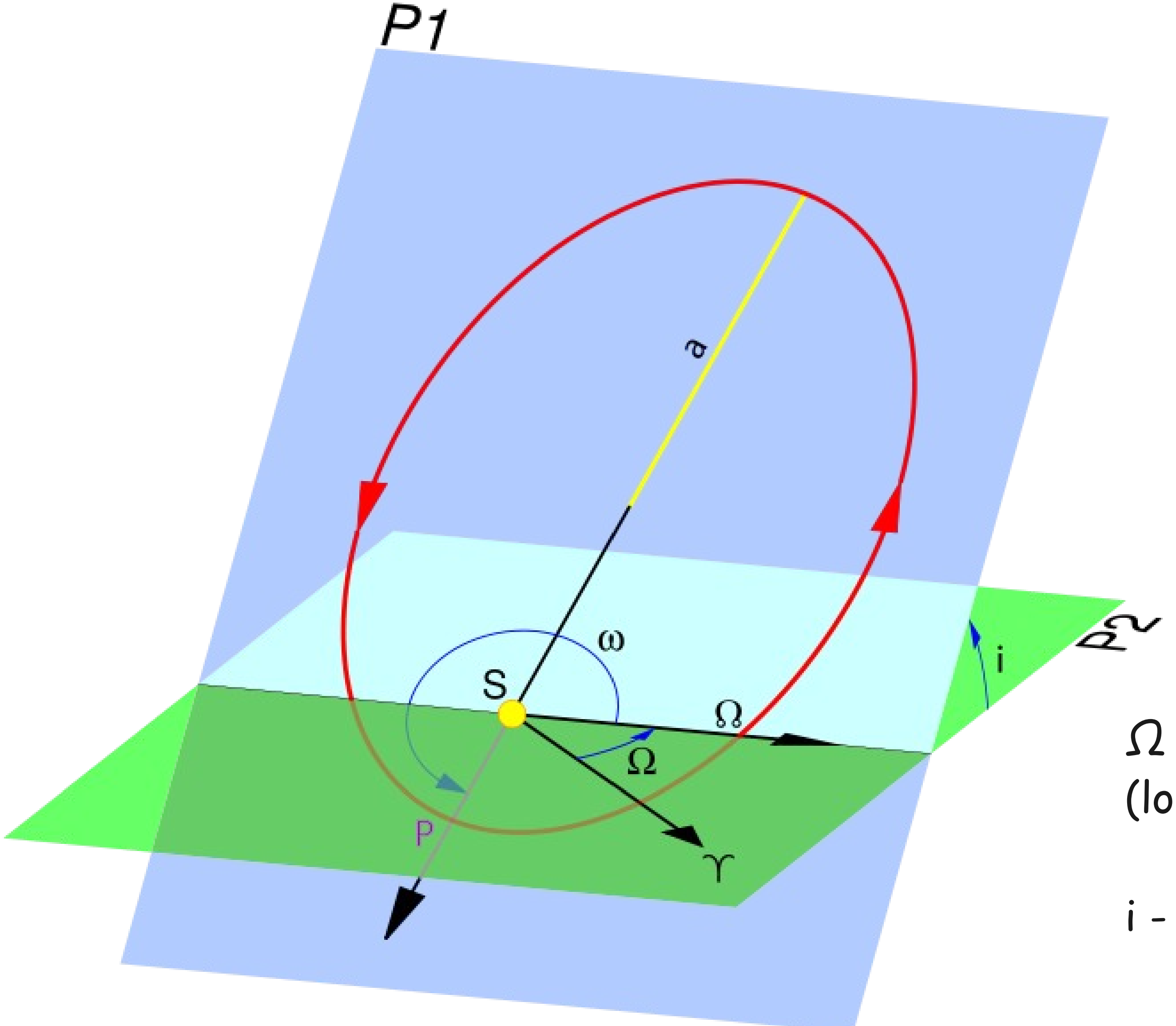
Gibanje 2 teles v prostoru



Ω – dolžina dvižnega vozla
(longitude of the ascending node)

i - naklon (inklinacija) tira

ω – argument perihelija
(argument of perihelion)

Parametri tira

1 ε [sploščenost tira]

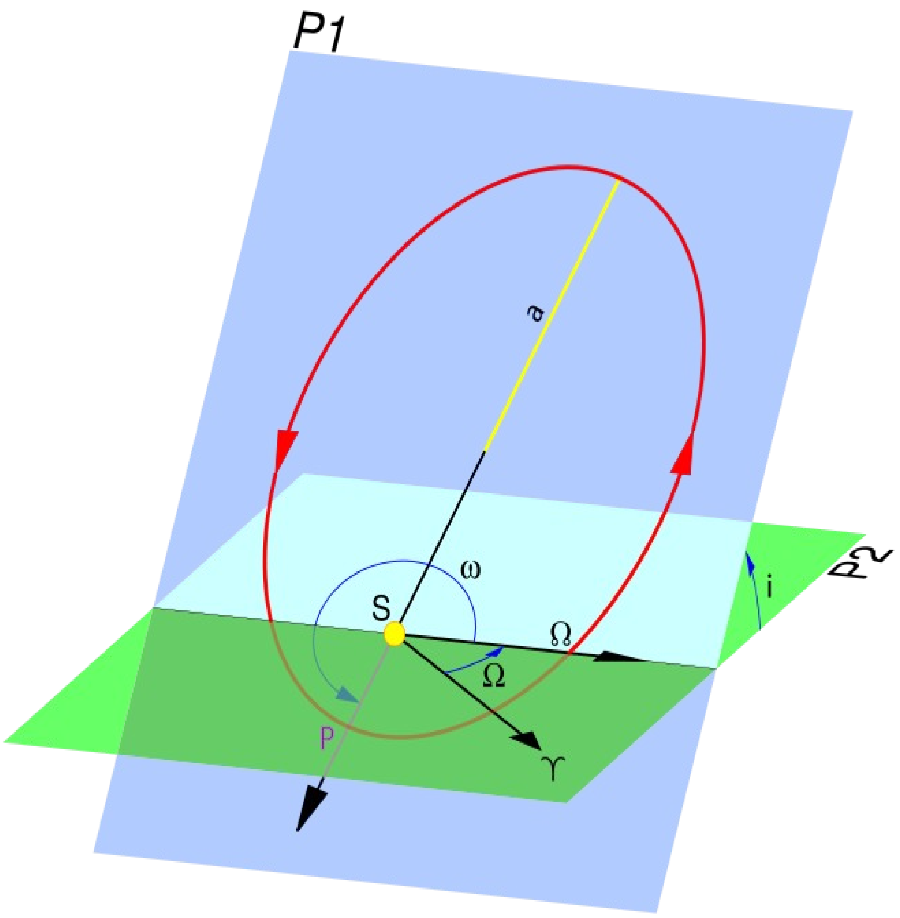
2
a [velika polos]
q [razdalja perihelija] = a(1-ε)
p [parameter r_o] = $a(1-\varepsilon^2)$
P [obhodni čas] = $(4\pi^2a^3/(GM))^{1/2}$
n [srednje (dnevno) gibanje] = 360°/P

3 i [naklon tira]

4 Ω [dolžina dvižnega vozla]

5
ω [argument perihelija]
ϖ [dolžina perihelija] = ω+Ω

6
t_o [trenutek perihelija, φ = 0]
M(določen hip) [srednja anomalija]
L [srednja dolžina] =M+ϖ

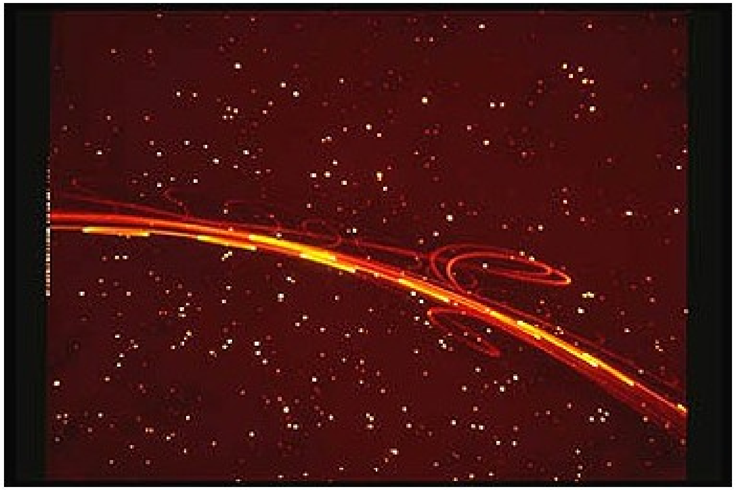


3-dimenzionalna predstava gibanja

http://neo.jpl.nasa.gov/orbits/

Eros
Halley
Apophis (leta 2029)
C/2006 P1 (McNaught) (začetek leta 2007)

Gibanje planetov



. This photograph shows the apparent movements of the planets against the background stars. Mars, Jupiter and Saturn appear to stop in their orbits, then reverse direction before continuing on – a phenomenon called retrograde motion by modern astronomers. Ancient and modern explanations for this temporary backward motion are illustrated in Figures 1.6 and 1.9, respectively. (Courtesy of Erich Lessing/Magnum).

