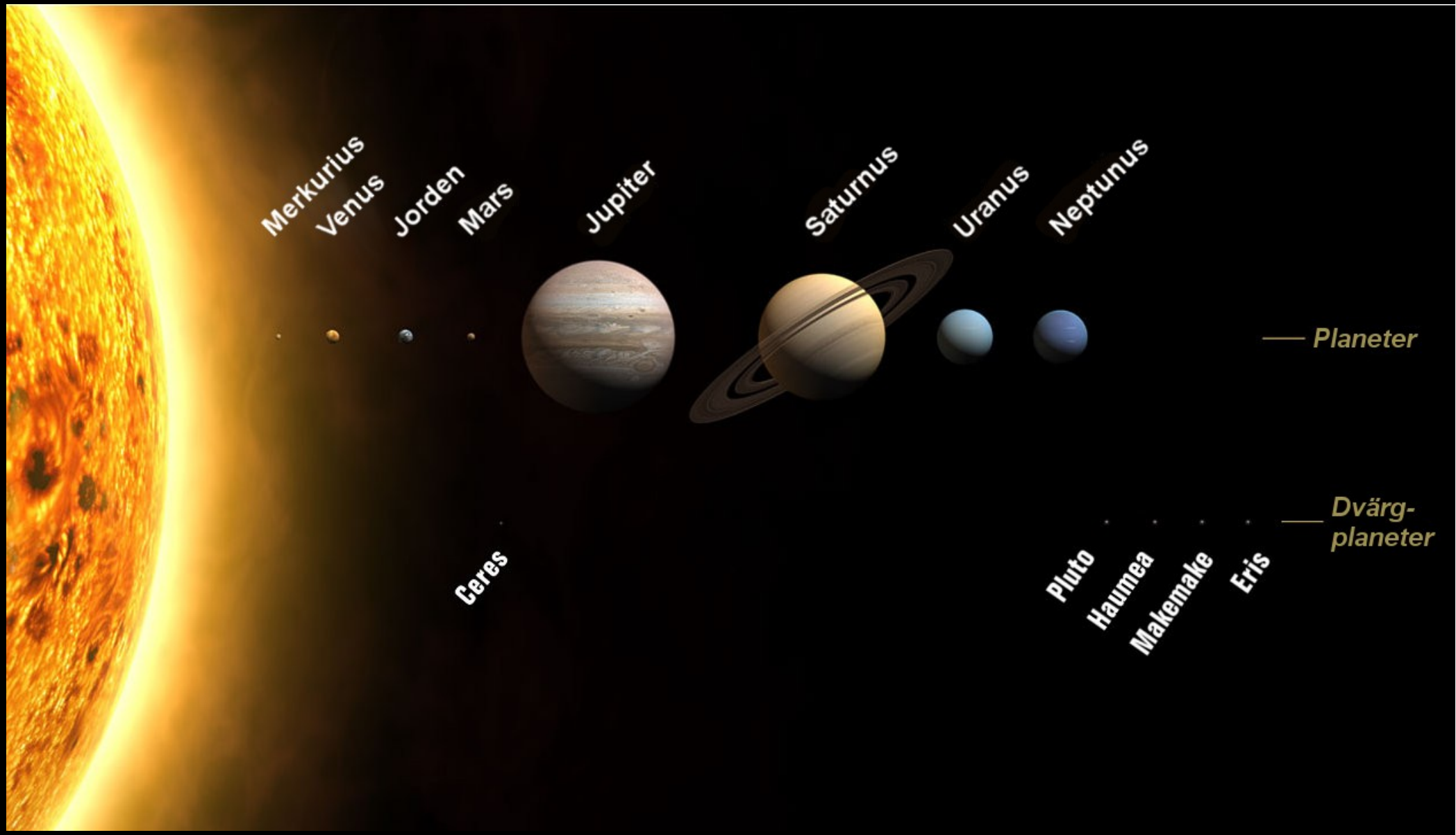
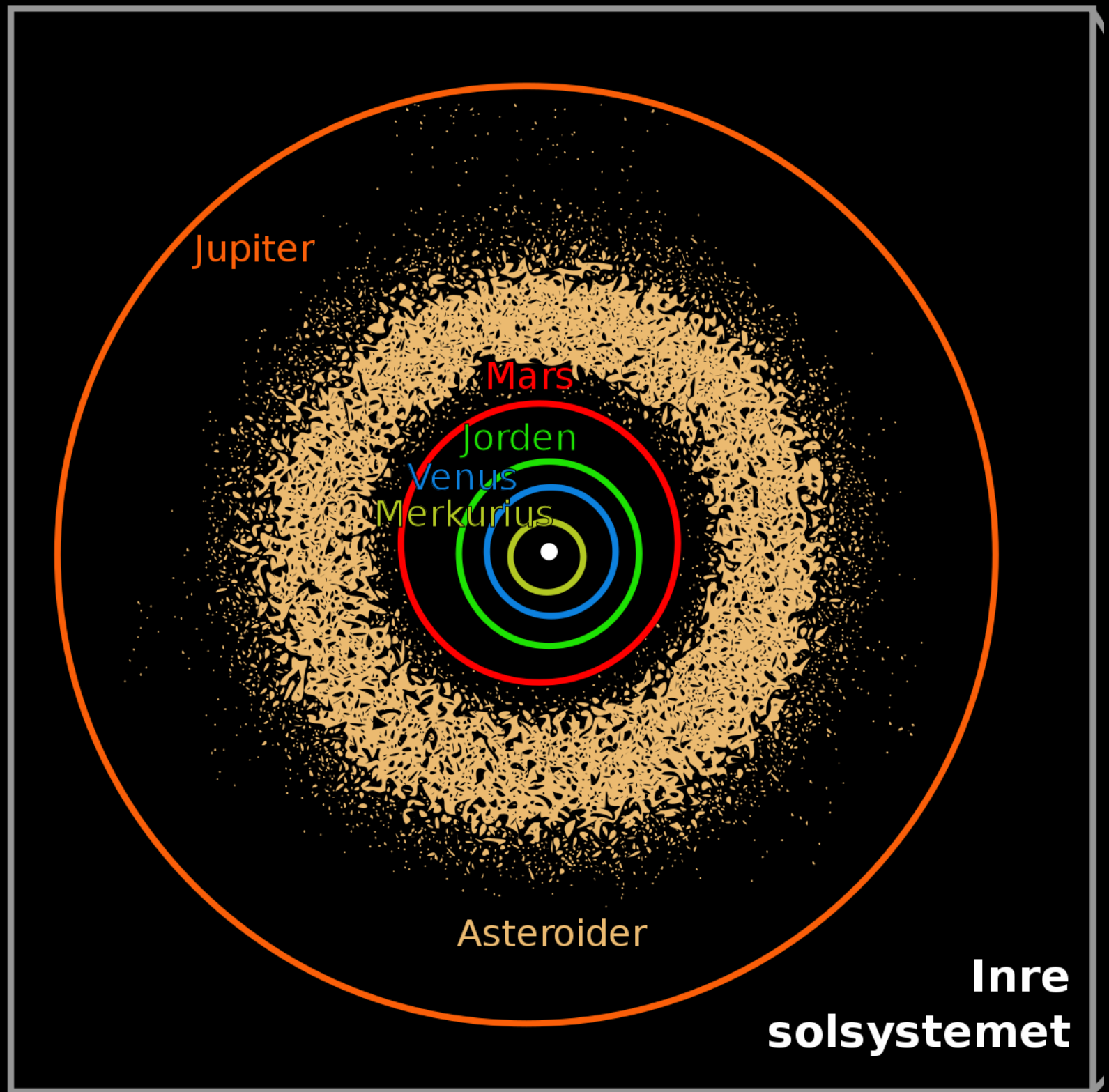
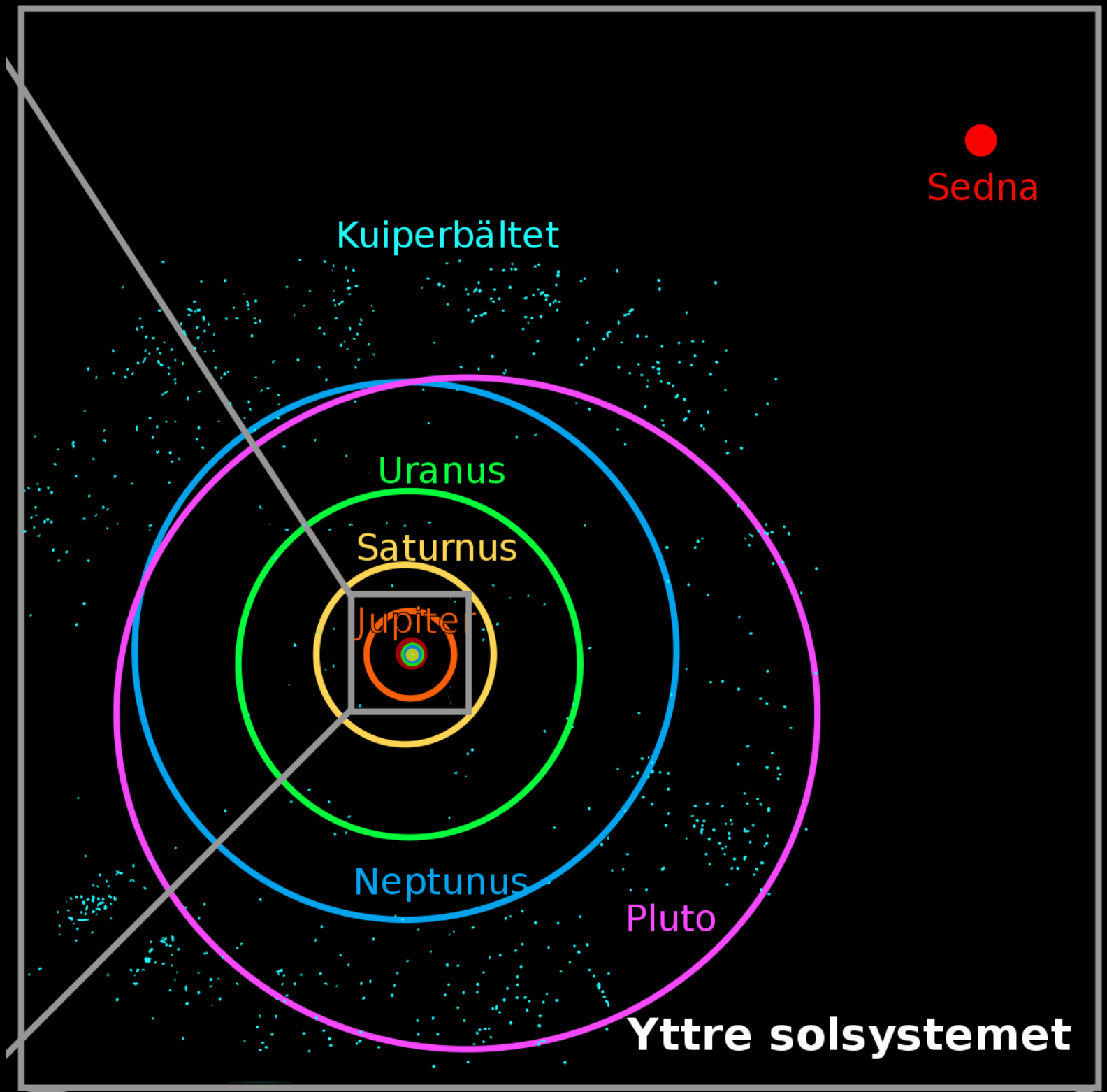
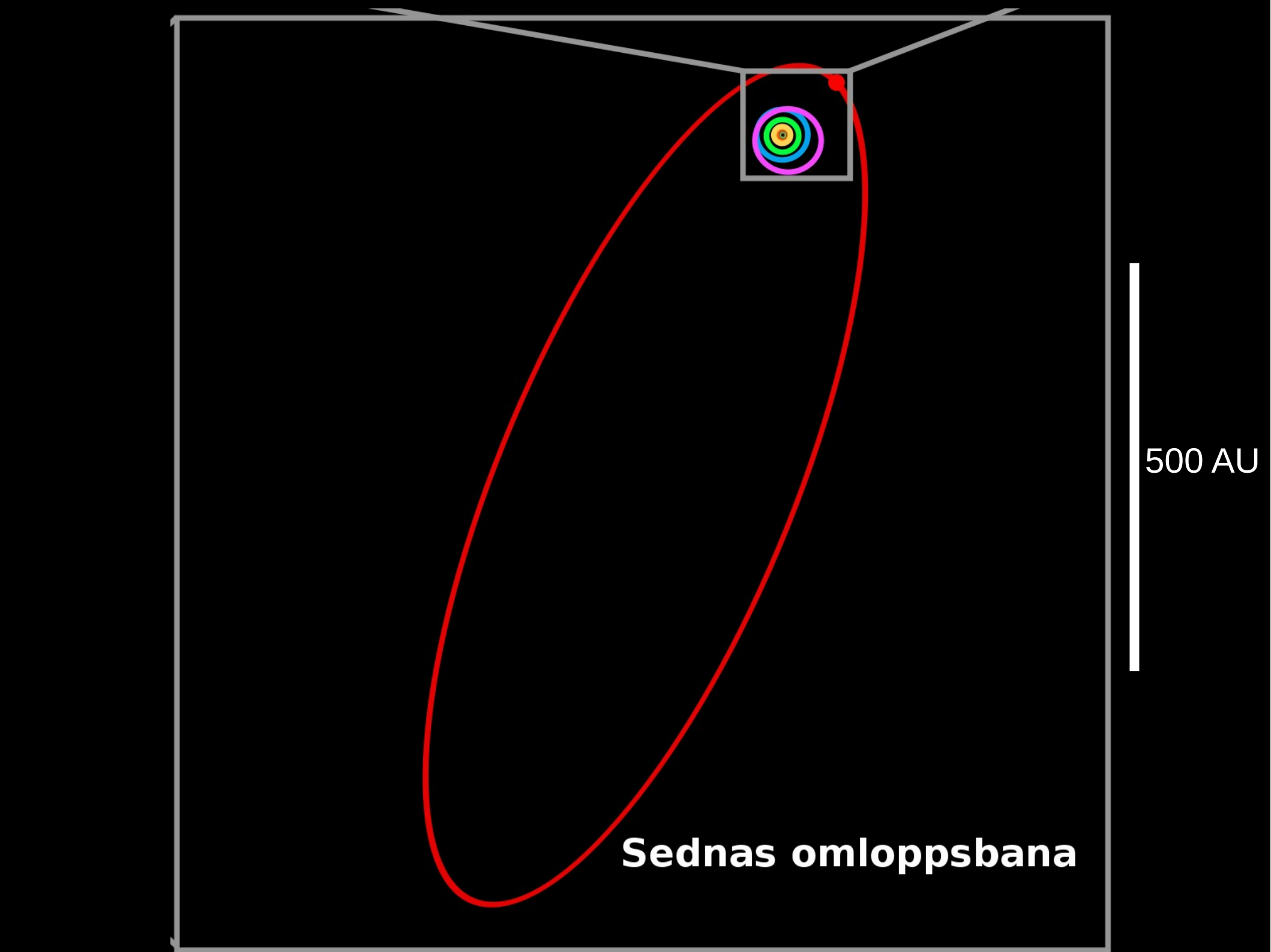
Gasjättarna, asteroider, dvärgar och Kuiperbältet

