup>d</sup>The Earth-Sun-S/C angle projected on the sun's equatorial plane where the current Earth-Sun line is always longitude = 0.0°



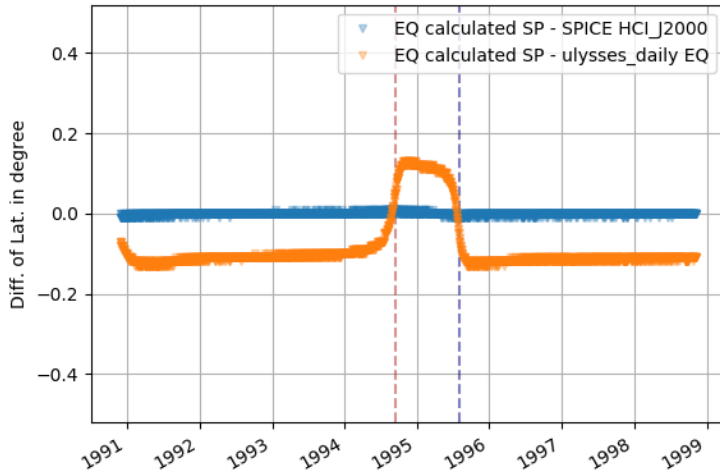
# Equatorial System – Latitude



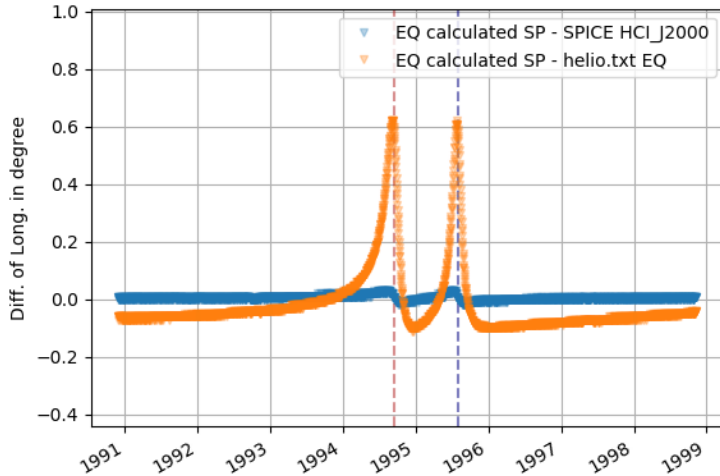
# Equatorial System – Longitude



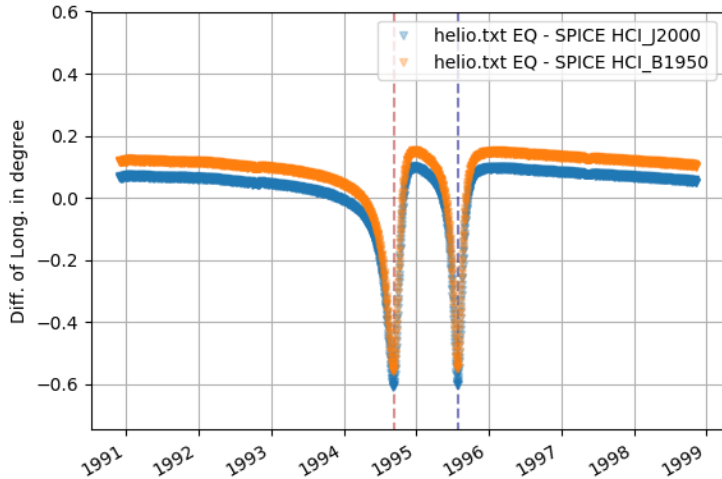
# Equatorial System – Latitude calculated



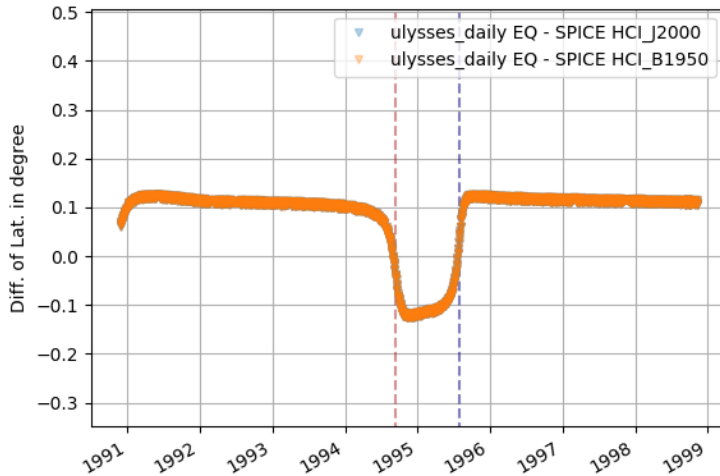
# Equatorial System – Longitude calculated