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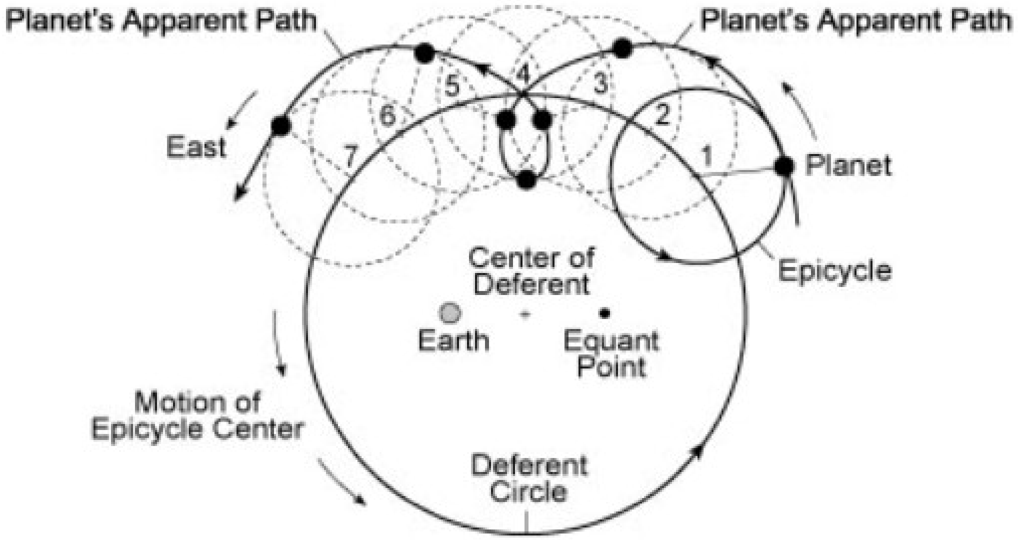
Razlage gibanja z epicikli



. To explain the occasional retrograde loops in the apparent motions of Mars, Jupiter and Saturn, astronomers in ancient times imagined that each planet travels with uniform speed around a small circle, known as the epicycle. The epicycle's center moves uniformly on a larger circle, the deferent. A similar scheme was used by Ptolemy to explain the wayward motions of the planets in his *Almagest*. In the Ptolemaic system, the Earth was displaced from the center of the large circle, and each planet traveled with uniform motion with respect to another imaginary point, the equant, appearing to move with variable speed when viewed from the Earth.

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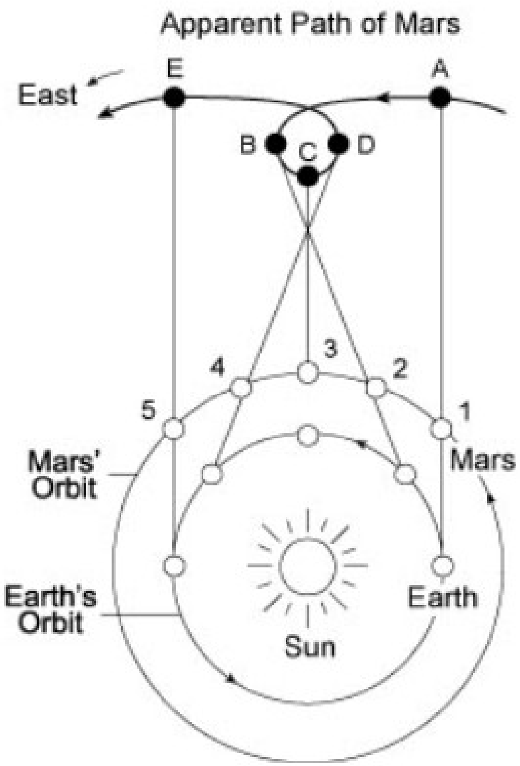
Napredno in vzvratno gibanje v heliocentričnem sistemu



. A Sun-centered model of the solar system explains the looping path of Mars in terms of the relative speeds of the Earth and Mars. The Earth travels around the Sun more rapidly than Mars does. As Earth overtakes and passes the slower moving planet (*points 2 to 4*), Mars appears to move backward (*points B to D*) for a few months.

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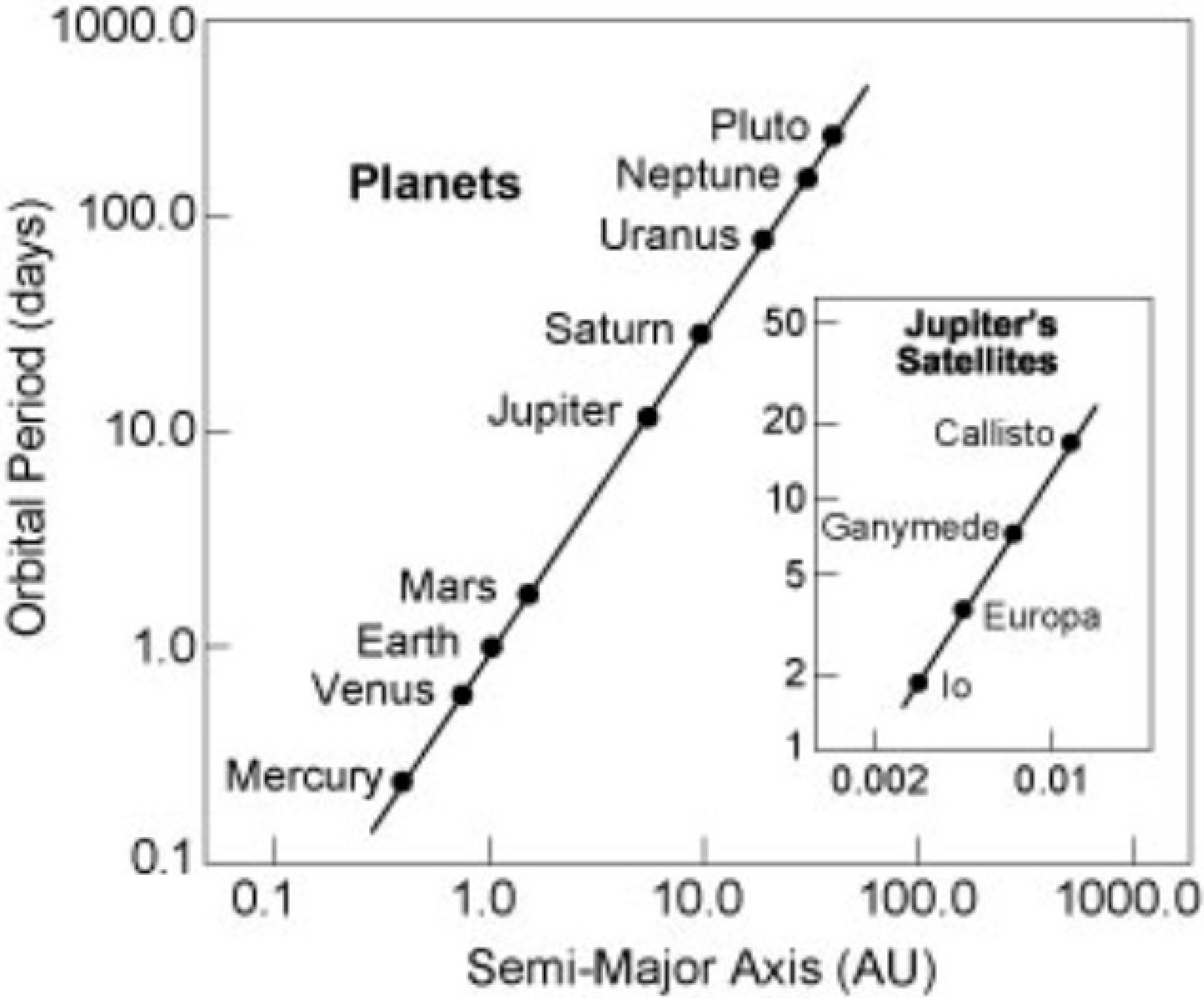
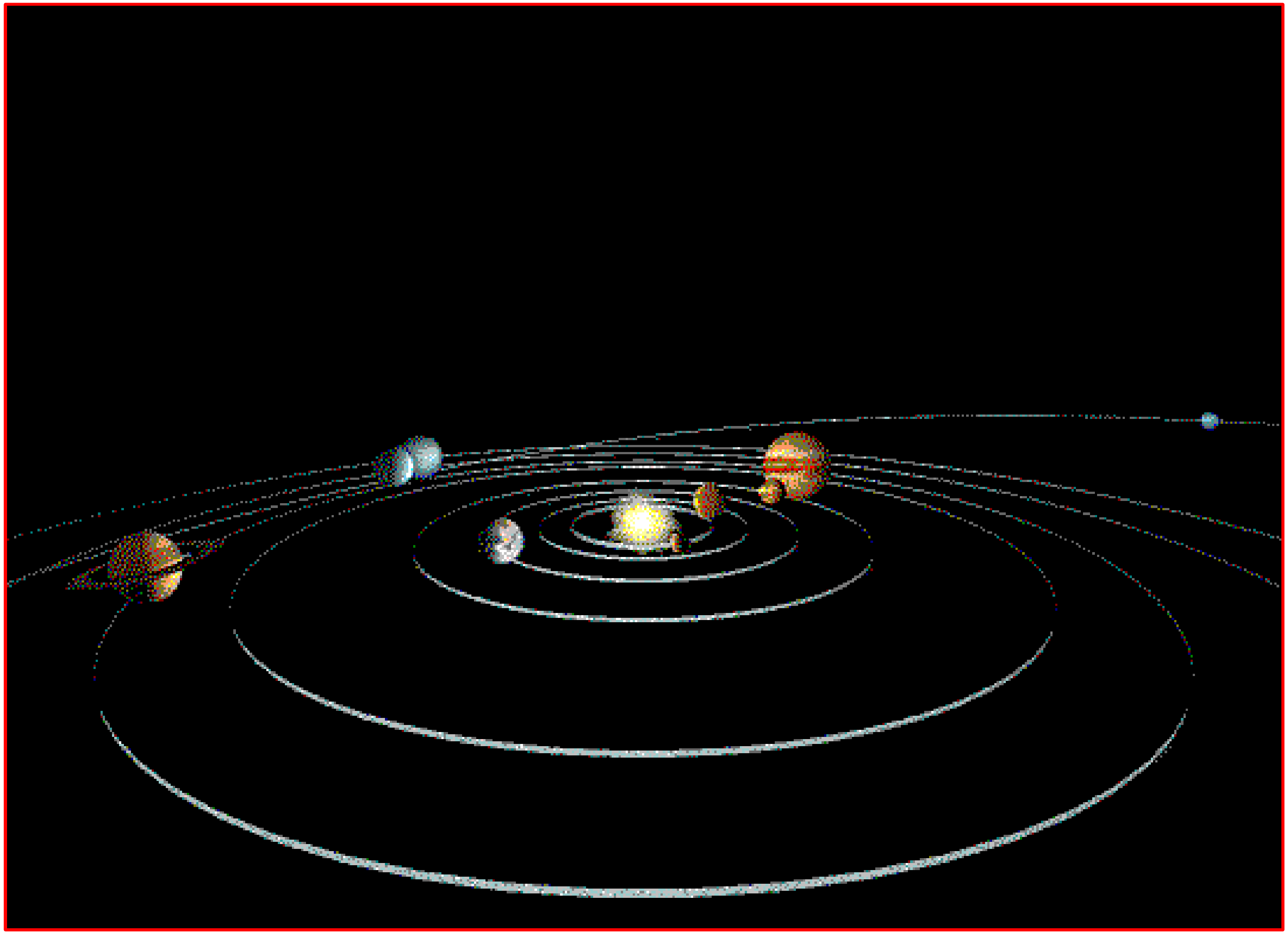
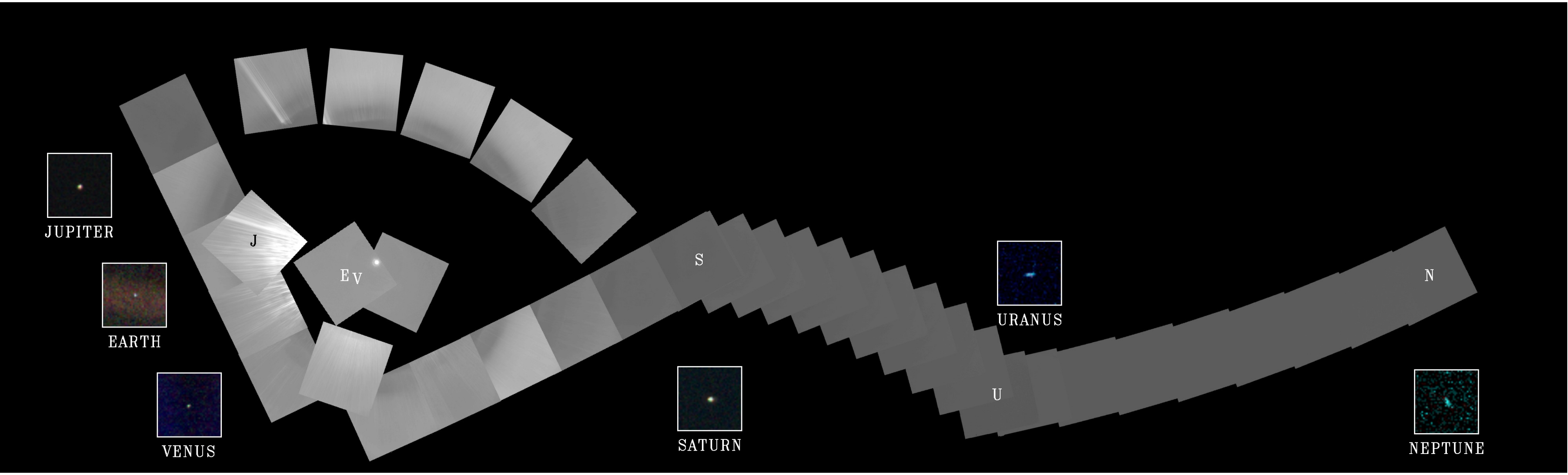
3. Keplerjev zakon