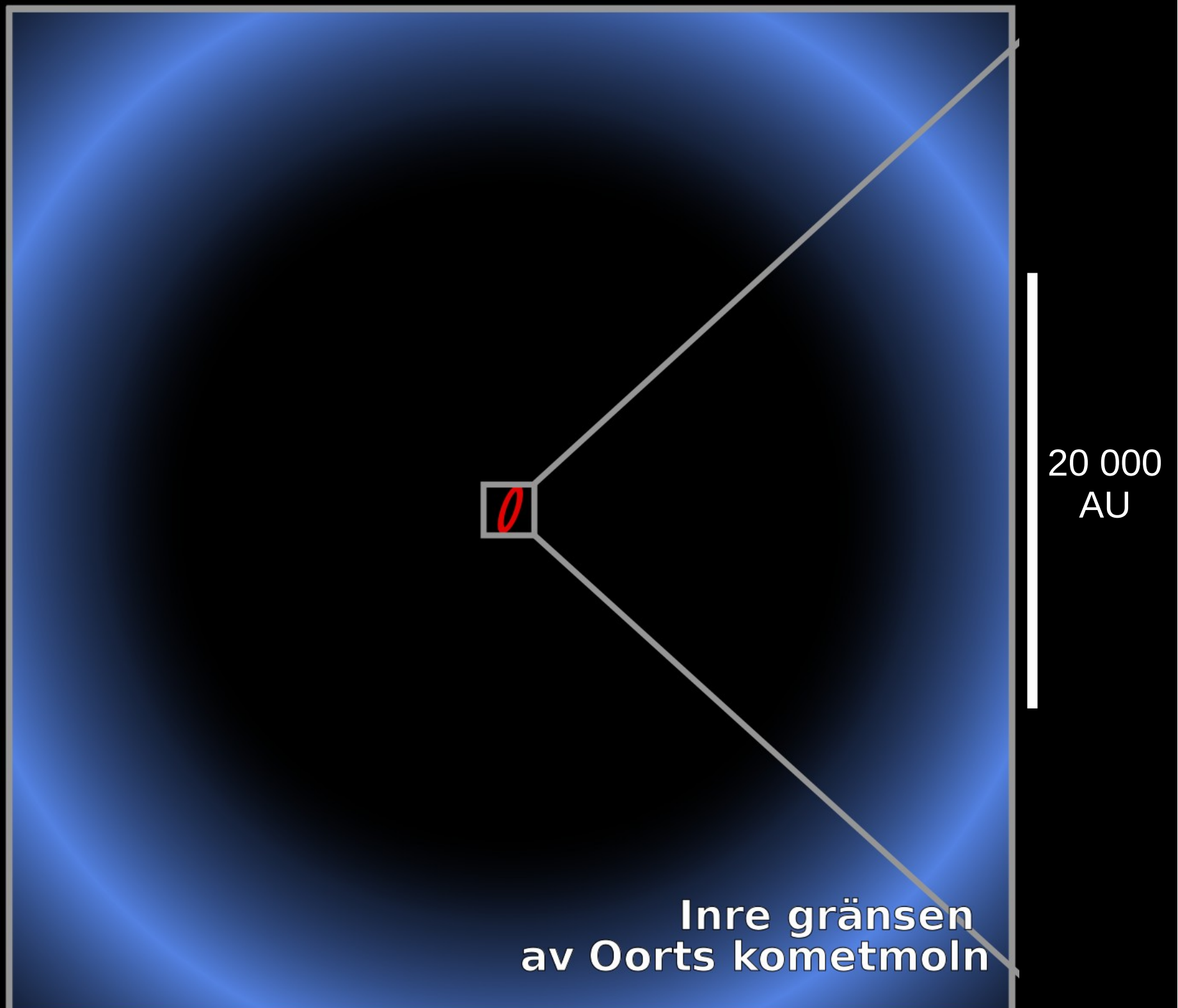
Översikt: Planeternas storlek

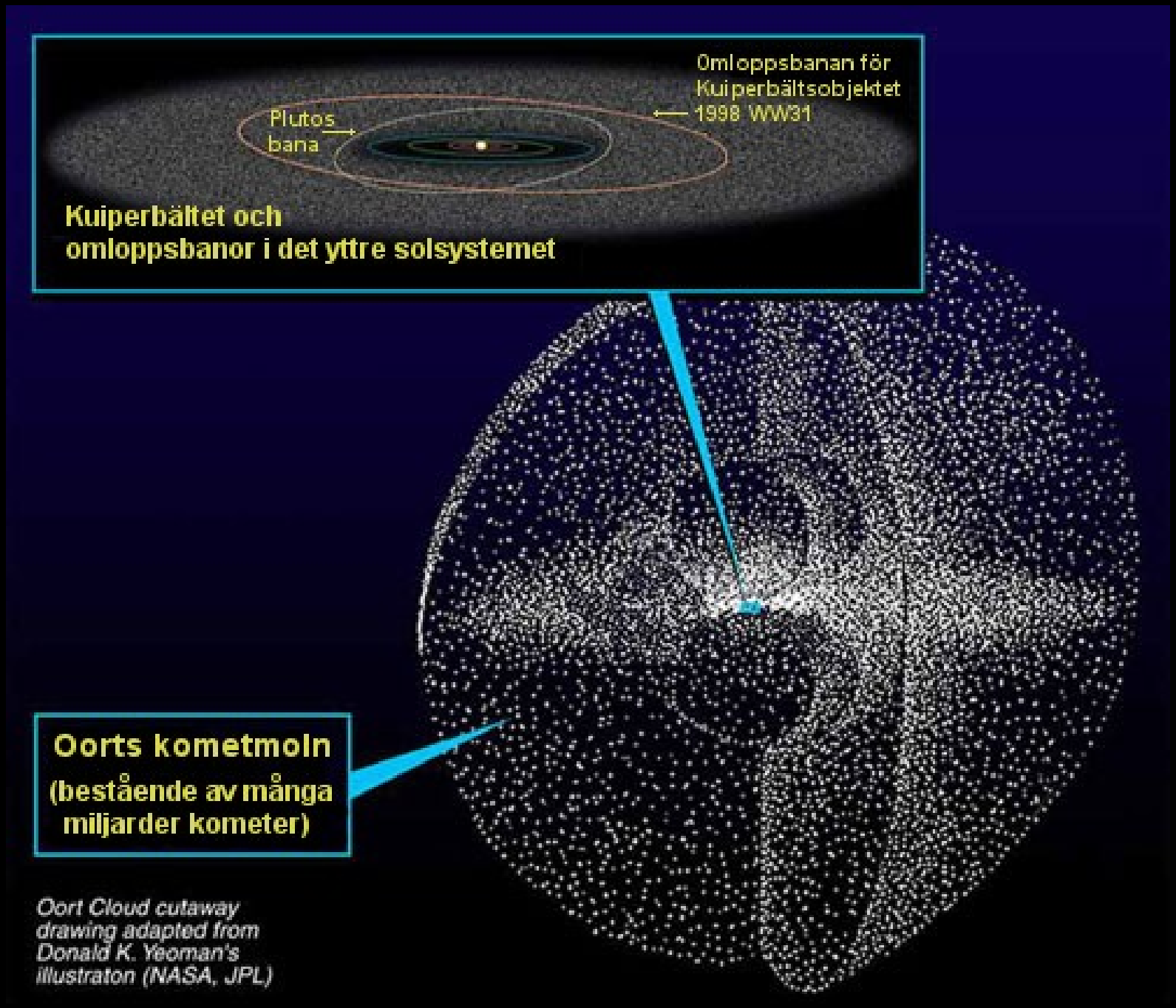



Jupiter
Mars
Jorden
Venus
Merkurius
Asteroider
5 AU
Inre
solsystemet

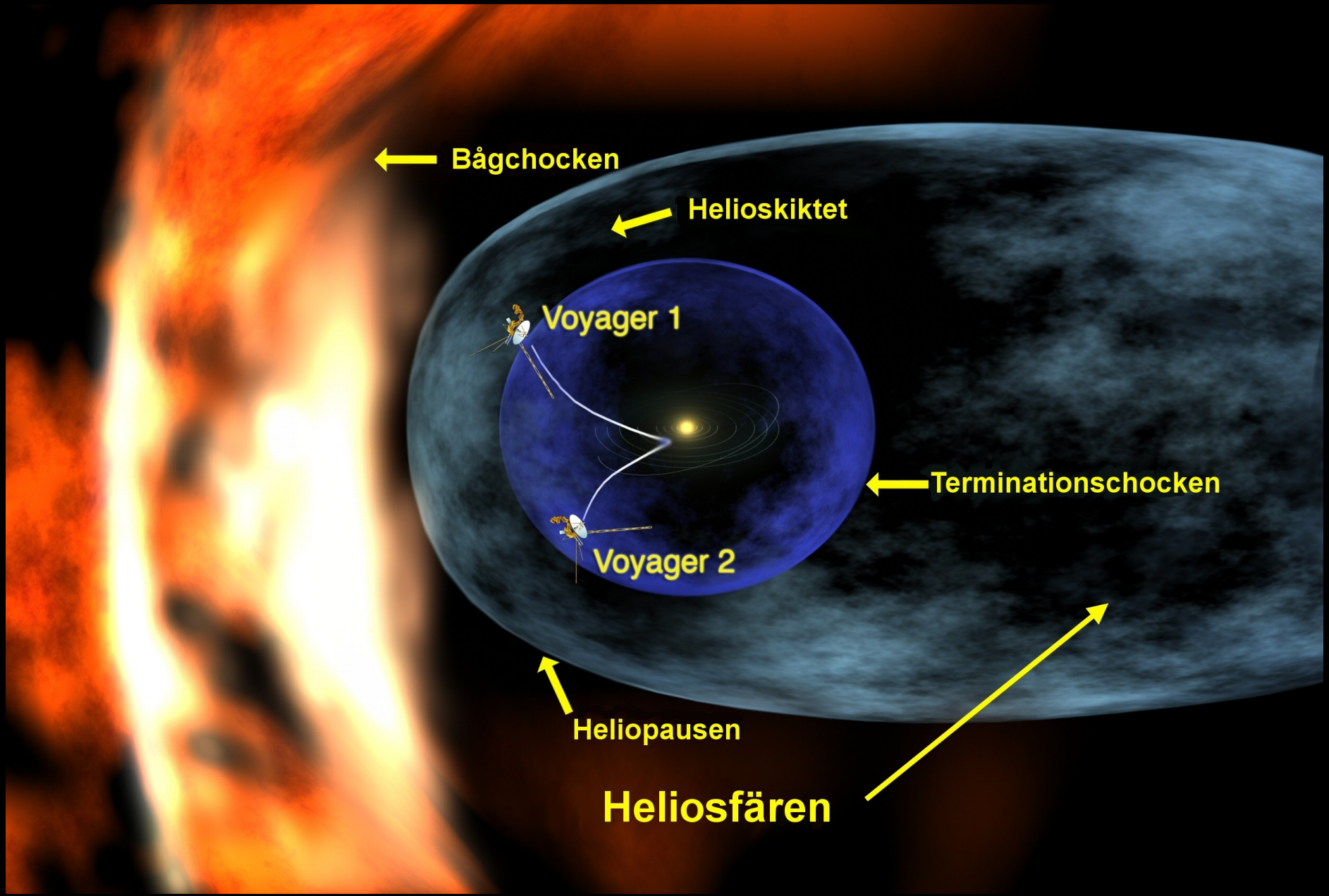

Sedna
Kuiperbältet
Uranus
Saturnus
Jupiter
Neptunus
Pluto
60 AU
Yttre solsystemet


500 AU
Sednas omloppsbana