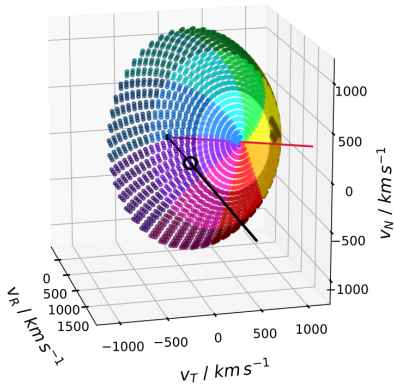
## Equatorial System – Longitude – B1950 vs. J2000



# Equatorial System – Latitude – B1950 vs. J2000



# Aspect Angle



Aspect angle:

$$\varphi = 25^\circ, \vartheta = -10^\circ$$

# SPICE Reference Frame Kernel



## Two-Vector Frame Concepts - 3

Navigation and Ancillary Information Facility

### • Secondary Vector

- A specified positive or negative axis of the two-vector frame is aligned with the component of the secondary vector orthogonal to the primary vector.
  - » The frame kernel creator associates with this vector one of the axis designations { +X, -X, +Y, -Y, +Z, -Z }, where the axis is orthogonal to that associated with the primary vector.

### Heliocentric Inertial (HCI) Frame

#### Definition of the Heliocentric Inertial frame:

All vectors are geometric: no aberration corrections are used.

The solar rotation axis is the primary vector: the Z axis points in the solar north direction (IAU\_SUN frozen at J2000 epoch).

The ascending node on the ecliptic of J2000 of the IAU\_SUN equator forms the X axis. \*\*\* N.B this is accomplished by using the +Z axis of the ecliptic of J2000 as the secondary vector and HCI +Y as the secondary axis

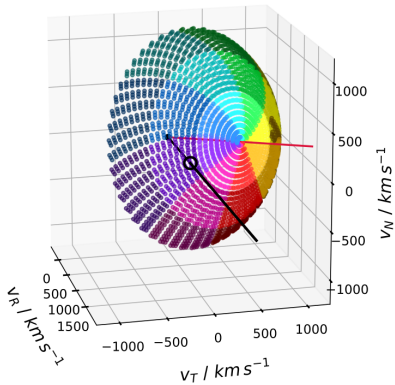
The Y axis is Z cross X, completing the right-handed reference frame.

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```
FRAME_HCI                                = 1810420
FRAME_1810420_NAME                       = 'HCI'
FRAME_1810420_CLASS                      = 5
FRAME_1810420_CLASS_ID                   = 1810420
FRAME_1810420_CENTER                     = 10
FRAME_1810420_RELATIVE                   = 'J2000'
FRAME_1810420_DEF_STYLE                   = 'PARAMETERIZED'
FRAME_1810420_FAMILY                     = 'TWO-VECTOR'
FRAME_1810420_FREEZE_EPOCH               = @2000-JAN-01/12:00:00
FRAME_1810420_PRI_AXIS                   = 'Z'
FRAME_1810420_PRI_VECTOR_DEF              = 'CONSTANT'
FRAME_1810420_PRI_FRAME                   = 'IAU_SUN'
FRAME_1810420_PRI_SPEC                    = 'RECTANGULAR'
FRAME_1810420_PRI_VECTOR                 = ( 0, 0, 1 )
FRAME_1810420_SEC_AXIS                    = 'Y'
FRAME_1810420_SEC_VECTOR_DEF              = 'CONSTANT'
FRAME_1810420_SEC_FRAME                   = 'ECLIPJ2000'
FRAME_1810420_SEC_SPEC                    = 'RECTANGULAR'
FRAME_1810420_SEC_VECTOR                 = ( 0, 0, 1 )
```



# Aspect Angle



Aspect angle:

$$\varphi = 25^\circ, \vartheta = -10^\circ$$