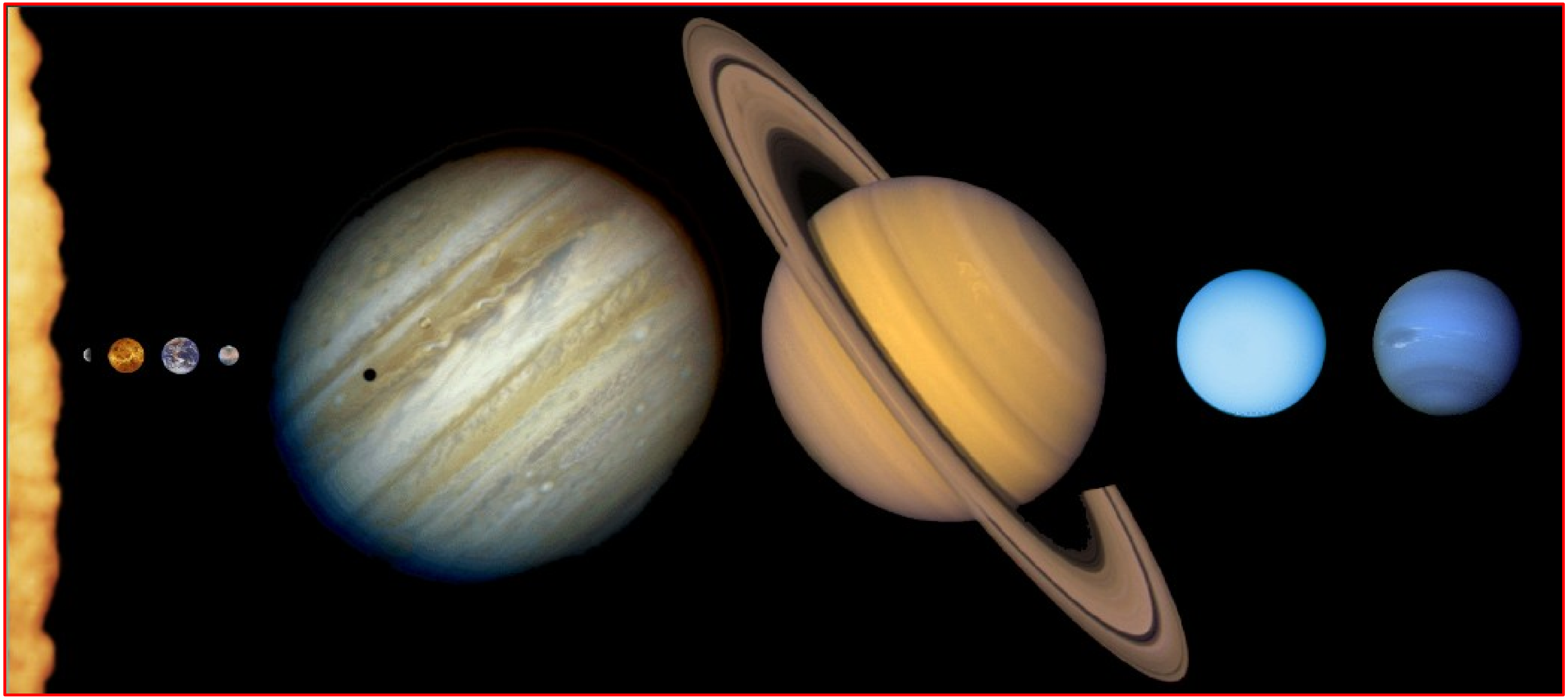
Naše Osončje



Naše Osončje:
portret s sonde Voyager



Naše Osončje



Orbitalni podatki Osončja

Name	#	Orbits	Distance (000 km)	O_Period (days)	Incl	Eccen	Discoverer	Date	A.K.A.
Sun	-	-	-	-	-	-	-	-	Sol (0)
Mercury	I	Sun	57910	87.97	7.00	0.21	-	-	(0)
Venus	II	Sun	108200	224.70	3.39	0.01	-	-	(0)
Earth	III	Sun	149600	365.26	0.00	0.02	-	-	(0)
Mars	IV	Sun	227940	686.98	1.85	0.09	-	-	(0)
Jupiter	V	Sun	778330	4332.71	1.31	0.05	-	-	(0)
Saturn	VI	Sun	1429400	10759.50	2.49	0.06	-	-	(0)
Uranus	VII	Sun	2870990	30685.00	0.77	0.05	Herschel	1781	(0)
Neptune	VIII	Sun	4504300	60190.00	1.77	0.01	Adams(9)	1846	(0)
Pluto	IX	Sun	5913520	90550	17.15	0.25	Tombaugh	1930	(0)
Moon	I	Earth	384	27.32	5.14	0.05	-	-	Luna (0)
Phobos	I	Mars	9	0.32	1.00	0.02	Hall	1877	
Deimos	II	Mars	23	1.26	1.80	0.00	Hall	1877	
Metis	XVI	Jupiter	128	0.29	0.00	0.00	Synnott	1979	1979 J 3
Adrastea	XV	Jupiter	129	0.30	0.00	0.00	Jewitt(1)	1979	1979 J 1
Amalthea	V	Jupiter	181	0.50	0.40	0.00	Barnard	1892	
Thebe	XIV	Jupiter	222	0.67	0.80	0.02	Synnott	1979	1979 J 2
Io	I	Jupiter	422	1.77	0.04	0.00	Galileo(2)	1610	
Europa	II	Jupiter	671	3.55	0.47	0.01	Galileo(2)	1610	
Ganymede	III	Jupiter	1070	7.15	0.19	0.00	Galileo(2)	1610	
Callisto	IV	Jupiter	1883	16.69	0.28	0.01	Galileo(2)	1610	
Themisto	XVIII	Jupiter	7507				Sheppard(i)	2000	S/1975 J 1, S/2000 J1
Leda	XIII	Jupiter	11094	238.72	27.00	0.15	Kowal	1974	
Himalia	VI	Jupiter	11480	250.57	28.00	0.16	Perrine	1904	
Lysithea	X	Jupiter	11720	259.22	29.00	0.11	Nicholson	1938	
Elara	VII	Jupiter	11737	259.65	28.00	0.21	Perrine	1905	
Ananke	XII	Jupiter	21200	-631	147.00	0.17	Nicholson	1951	
Carme	XI	Jupiter	22600	-692	163.00	0.21	Nicholson	1938	
Pasiphae	VIII	Jupiter	23500	-735	147.00	0.38	Melotte	1908	
Sinope	IX	Jupiter	23700	-758	153.00	0.28	Nicholson	1914	
Iocaste	XXIV	Jupiter	20216				Sheppard(i)	2000	S/2000 J 3
Harpalyke	XXII	Jupiter	21132				Sheppard(i)	2000	S/2000 J 5
Praxidike	XXVII	Jupiter	20964				Sheppard(i)	2000	S/2000 J 7
Taygete	XX	Jupiter	23312				Sheppard(i)	2000	S/2000 J 9
Chaldene	XXI	Jupiter	23387				Sheppard(i)	2000	S/2000 J 10
Kalyke	XXIII	Jupiter	23745				Sheppard(i)	2000	S/2000 J 2
Callirrhoe	XVII	Jupiter	24100				Sheppard(i)	2000	S/1999 J 1
Megaclite	XIX	Jupiter	23911				Sheppard(i)	2000	S/2000 J 8
Isonoe	XXVI	Jupiter	23078				Sheppard(i)	2000	S/2000 J 6
Erinome	XXV	Jupiter	23168				Sheppard(i)	2000	S/2000 J 4