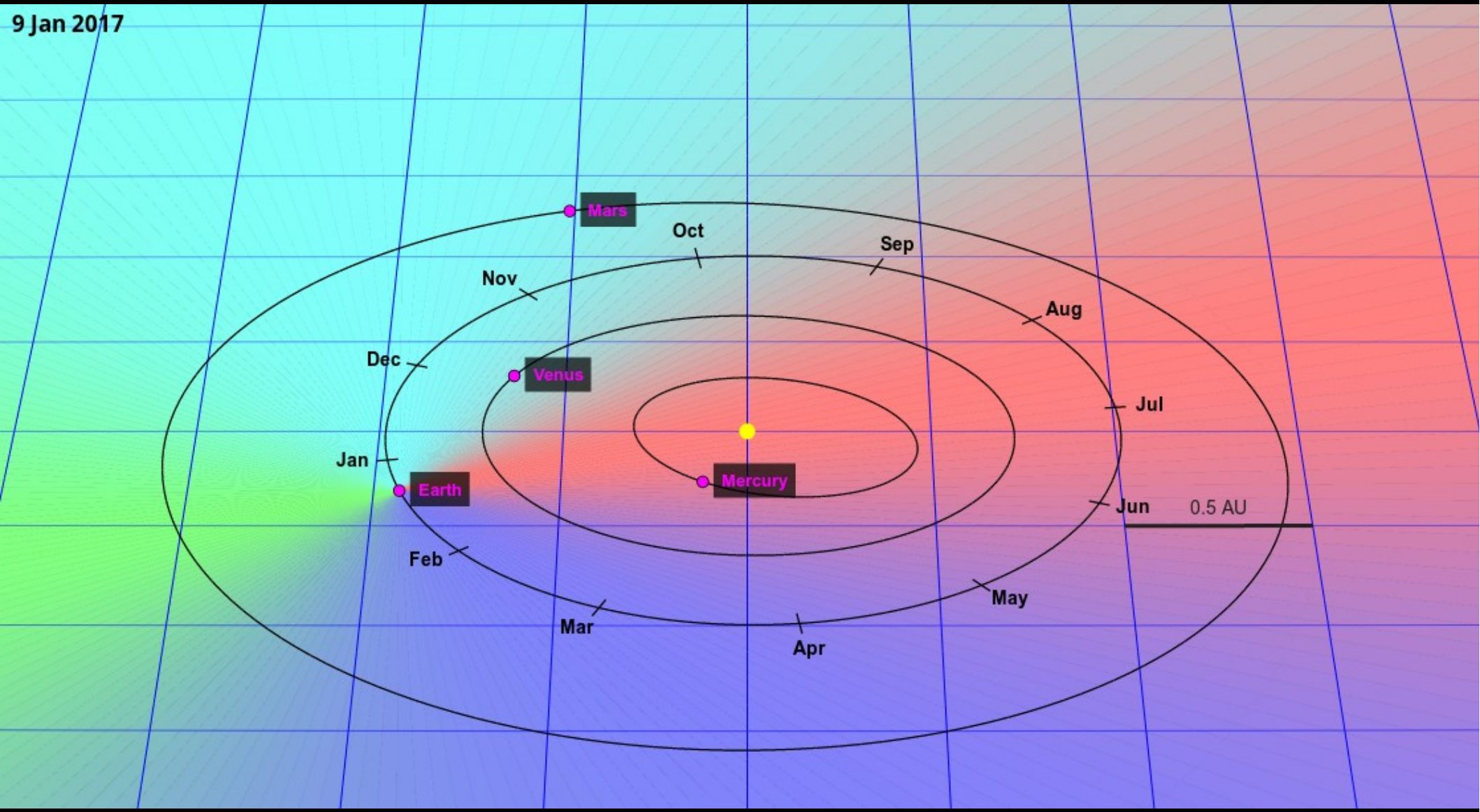

0
20 000
AU
Inre gränsen
av Oorts kometmoln


Omloppsbanan för
Kuiperbältsobjektet
1998 WW31
Plutos
bana
Kuiperbältet och
omloppsbanor i det yttre solsystemet
Oorts kometmoln
(bestående av många
miljarder kometer)
Oort Cloud cutaway
drawing adapted from
Donald K. Yeoman's
illustraton (NASA, JPL)