Orbitalni podatki Osončja

Name	#	Orbits	Distance (000 km)	O_Period (days)	Incl	Eccen	Discoverer	Date	A.K.A.
Pan	XVIII	Saturn	134	0.58	0.00	0.00	Showalter	1990	1981 S 13
Atlas	XV	Saturn	138	0.60	0.00	0.00	Terrile	1980	1980 S 28
Prometheus	XVI	Saturn	139	0.61	0.00	0.00	Collins(3)	1980	1980 S 27
Pandora	XVII	Saturn	142	0.63	0.00	0.00	Collins(3)	1980	1980 S 26
Epimetheus	XI	Saturn	151	0.69	0.34	0.01	Walker(8)	1980	1980 S 3
Janus	X	Saturn	151	0.69	0.14	0.01	Dollfus	1966	1980 S 1
Mimas	I	Saturn	186	0.94	1.53	0.02	Herschel	1789	
Enceladus	II	Saturn	238	1.37	0.02	0.00	Herschel	1789	
Tethys	III	Saturn	295	1.89	1.09	0.00	Cassini	1684	
Telesto	XIII	Saturn	295	1.89	0.00	0.00	Smith(6)	1980	1980 S 13
Calypso	XIV	Saturn	295	1.89	0.00	0.00	Pascu(7)	1980	1980 S 25
Dione	IV	Saturn	377	2.74	0.02	0.00	Cassini	1684	
Helene	XII	Saturn	377	2.74	0.20	0.01	Laques(4)	1980	1980 S 6, Dione B
Rhea	V	Saturn	527	4.52	0.35	0.00	Cassini	1672	
Titan	VI	Saturn	1222	15.95	0.33	0.03	Huygens	1655	
Hyperion	VII	Saturn	1481	21.28	0.43	0.10	Bond(5)	1848	
Iapetus	VIII	Saturn	3561	79.33	14.72	0.03	Cassini	1671	
Phoebe	IX	Saturn	12952	-550.48	175.30	0.16	Pickering	1898	
Cordelia	VI	Uranus	50	0.34	0.14	0.00	Voyager 2	1986	1986 U 7
Ophelia	VII	Uranus	54	0.38	0.09	0.00	Voyager 2	1986	1986 U 8
Bianca	VIII	Uranus	59	0.43	0.16	0.00	Voyager 2	1986	1986 U 9
Cressida	IX	Uranus	62	0.46	0.04	0.00	Voyager 2	1986	1986 U 3
Desdemona	X	Uranus	63	0.47	0.16	0.00	Voyager 2	1986	1986 U 6
Juliet	XI	Uranus	64	0.49	0.06	0.00	Voyager 2	1986	1986 U 2
Portia	XII	Uranus	66	0.51	0.09	0.00	Voyager 2	1986	1986 U 1
Rosalind	XIII	Uranus	70	0.56	0.28	0.00	Voyager 2	1986	1986 U 4
Belinda	XIV	Uranus	75	0.62	0.03	0.00	Voyager 2	1986	1986 U 5
Puck	XV	Uranus	86	0.76	0.31	0.00	Voyager 2	1985	1985 U 1
Miranda	V	Uranus	130	1.41	4.22	0.00	Kuiper	1948	
Ariel	I	Uranus	191	2.52	0.00	0.00	Lassell	1851	
Umbriel	II	Uranus	266	4.14	0.00	0.00	Lassell	1851	
Titania	III	Uranus	436	8.71	0.00	0.00	Herschel	1787	
Oberon	IV	Uranus	583	13.46	0.00	0.00	Herschel	1787	
Caliban	XVI	Uranus	7169	-580	140.	0.08	Gladman (c)	1997	1997 U 1
Stephano	XX	Uranus	7948	-674	143.	0.24	Gladman (f)	1999	1999 U 2
Sycorax	XVII	Uranus	12213	-1289	153.	0.51	Nicholson(e)	1997	1997 U 2
Prospero	XVIII	Uranus	16568	-2019	152.	0.44	Holman (g)	1999	1999 U 3
Setebos	XIX	Uranus	17681	-2239	158.	0.57	Kavelaars(d)	1999	1999 U 1
Trinculo	XXI	Uranus					Gladman (f)	2001	2001 U 1
Naiad	III	Neptune	48	0.29	0.00	0.00	Voyager 2	1989	1989 N 6
Thalassa	IV	Neptune	50	0.31	4.50	0.00	Voyager 2	1989	1989 N 5
Despina	V	Neptune	53	0.33	0.00	0.00	Voyager 2	1989	1989 N 3
Galatea	VI	Neptune	62	0.43	0.00	0.00	Voyager 2	1989	1989 N 4
Larissa	VII	Neptune	74	0.55	0.00	0.00	Reitsema (h)	1989	1989 N 2
Proteus	VIII	Neptune	118	1.12	0.00	0.00	Voyager 2	1989	1989 N 1
Triton	I	Neptune	355	-5.88	157.00	0.00	Lassell	1846	
Nereid	II	Neptune	5513	360.13	29.00	0.75	Kuiper	1949	
Charon	I	Pluto	20	6.39	98.80	0.00	Christy	1978	1978 P 1
Nix	II	Pluto	49	24.86	0.20	0.00	Stern (j)	2005	2005 P 1
Hydra	III	Pluto	65	38.21	0.21	0.01	Stern (j)	2005	2005 P 2

) J1

Dejanske, skalirane, kotne velikosti

Name	#	Orbits	Distance (000 km)	O_Period (days)	Incl	Eccen	Discoverer	Date	A.K.A.
Sun	-	-	-	-	-	-	-	-	Sol (0)
Mercury	I	Sun	57910	87.97	7.00	0.21	-	-	(0)
Venus	II	Sun	108200	224.70	3.39	0.01	-	-	(0)
Earth	III	Sun	149600	365.26	0.00	0.02	-	-	(0)
Mars	IV	Sun	227940	686.98	1.85	0.09	-	-	(0)
Jupiter	V	Sun	778330	4332.71	1.31	0.05	-	-	(0)
Saturn	VI	Sun	1429400	10759.50	2.49	0.06	-	-	(0)
Uranus	VII	Sun	2870990	30685.00	0.77	0.05	Herschel	1781	(0)
Neptune	VIII	Sun	4504300	60190.00	1.77	0.01	Adams(9)	1846	(0)
Pluto	IX	Sun	5913520	90550	17.15	0.25	Tombaugh	1930	(0)
Moon	I	Earth	384	27.32	5.14	0.05	-	-	Luna (0)

Name	Radius (km)	Mass (kg)	Dens	Abo	Vo	Rotate (days)	Dimensions (km)
Sun	695000	1.99e30	1.41	?	-26.	24.6	
Mercury	2440	3.30e23	5.43	.11	-1.9	58.6	
Venus	6052	4.87e24	5.24	.65	-4.4	-243	
Earth	6378	5.97e24	5.52	.30	-	0.99	
Mars	3397	6.42e23	3.93	.15	-2.0	1.03	
Jupiter	71492	1.90e27	1.33	.52	-2.7	0.41	
Saturn	60268	5.68e26	0.69	.47	0.7	0.45	
Uranus	25559	8.68e25	1.32	.51	5.5	-0.72	
Neptune	24766	1.02e26	1.64	.41	7.8	0.67	
Pluto	1150	1.27e22	2.06	.55	13.6	-6.39	(z)
Moon	1738	7.35e22	3.34	.12	-12.7	S	

Name	Gravity (g)	Esc vel (km/s)	M.O.V (km/s)	Axial incl	Oblate	Ascend node	Peri-helion	Equilib (K)	Surface (K)	Press (atm)	Atmospheric Composition
Mercury	0.378	4.44	47.87	0		48.35	77.44	449	440	0	--
Venus	0.907	10.36	35.02	177.36		76.72	131.56	328	730	93	CO_2, N_2
Earth	1.000	11.19	29.79	23.45	.00335	354.90	102.83	279	287	1	N_2, O_2, Ar
Mars	0.377	5.03	24.13	25.19	.00519	49.60	335.99	226	218	0.007	CO_2, N_2, Ar
Jupiter	2.364	59.5	13.06	3.13	.06481	100.47	15.63	122	120	(x)	H_2, He
Saturn	0.916	35.5	9.66	26.73	.1076	113.71	92.80	90	88		H_2, He
Uranus	0.889	21.3	6.80	97.86	.030	74.06	176.29	64	59		H_2, He, CH_4
Neptune	1.125	23.5	5.44	29.60	.026	131.81	1.95	51	48		H_2, He, CH_4
Pluto	0.067	1.3	4.74	122.52		110.42	224.59	44	37	1e-5	N_2, CH_4, CO

Key:

Gravity	Equatorial surface gravity in g's (see also "Your Weight On Other Worlds")
Esc vel	Escape velocity in kilometers per second
M.O.V.	Mean Orbital Velocity in kilometers per second
Axial incl	Inclination of the rotation axis in degrees (obliquity)
Oblate	Oblateness
Ascend	Longitude of the ascending node
Perihelion	Longitude of perihelion
Equilib	Equilibrium temperature in Kelvins
Surface	Surface temperature in Kelvins
Press	Surface pressure in atmospheres

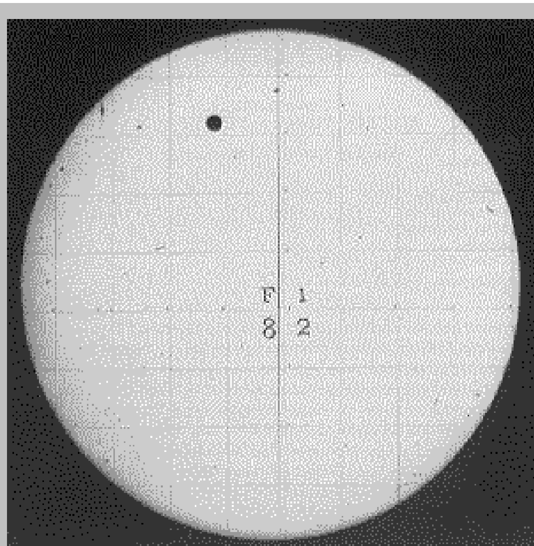
Notes:

(x) for the jovian planets "surface" refers to the cloud tops or 1 bar level

Much more accurate and detailed data is available from JPL's Horizons **telnet** interface

- **Transits of Mercury and Venus** are easy to see against the background of the Sun

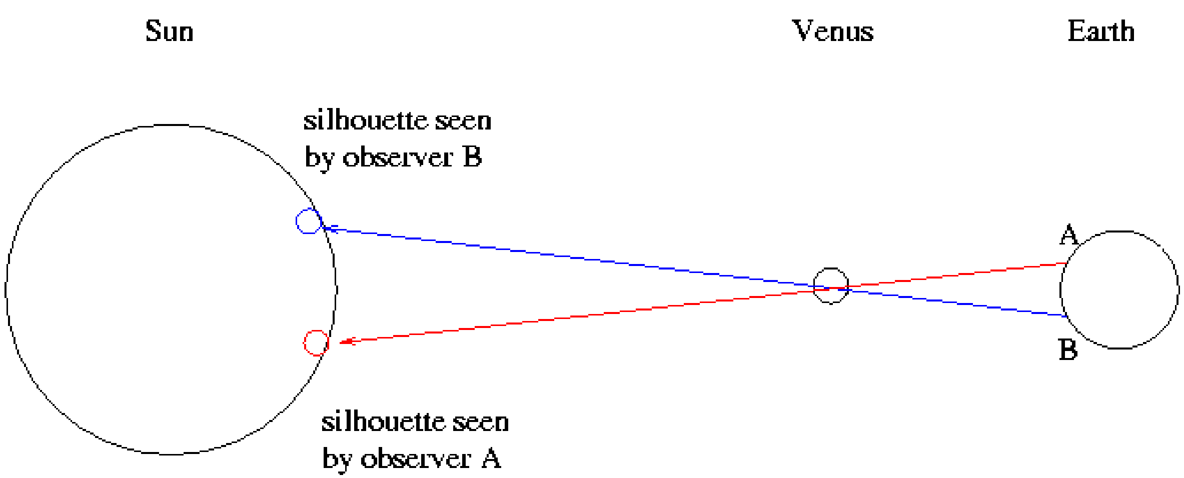
Here's a photograph of the transit of Venus in 1882, taken from Wellington, South Africa.



An image of one of the 1700 plates taken worlwide during the 1882 transit, showing Venus crossing the disk of the Sun. Also visible is the image of the ruled glass reticle mounted in front of the plate and the vertical line in the centre is that of a thin silver plumb line that hung between the plate and grid. The small dots on the picture were caused by defects in the glass photographic plates. (*JHA* XXIX, 1998)

Razdalje v Osončju: prehodi Venere

The basic idea is that observers at different points on the Earth will see Venus silhouetted in front of different points on the Sun:

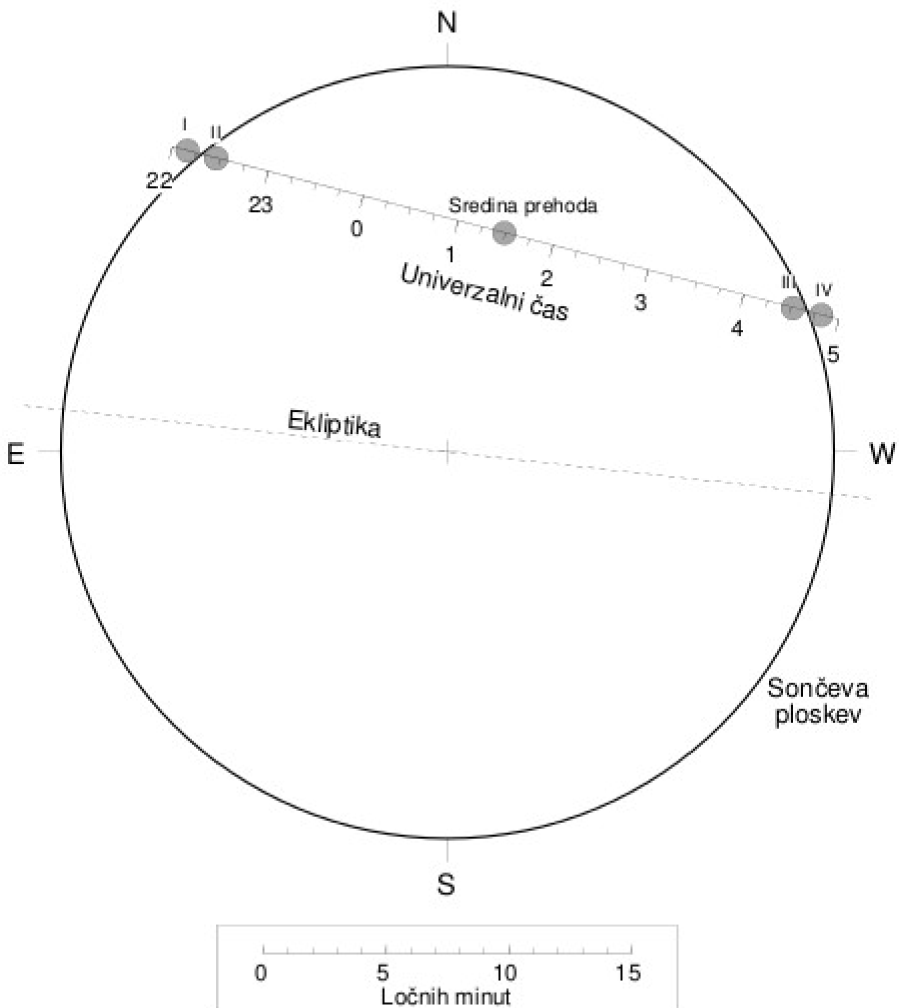


(Note that this figure is not to scale!)

Prehod Venere 2012

6. junija 2012 zjutraj bo tudi iz Evrope mogoče opazovati prehod Venere preko Sončeve ploskvice. Venera se bo dotaknila Sončeve ploskvice 9 minut čez polnoč po srednjeevropskem poletnem času. Notranji kontakt, ko bo celotna Venerina ploskvica pred Soncem, bo nastopil 18 minut kasneje. Tedaj bo pri nas še noč, zato prvega kontakta ne bo mogoče opazovati. Sonce bo skupaj z Venero v Ljubljani vzšlo ob 5. uri in 18 minut po srednjeevropskem poletnem času. Venerina ploskvica se bo dotaknila roba Sonca ob 6. uri in 32 minut ter povsem odkrila Sonce ob 6. uri in 50 minut. Minimalni kot med središčema Venere in Sonca bo ob tem prehodu enak 554 ločnih sekund. Vsi številski podatki se nanašajo na geocentričnega opazovalca. Torej se navedeni časi na posameznih mestih na Zemlji od navedenih lahko razlikujejo za do 7 minut. Prejšnji prehod Venere preko Sončeve ploskvice je bil viden 8. junija 2004, naslednji pa bo nastopil šele 11. decembra leta 2117, torej gre za redek dogodek. Pari prehodov (npr. 2004 in 2012) nastopijo v 8-letnem razmaku, med zaporednima paroma prehodov pa mine 113 ali 130 let. Tako so bili oziroma bodo prehodi v letih 1631, 1639, 1761, 1769, 1874, 1882, 2004, 2012, 2117 in 2125.