Solvindens påverkan på planetsystemet



Planeternas nuvarande läge + video



Jupiter

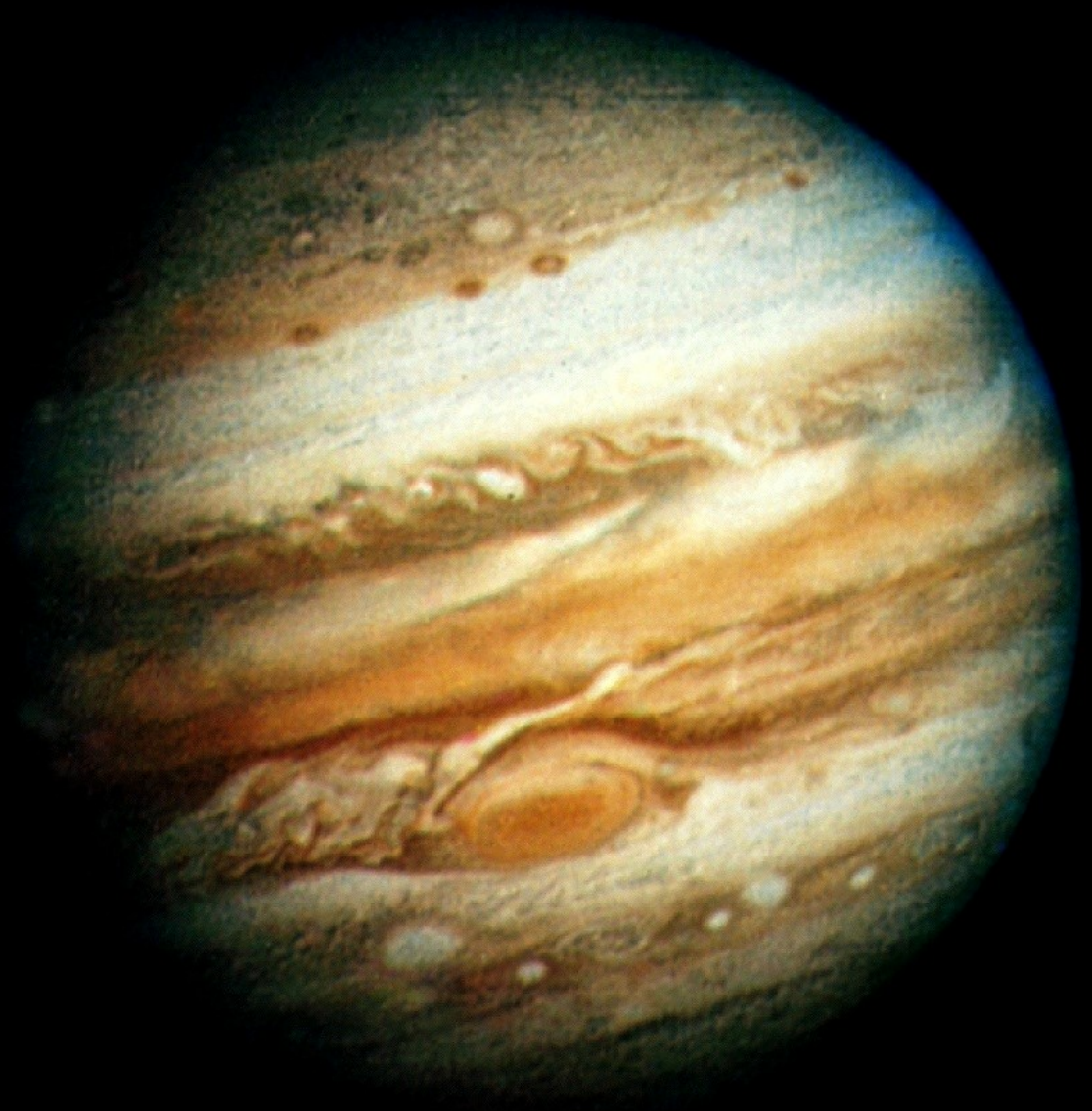
Jupiterfakta

Table 13-1 Jupiter Data

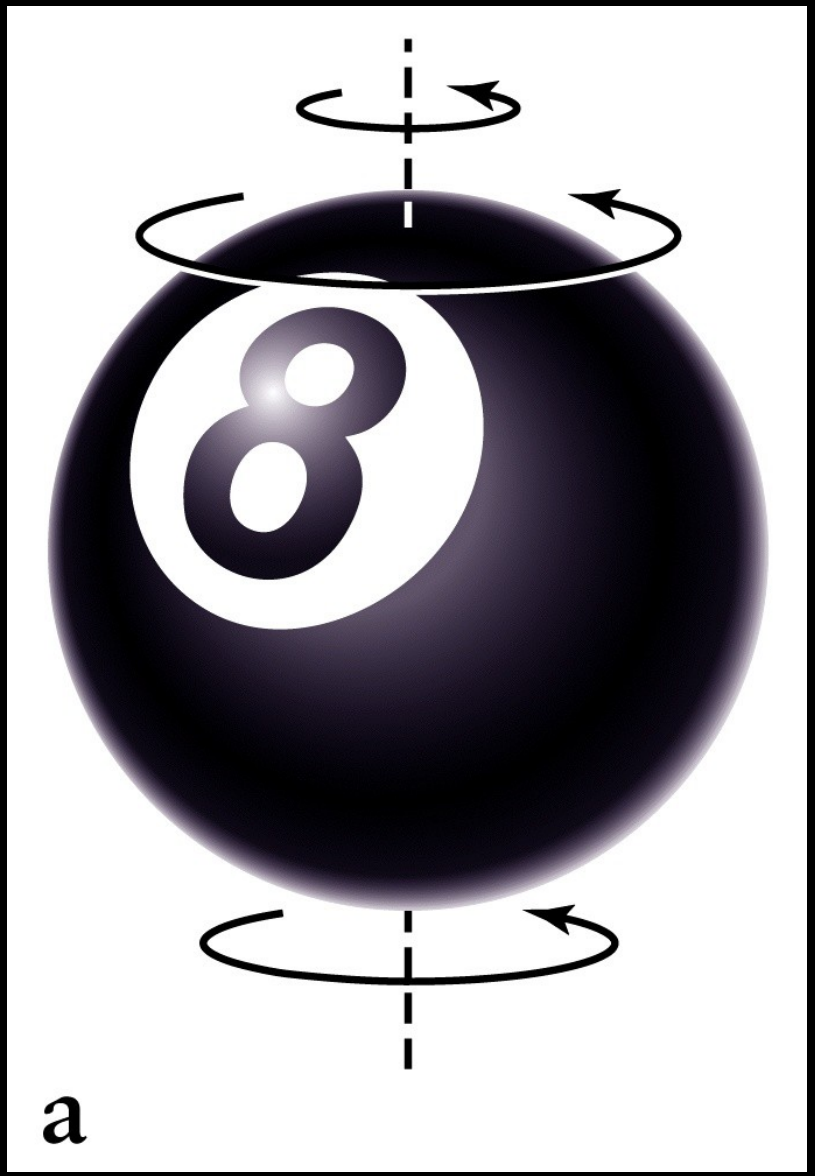
Average distance from Sun:	5.203 AU = 7.783×10^8 km
Maximum distance from Sun:	5.455 AU = 8.160×10^8 km
Minimum distance from Sun:	4.950 AU = 7.406×10^8 km
Eccentricity of orbit:	0.048
Average orbital speed:	13.1 km/s
Orbital period:	11.86 years
Rotation period:	$9^h\ 50^m\ 28^s$ (equatorial) $9^h\ 55^m\ 29^s$ (internal)
Inclination of equator to orbit:	3.12°
Inclination of orbit to ecliptic:	1.30°
Diameter:	142,984 km = 11.209 Earth diameters (equatorial) 133,708 km = 10.482 Earth diameters (polar)
Mass:	1.899×10^{27} kg = 317.8 Earth masses
Average density:	1326 kg/m^3
Escape speed:	60.2 km/s
Surface gravity (Earth = 1):	2.36
Albedo:	0.44
Average temperature at cloudtops:	−108°C = −162°F = 165 K