Prehod Venere 2012

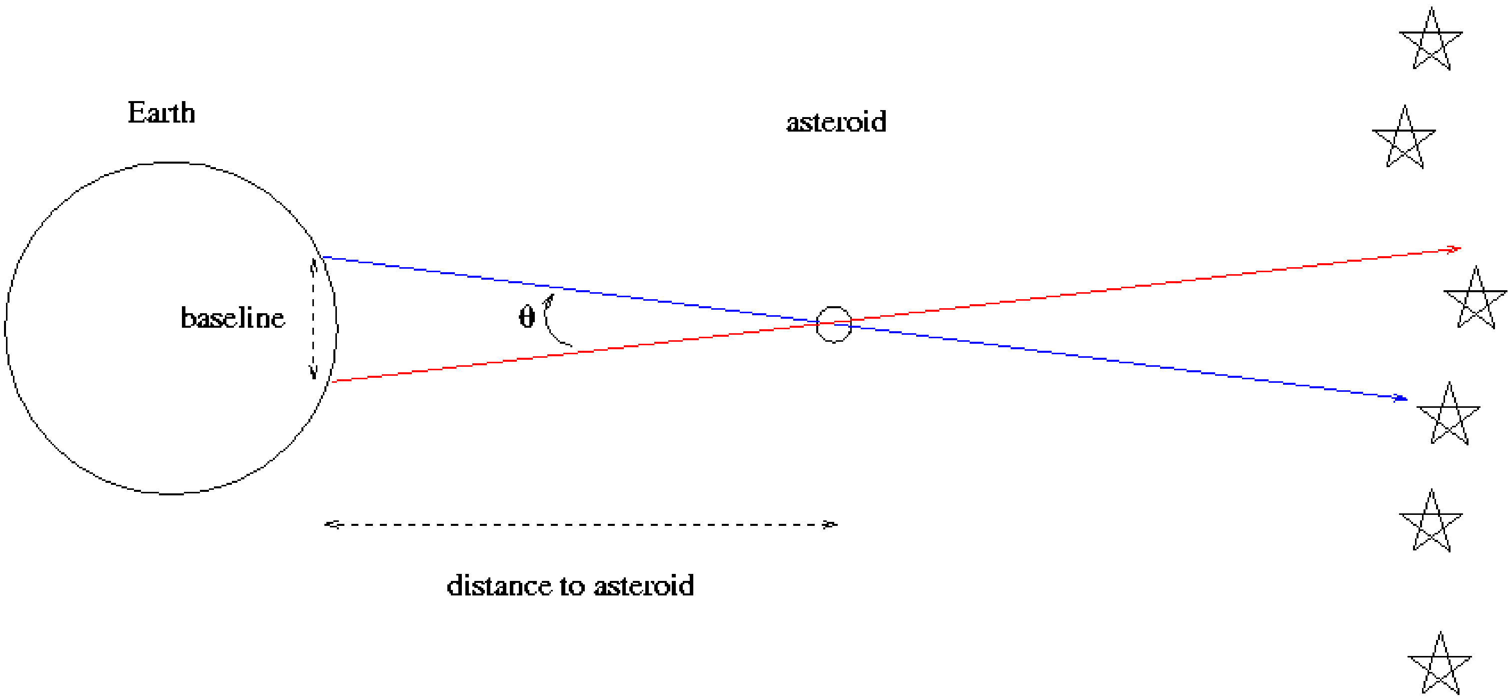


Slika 5: Prehod Venere preko Sončeve ploskvice 6. junija 2012. Označeni so univerzalni časi za geocentričnega opazovalca: I: 22:09:38, II: 22:27:34, sredina prehoda: 01:29:36, III: 04:31:39, IV: 04:49:35. Univerzalni čas pretvorimo v srednjeevropski poletni čas tako, da mu prištejemo dve uri. Označena je tudi ravnina Zemljinega tira okoli Sonca (ekliptika) in kotno merilo velikosti Sončevega diska. Vir: Fred Espenak, NASA/GSFC

Razdalje v Osončju: paralaksa bližnjih asteroidov

- **Nearby asteroids** are faint enough that they don't overwhelm reference stars.

  Again, the basic idea is to observe the asteroid from widely separated locations on Earth, and measure the shift in its apparent position with respect to background stars.



(Note that this figure is not to scale!)

The closer the asteroid comes to the Earth, the larger the parallax and the easier it is to measure. In 1931, the asteroid Eros came within 16 million kilometers of the Earth (compared to mininum distances of 42 million km for Venus and 55 million km for Mars). Observatories around the world measured its position very carefully over a period of several months, and -- many years later -- the data were finally reduced to yield

1. a precise distance between Eros and the Earth
2. an accurate orbit for Eros

Razdalje v Osončju: paralaksa bližnjih asteroidov

Eros at Opposition in 2012

Eros is at opposition in early February when it will reach magnitude 8.55 from February 1 to 5 and be 8.6 or brighter between January 27 and February 11. It is actually closest to the Earth on January 31 with a distance of 0.179 Astronomical Units, just under 27 million kilometres. This is about 70 times the mean distance of the Moon. Hence Eros is a Near Earth Asteroid so being the first NEA to be discovered.

Full moon is on February 8 (NZDT) so there will be considerable moonlight at the time Eros is brightest. However Eros is always some distance from the moon so the asteroid is likely to be visible in binoculars.

Eros first brightens to magnitude 9.5 on December 29 as it moves from Leo Minor into Leo. It will then be well north of the celestial equator and low in New Zealand skies. Over the next few weeks during the period near opposition, Eros will be moving to the south as seen from the Earth, rather than the more normal west. After being in Leo, Eros will move into Sextans on January 20 and then cross Hydra during February. It will move into Antlia at the beginning of March as its magnitude drops back to 9.5.

The southerly motion will bring it higher into southern hemisphere skies. It is just south of the equator when brightest at the beginning of February. The north to south motion is similar to that of **(1036) Ganymed**, the largest NEA, which was at opposition at the end of October 2011 and brightened to magnitude 8.3.

Discovery and History of Eros.

Eros was discovered by G. Witt at Berlin on 1898 August 13. It was also observed a little earlier the same night by A. Chalois at Nice. It was the first asteroid to be discovered that crossed the orbit of Mars to make a close approach to the Earth. At its opposition in 1900/1901 and again at the close approach in 1931 the parallax of was used to determine the distance of the Sun. The parallax is the apparent change in position of Eros as seen from different parts of the Earth.

The previous best determinations of the Sun's distance had been made by observations of the transit of Venus in the 18th and 19th centuries. So it seems appropriate that Eros should make another close approach in 2012 with another **transit of Venus** also occurring in June. The determinations of the Sun's distance using Eros remained the most accurate until radar measures later in the 20th century.

Eros was visited by the NASA spacecraft NEAR Shoemaker in 2000 when the elongated shape of the asteroid was imaged. In 2001 it descended to the surface. Eros is roughly cylindrical with dimensions about 34km x 11km x 11 km.

Eros's orbital period is 1.761 years, just over 643 days. Its distance from the Sun varies from 1.134 to 1.78 AU with a mean distance 1.46 AU. Thus at aphelion it is beyond the orbit of Mars. The eccentricity of the orbit is 0.223 and its inclination to the ecliptic is 10.8°.

Favourable oppositions of Eros always occur close to the end of January. At that time the Earth is 0.985 AU from the Sun. At the closest oppositions Eros is 0.149 AU from the Earth. The last close opposition of Eros was 1975 January 23 with at a distance of 0.151 AU, the next is 2056 January 24 at 0.150 AU. The close oppositions occur alternately at intervals of 37 and 44 years.

Razdalje v Osončju: radarski odboj z bližnjih asteroidov

Scheduled Arecibo Radar Asteroid Observations

This is a list of scheduled Arecibo radar asteroid observations. Entries are submitted by the principal investigators and may not be comprehensive. Objects listed here are flagged as being radar targets in the MPC's Minor Planet Ephemeris Service.

Objects with "Yes" in the "Posns?" column need optical astrometry to assure the success of radar observations.

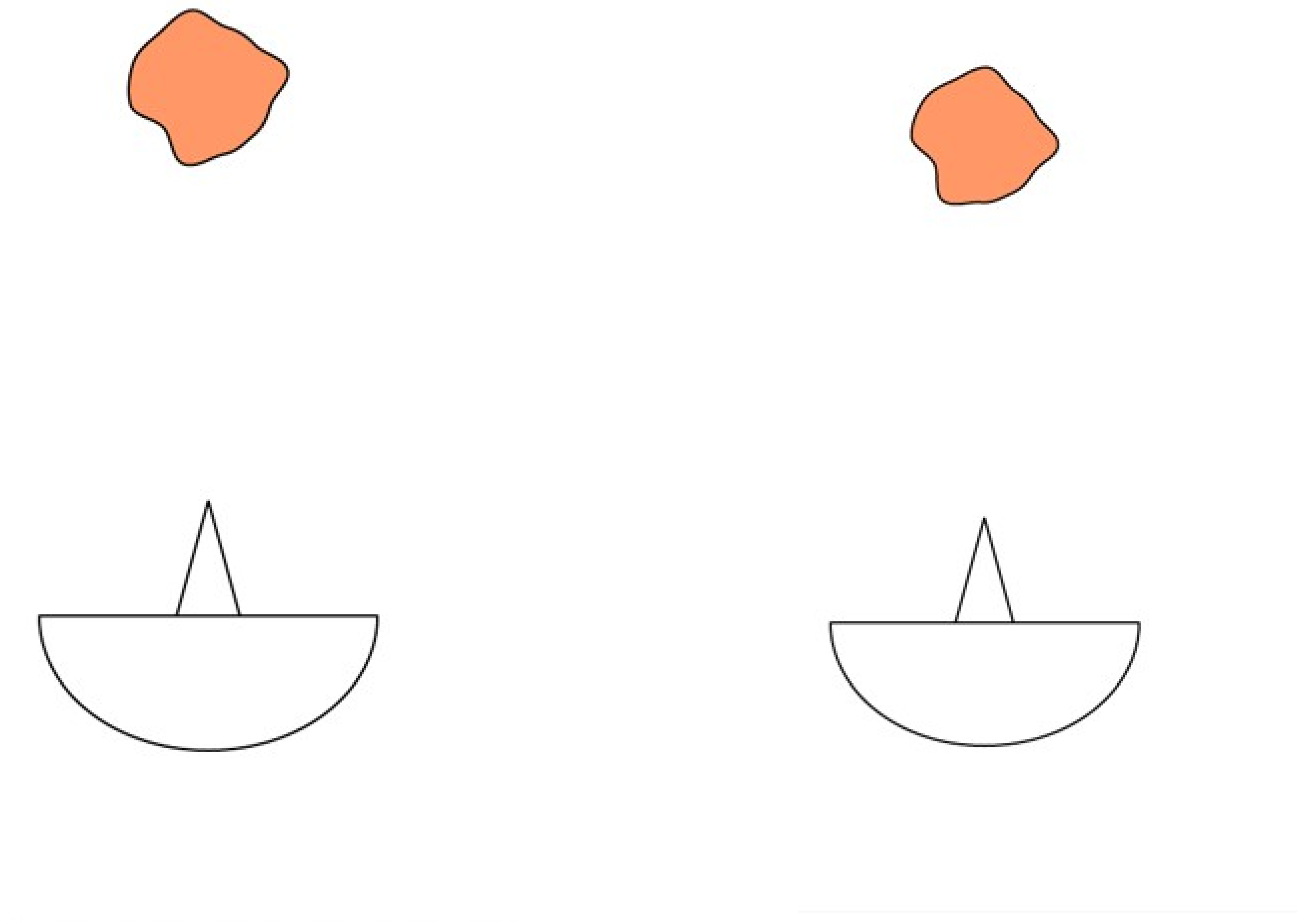
Objects with "Yes" in the "Phys?" columns would benefit particularly from physical observations (lightcurves, colors, etc.). Note that they're almost all "Yes".

Scheduled Goldstone Asteroid Radar observations are listed at the JPL Asteroid Radar Research page.

Future observations

			Needs		
Date	**Object**	**PI**	**Posns?**	**Phys?**	**Status**
2012 Jan	2001 YE4	TBD	No	Yes	Completed. R2629
2012 Jan	(7341) 1991 VK	L. Benner	No	Yes	Completed. R2629
2012 Jan	(263976) 2009 KD5	TBD	No	Yes	Cancelled due to a scheduling conflict. R2629
2012 Jan	(433) Eros	TBD	No	Yes	Requested but not scheduled. R2629
2012 Feb	(96590) 1998 XB	TBD	No	Yes	Scheduled (4 sessions). R2658
2012 Feb	2006 CJ	C. Nugent	No	Yes	Scheduled (2 sessions). R2658
2012 Feb	(162421) (2000 ET70)	S. P. Naidu	No	Yes	Scheduled (6 sessions). R2658
2012 Feb	2002 QC7	S. P. Naidu	No	Yes	Scheduled (4 sessions). R2658
2012 Feb	2011 CP4	S. P. Naidu	Yes	Yes	Scheduled (5 sessions). R2658
2012 Feb	2012 DX13	?	Yes	Yes	Scheduled. R????
2012 Mar	(5) Astraea	C. Magri	No	Yes	Scheduled. R2312
2012 Mar	(192642) 1999 RD32	TBD	No	Yes	Scheduled. R2658
2012 Mar	(2201) Oljato	C. Nugent	No	Yes	Scheduled. R2658

Razdalje v Osončju: radarski odboj z bližnjih asteroidov



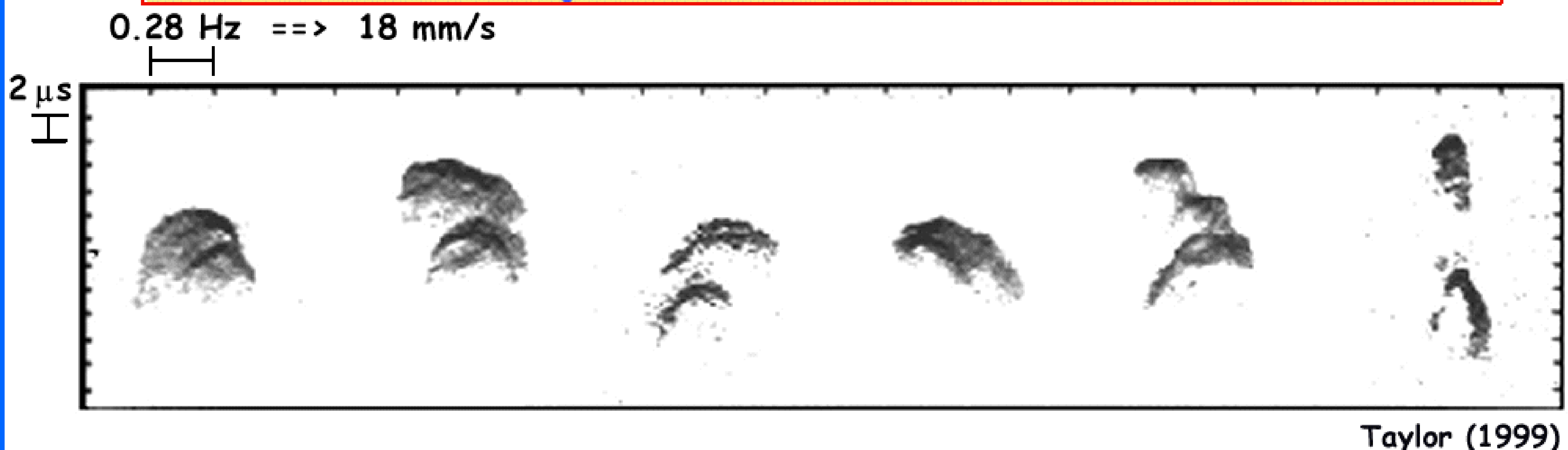
Prednosti in slabosti: razdalja, Doppler; kotna resolucija.

Razdalje v Osončju

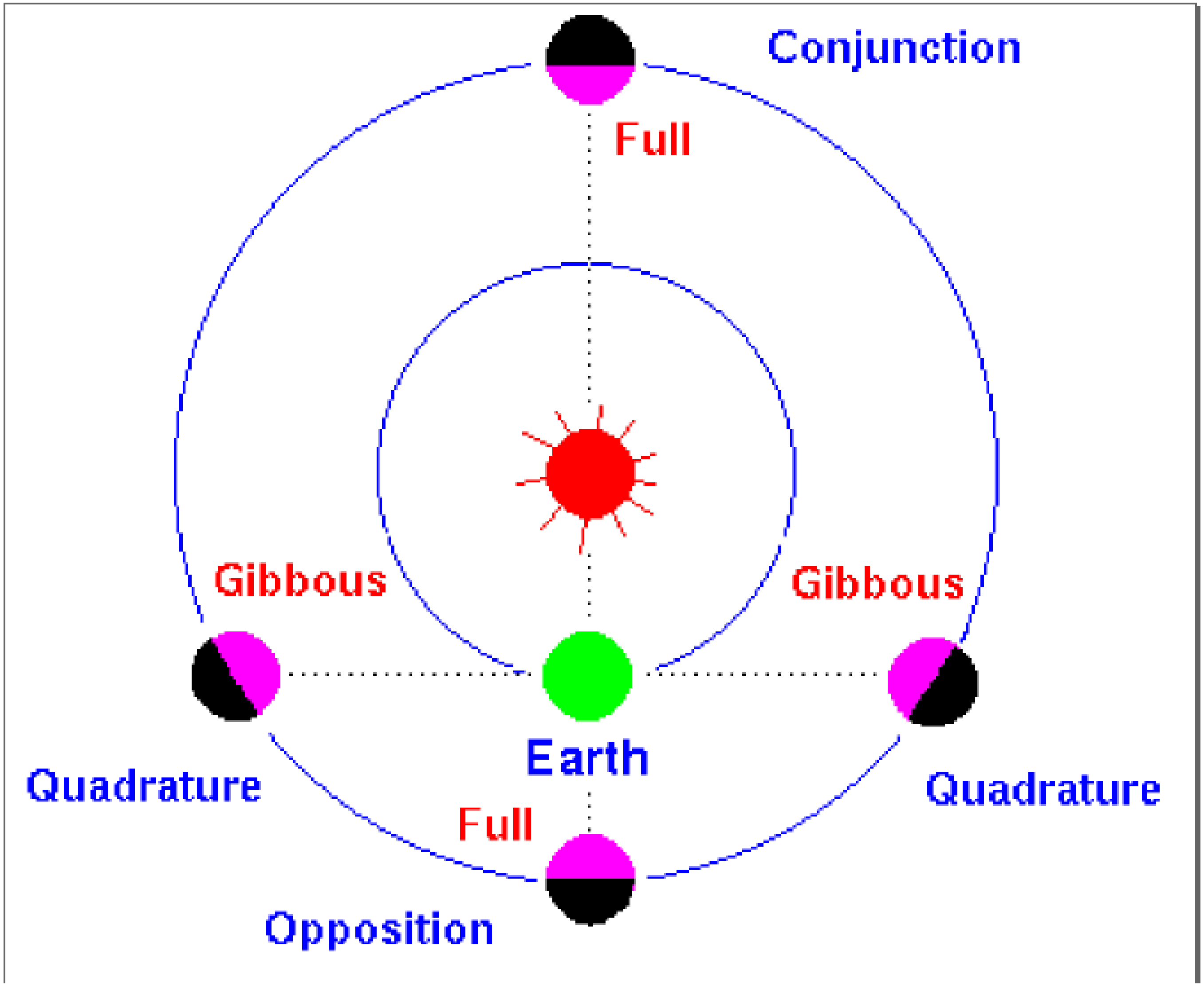
$$a^3/P^2 = G(M_S+m)/4\pi^2$$

Z odboji radarskih valov merijo razdalje do asteroidov, Venere in Merkurja in medplanetarnih sond.
Tako so določili astronomsko enoto na
149.597.870.691 ± 3 m

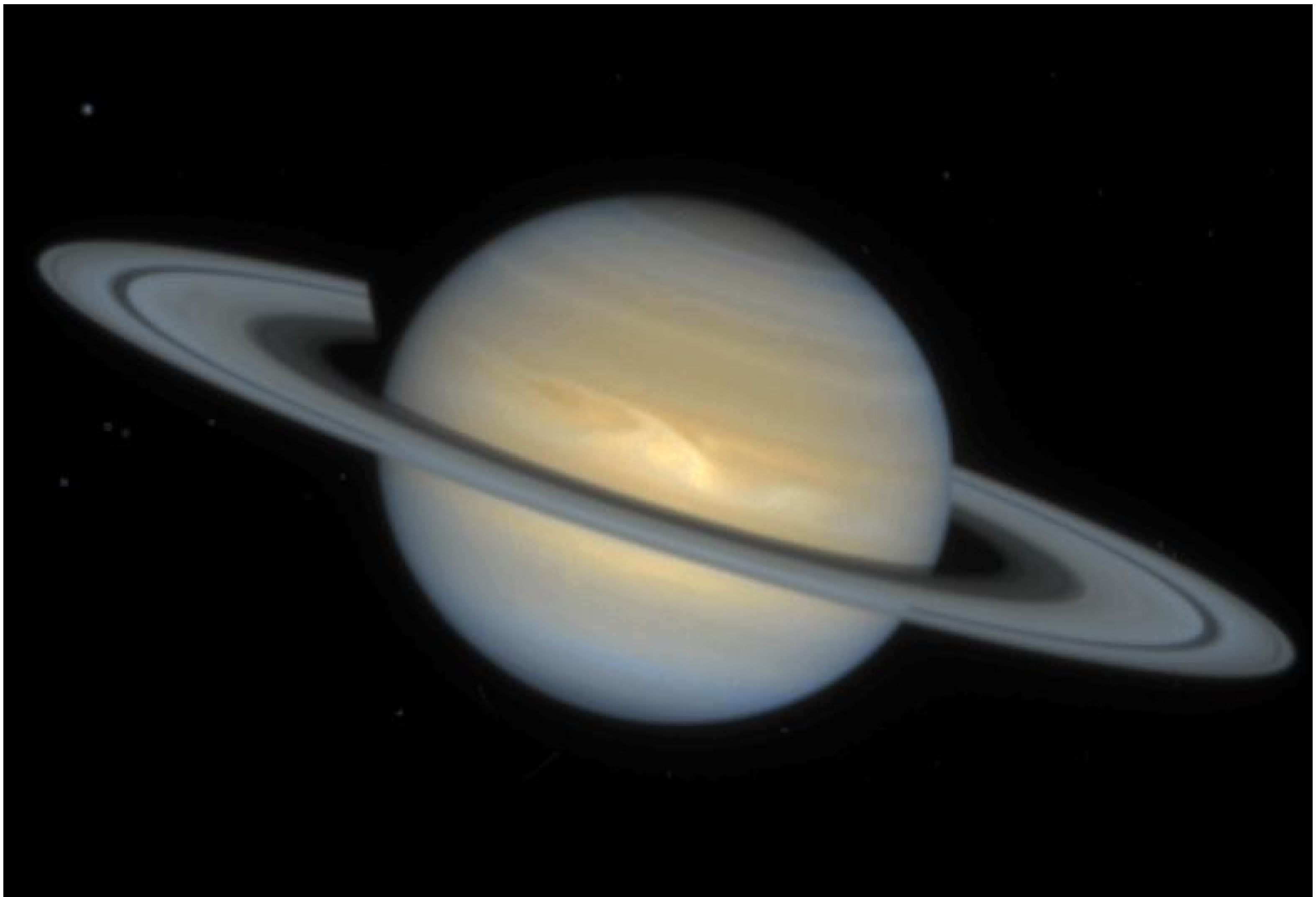
Asteroid 4179 Toutatis, opazovanja 14-19 Dec 1992, Arecibo
časovna resolucija 125 ns ustreza 19 m v razdalji
frekvenčna resolucija 8.3 mHz ustreza 0.15 mm/s v hitrosti