Pioneer 11, 1974

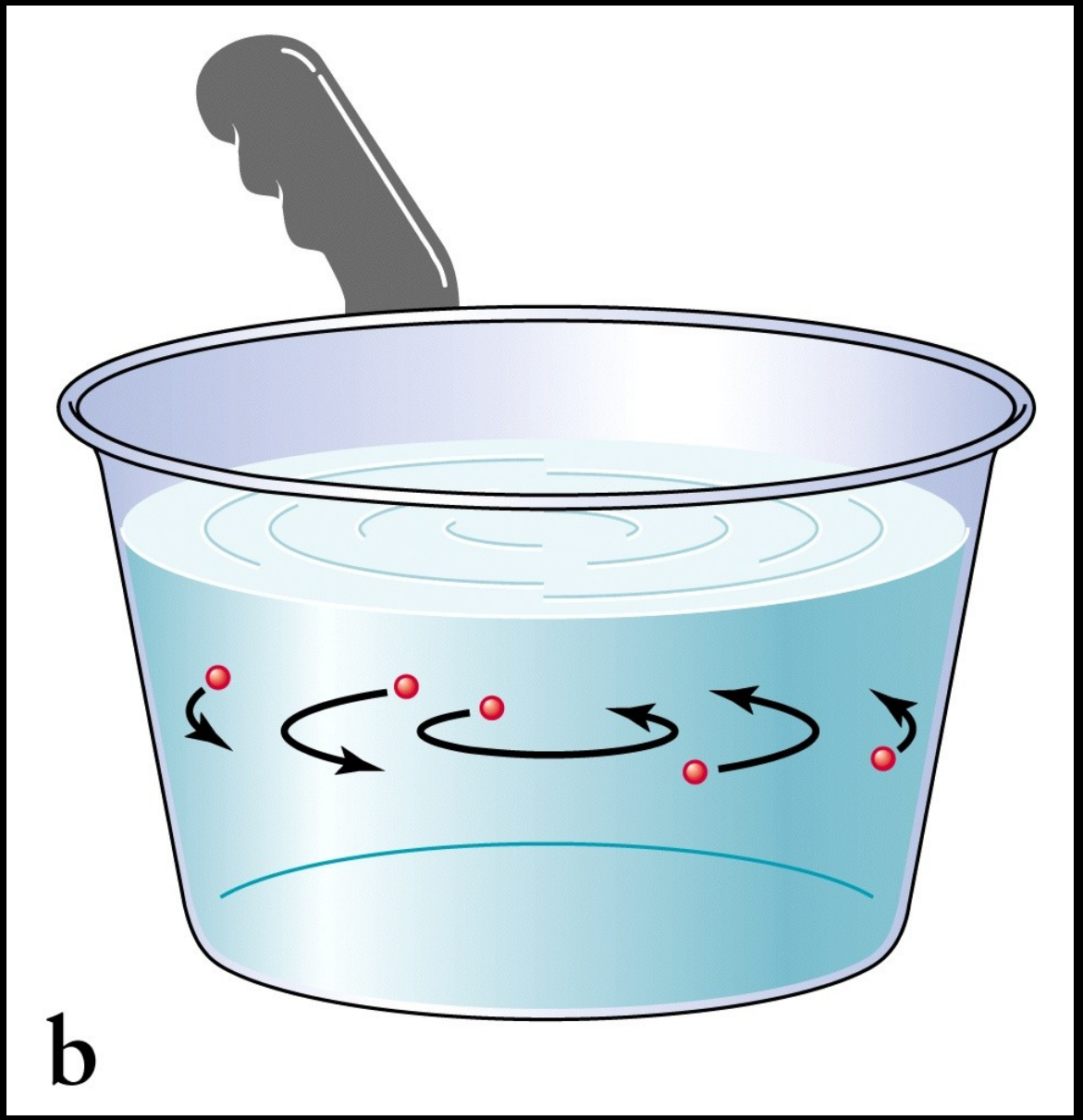
Voyager 1, mars 1979



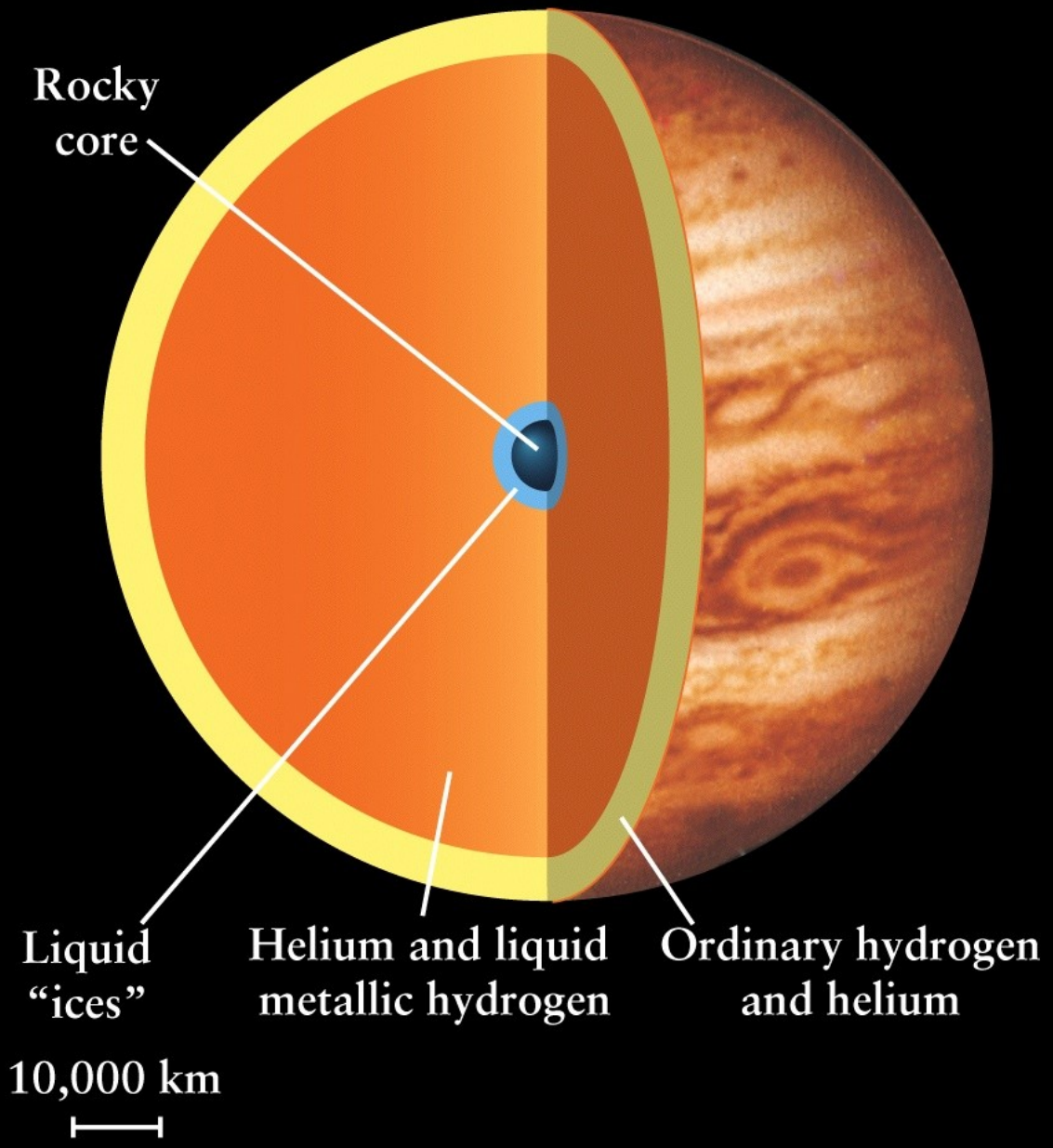
Stel rotation

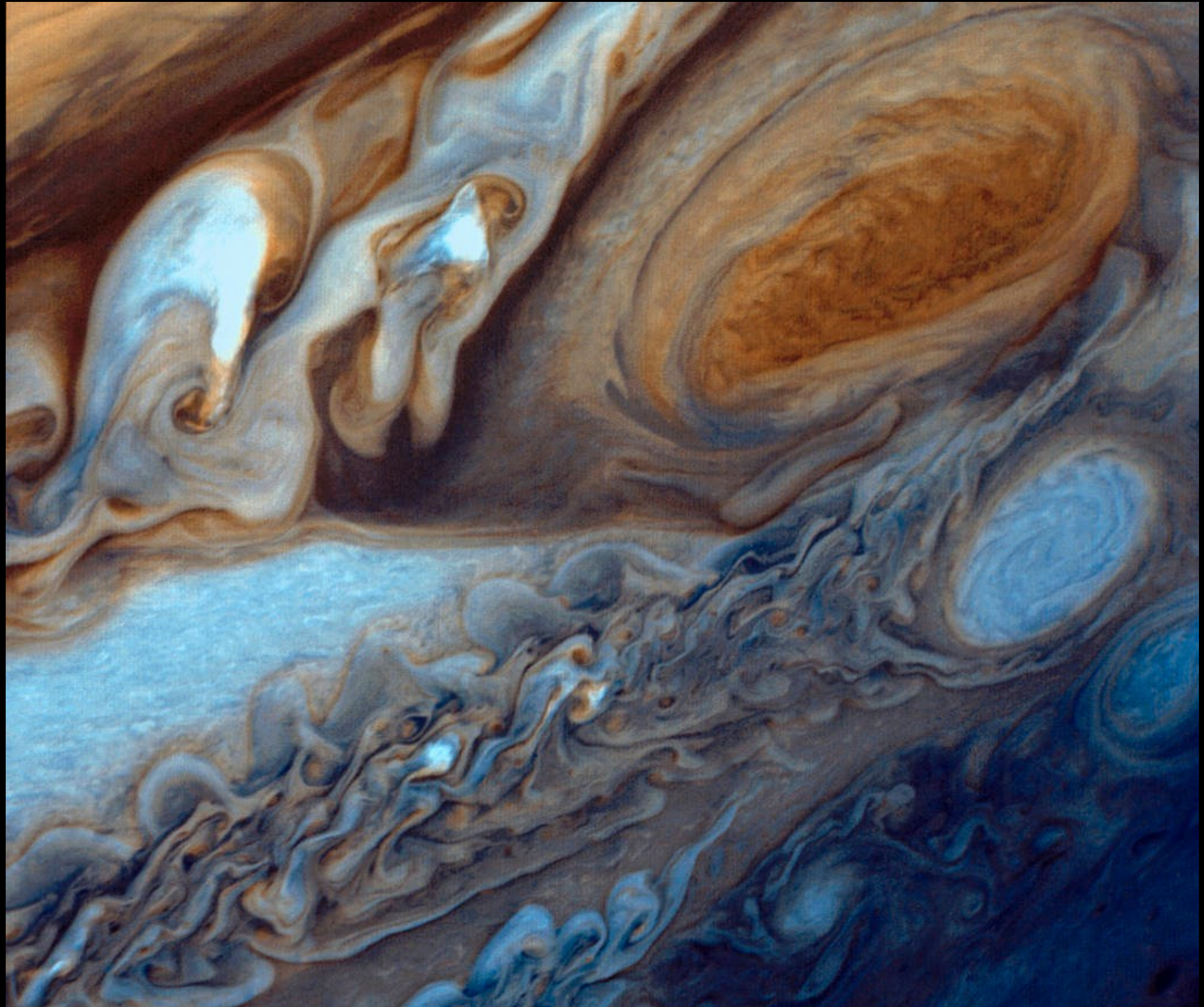


Differentiell rotation

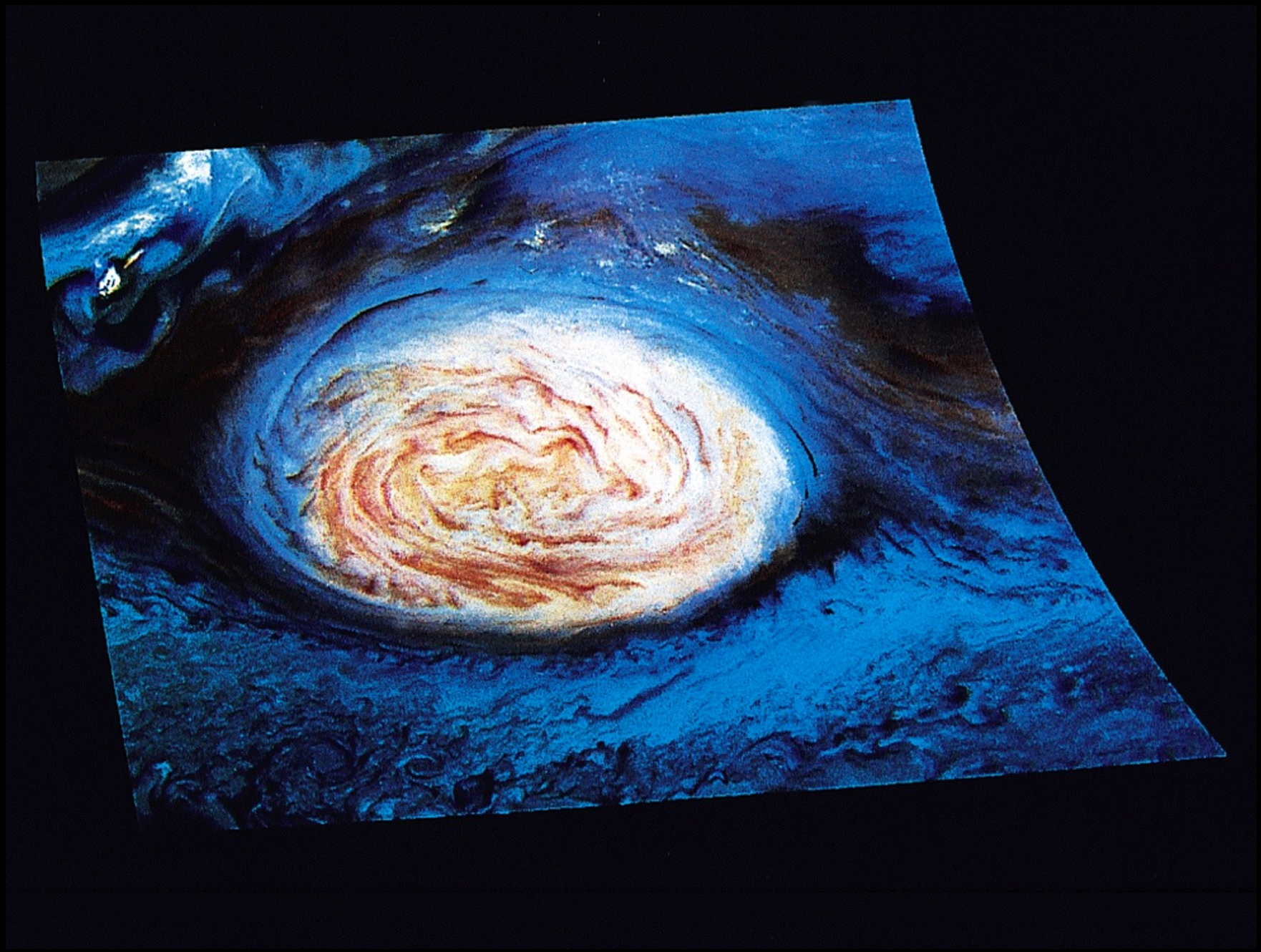


Jupiters inre struktur

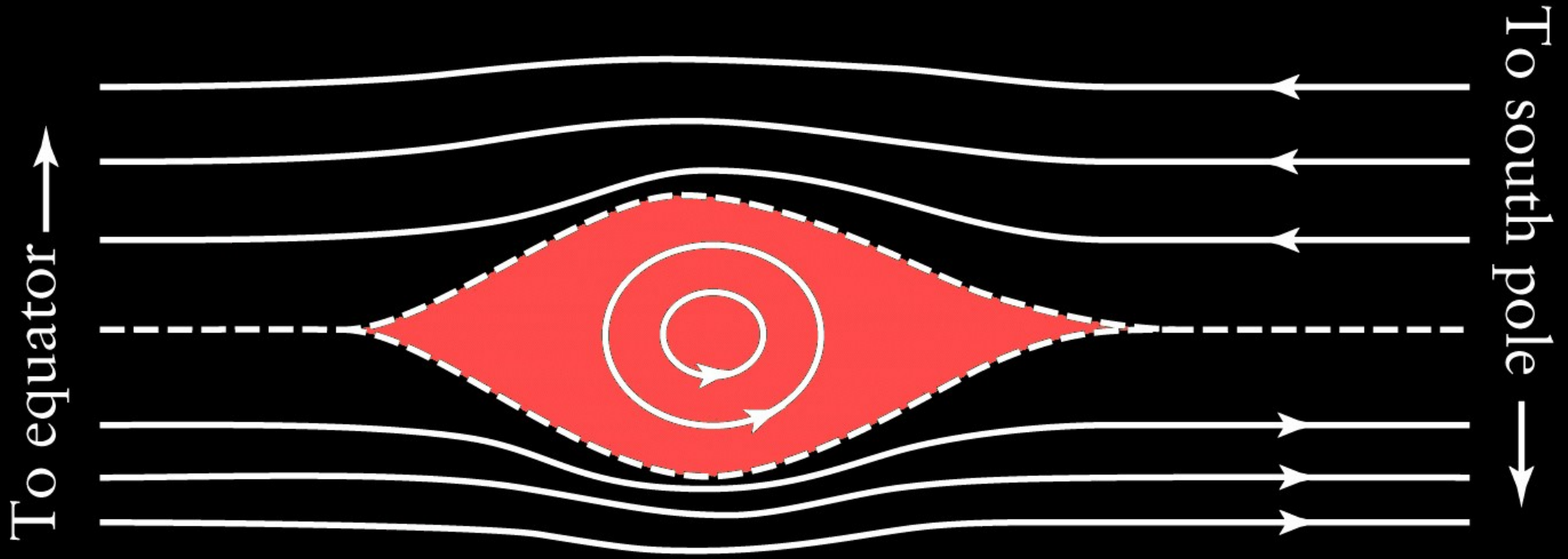




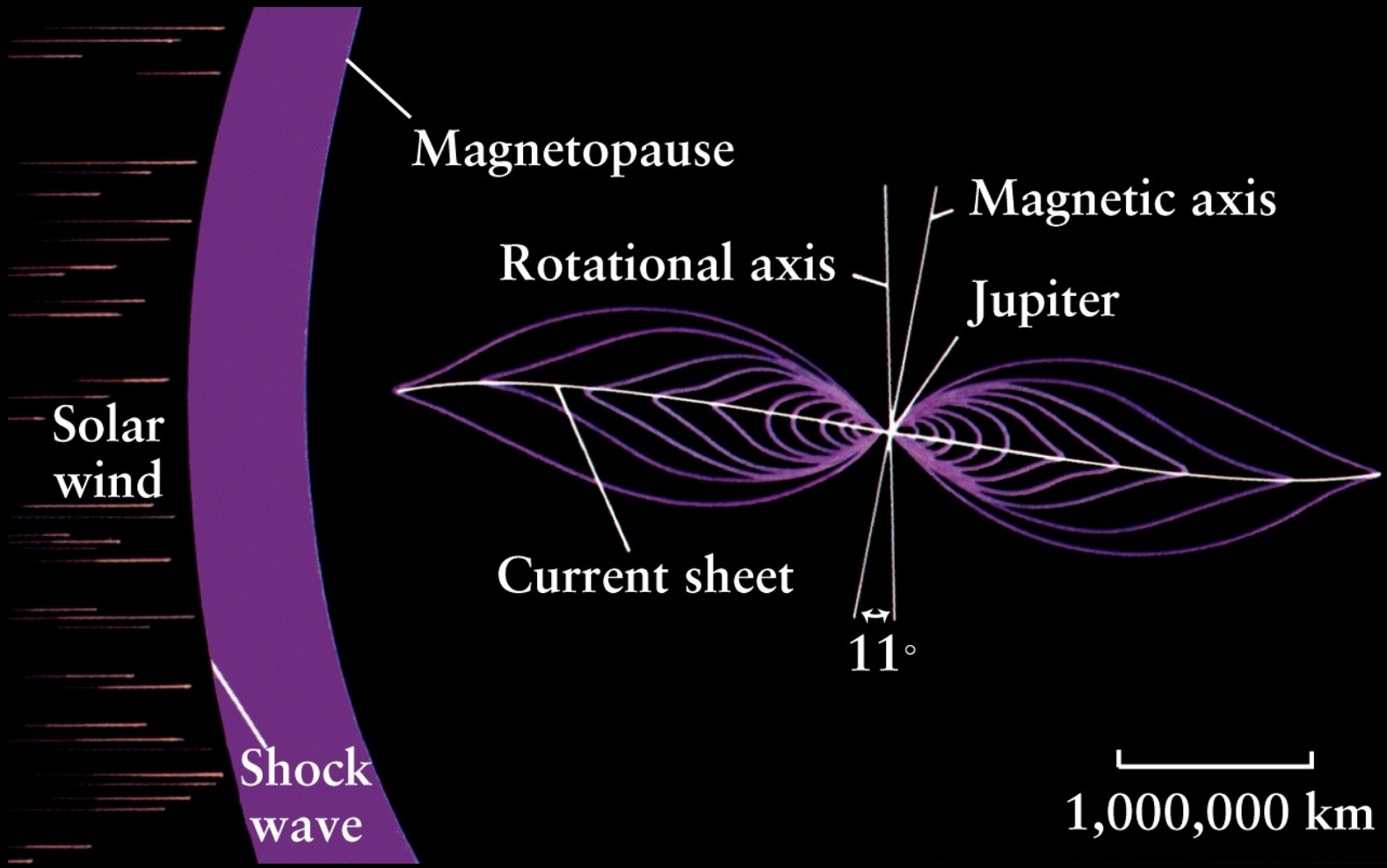
Röda fläcken (från Galileo) + video



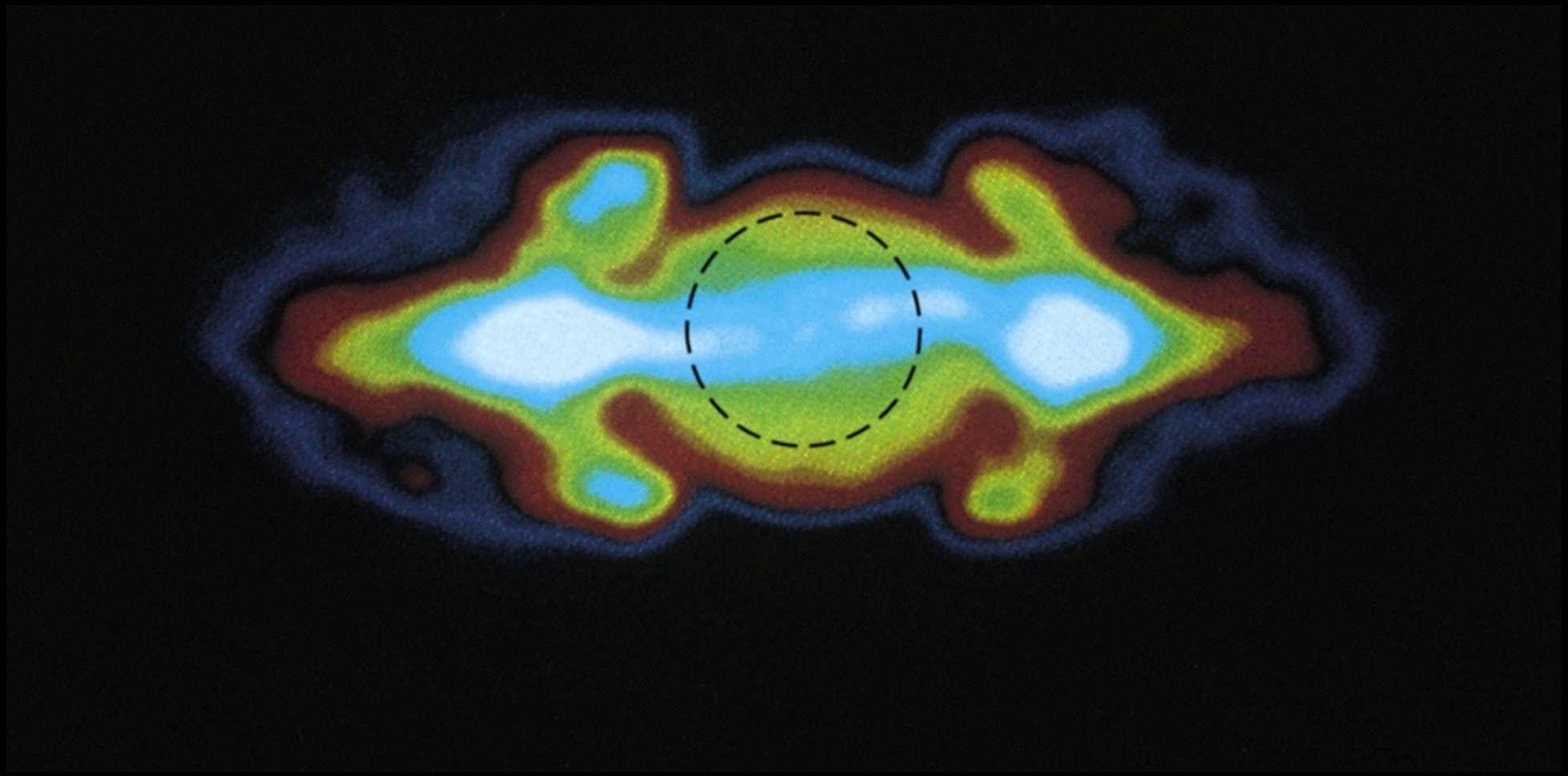
Cirkulation runt röda fläcken