Mene zunanjih planetov



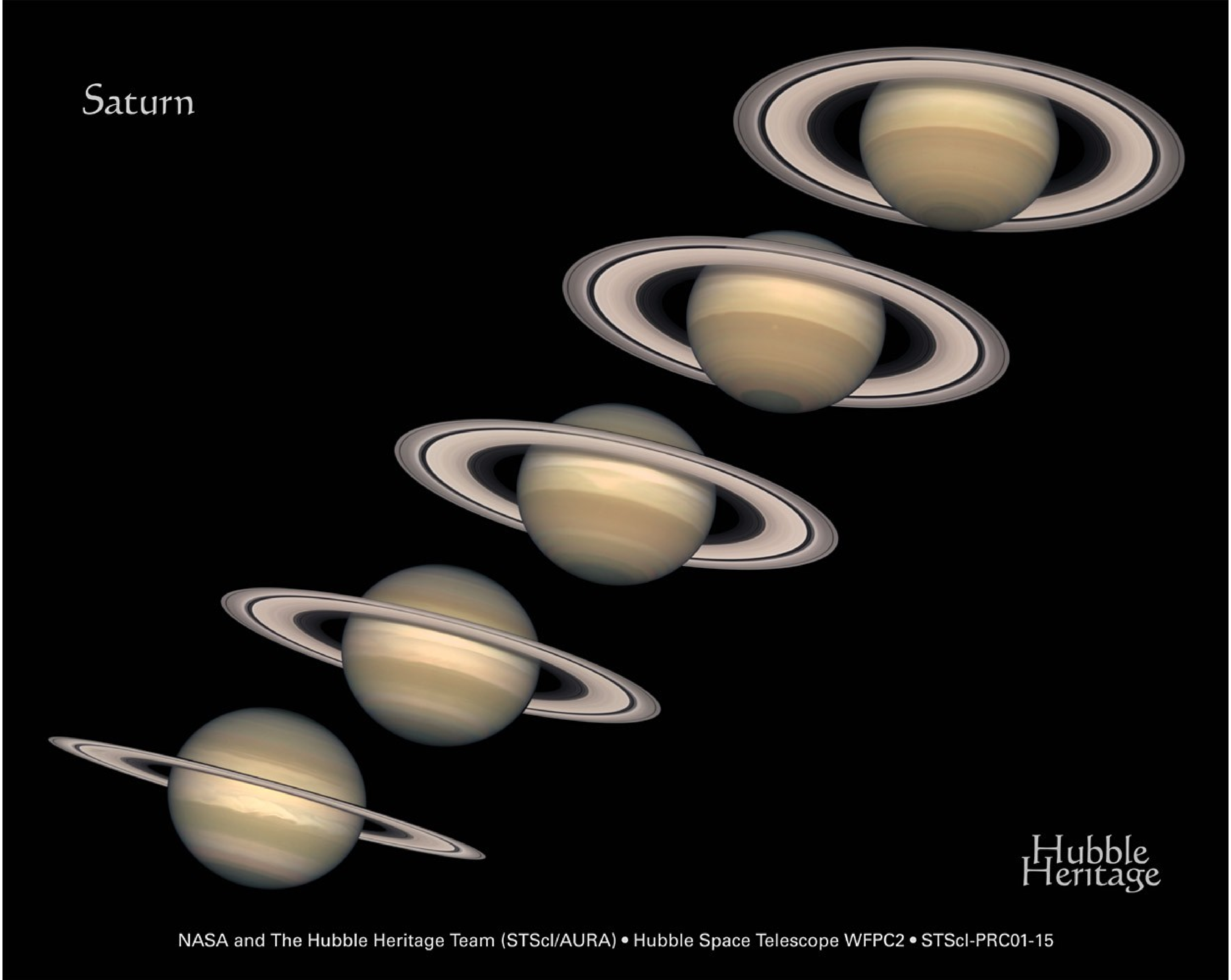
Mene zunanjih planetov z (bližine) Zemlje



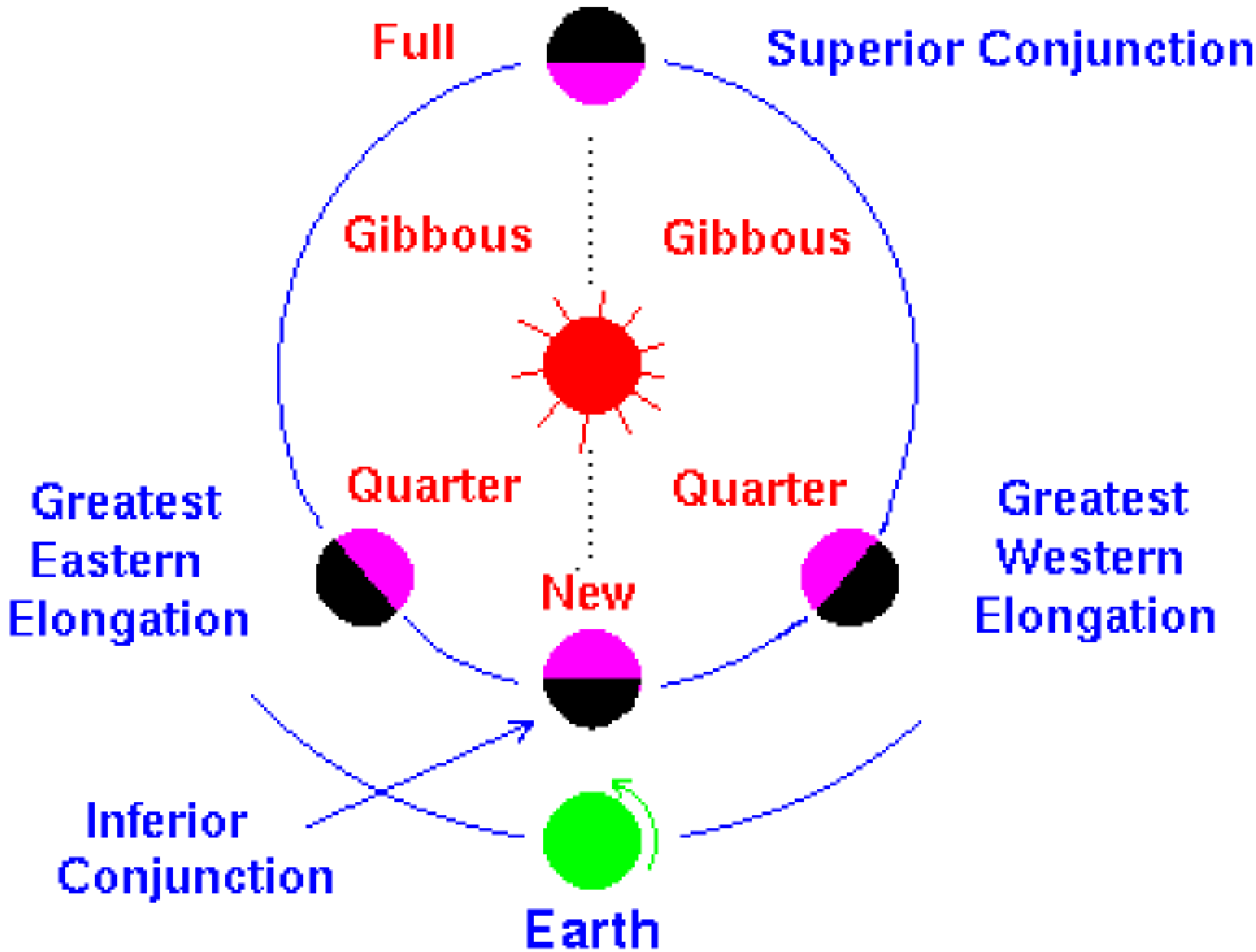
Hubble Observes A New Saturn Storm

Mene zunanjih planetov ob mimoletu

Let Voyagerja 1 mimo Saturna 14.novembra 1980


Saturn
Hubble Heritage
NASA and The Hubble Heritage Team (STScI/AURA) • Hubble Space Telescope WFPC2 • STScI-PRC01-15

Mene notranjih planetov



Mene notranjih planetov

Efemeride

Naše nebo 2012 (od str. 36)

Astronomical almanah

Stellarium (Jupiter)