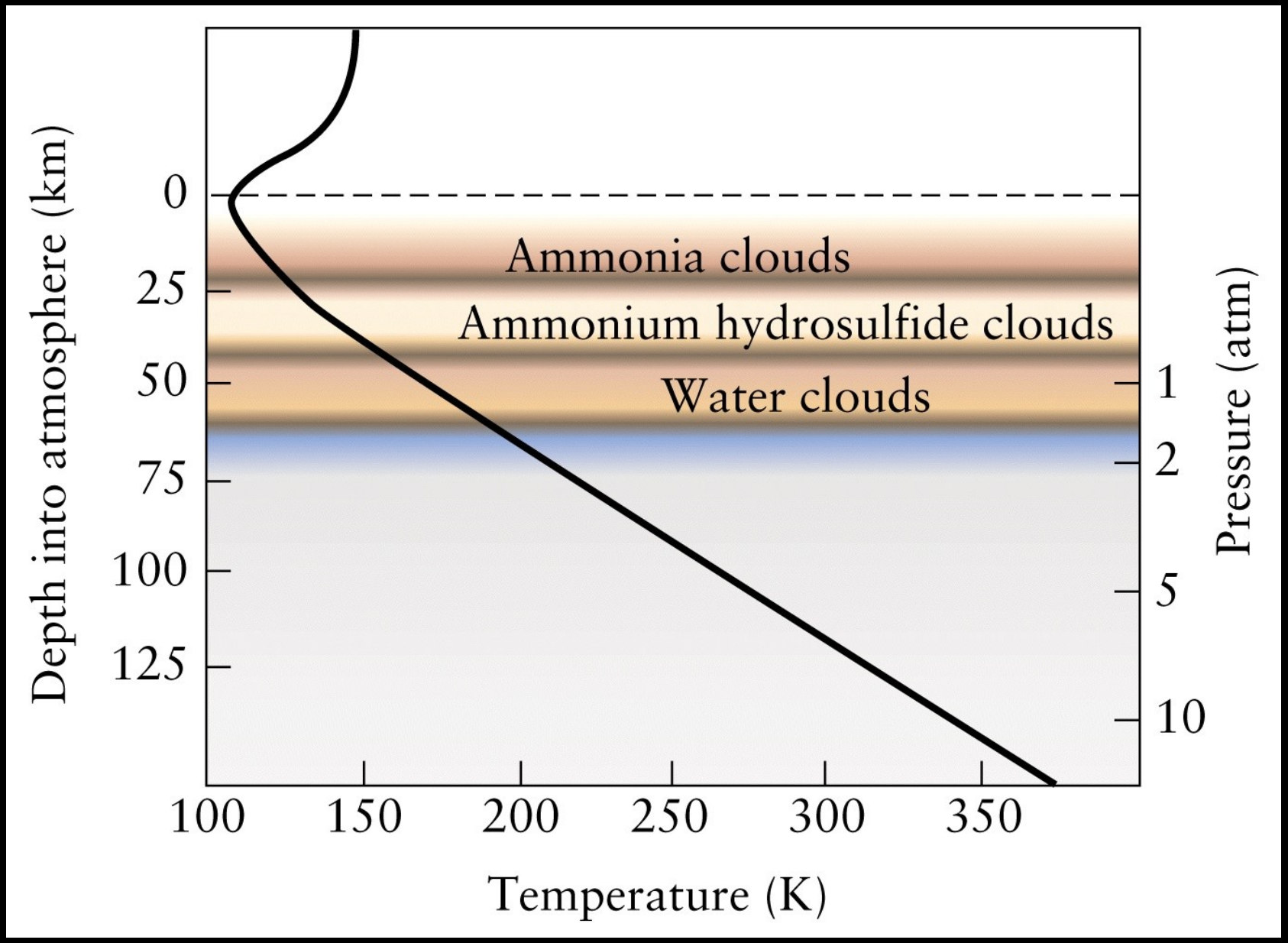
Jupiters magnetosfär



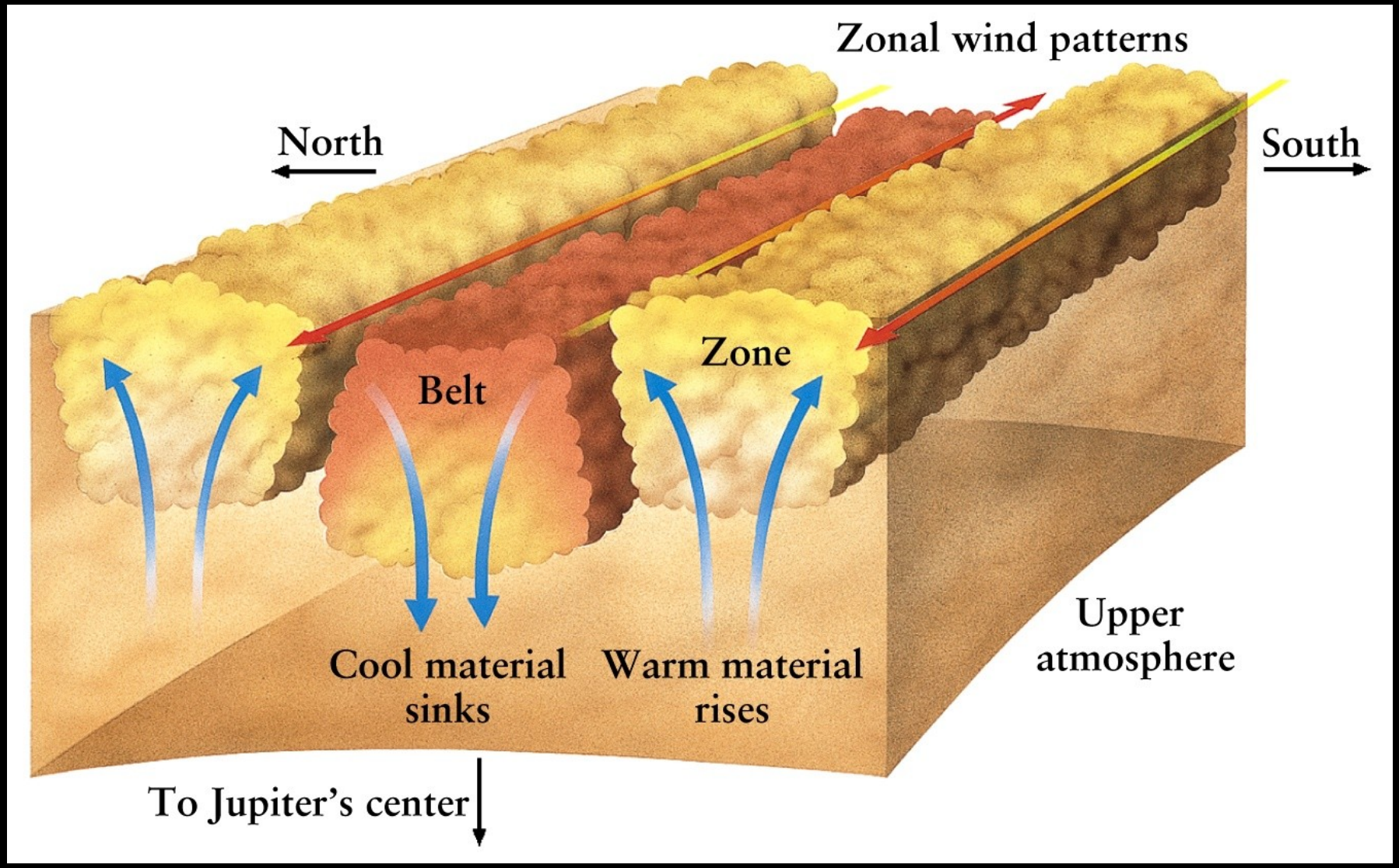
Radiojupiter



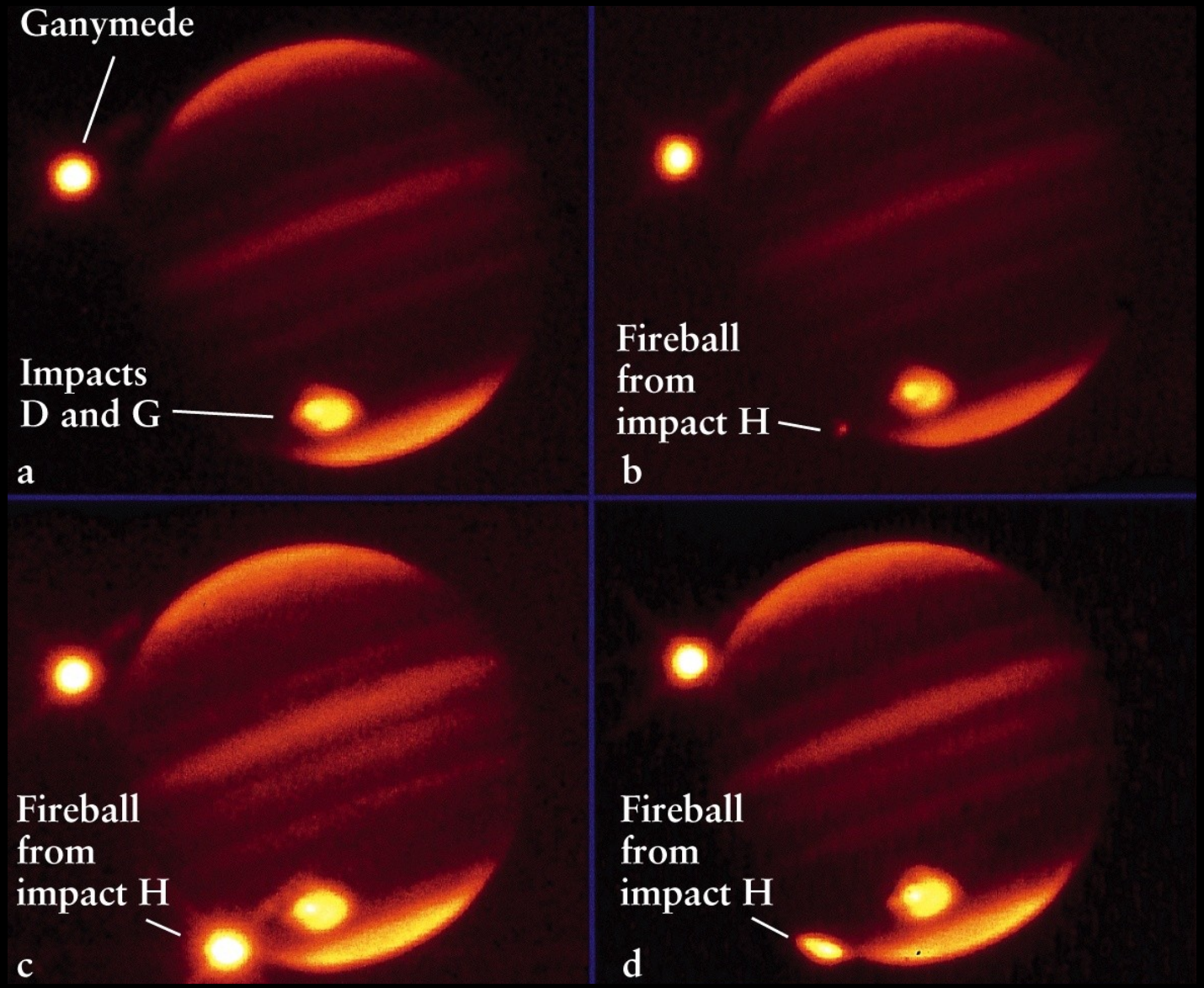
Jupiters övre atmosfär



Strukturen i bältes-zonen

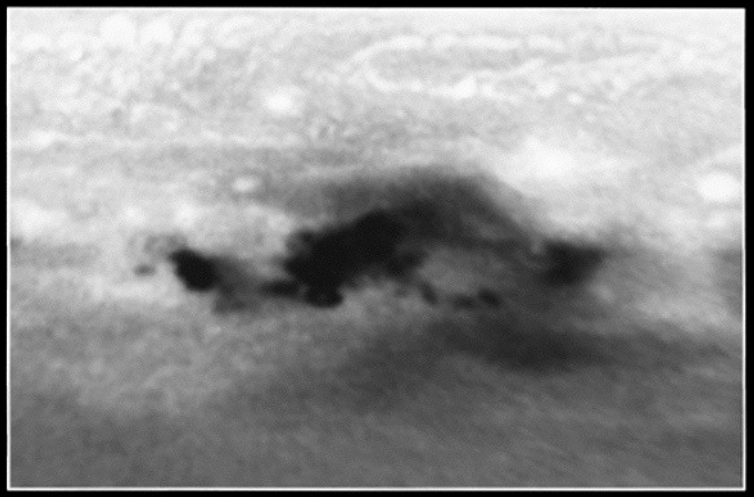


Nerslag på Jupiter 1994

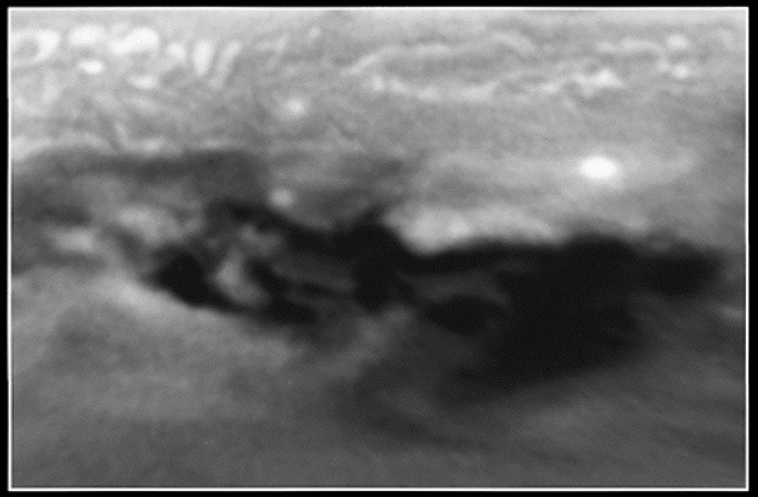


En nedslagsplats

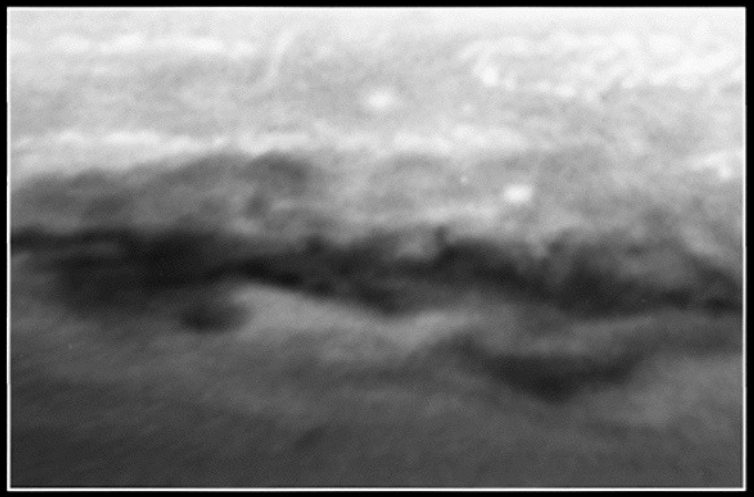
July 18, 1994



July 23, 1994

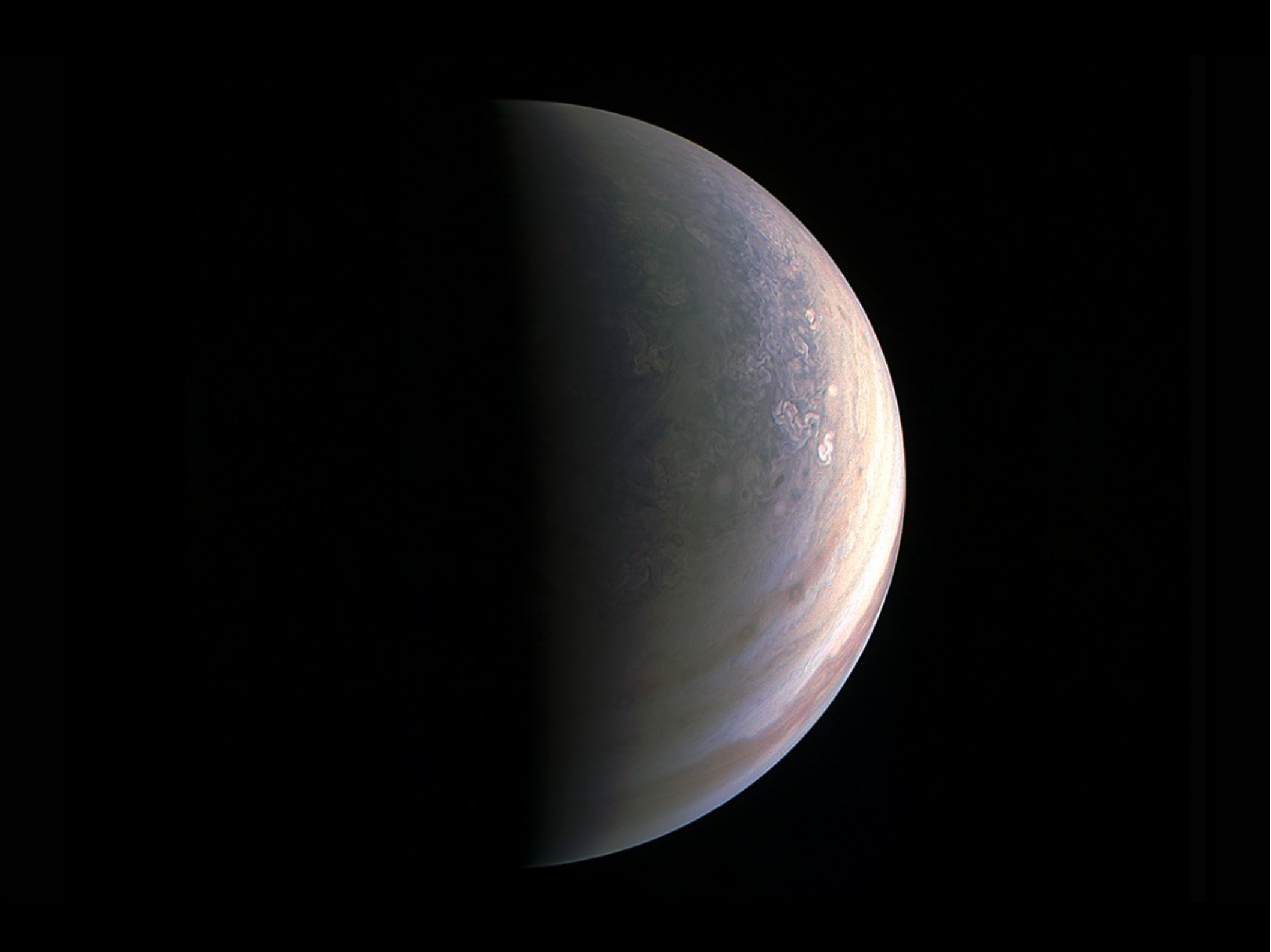


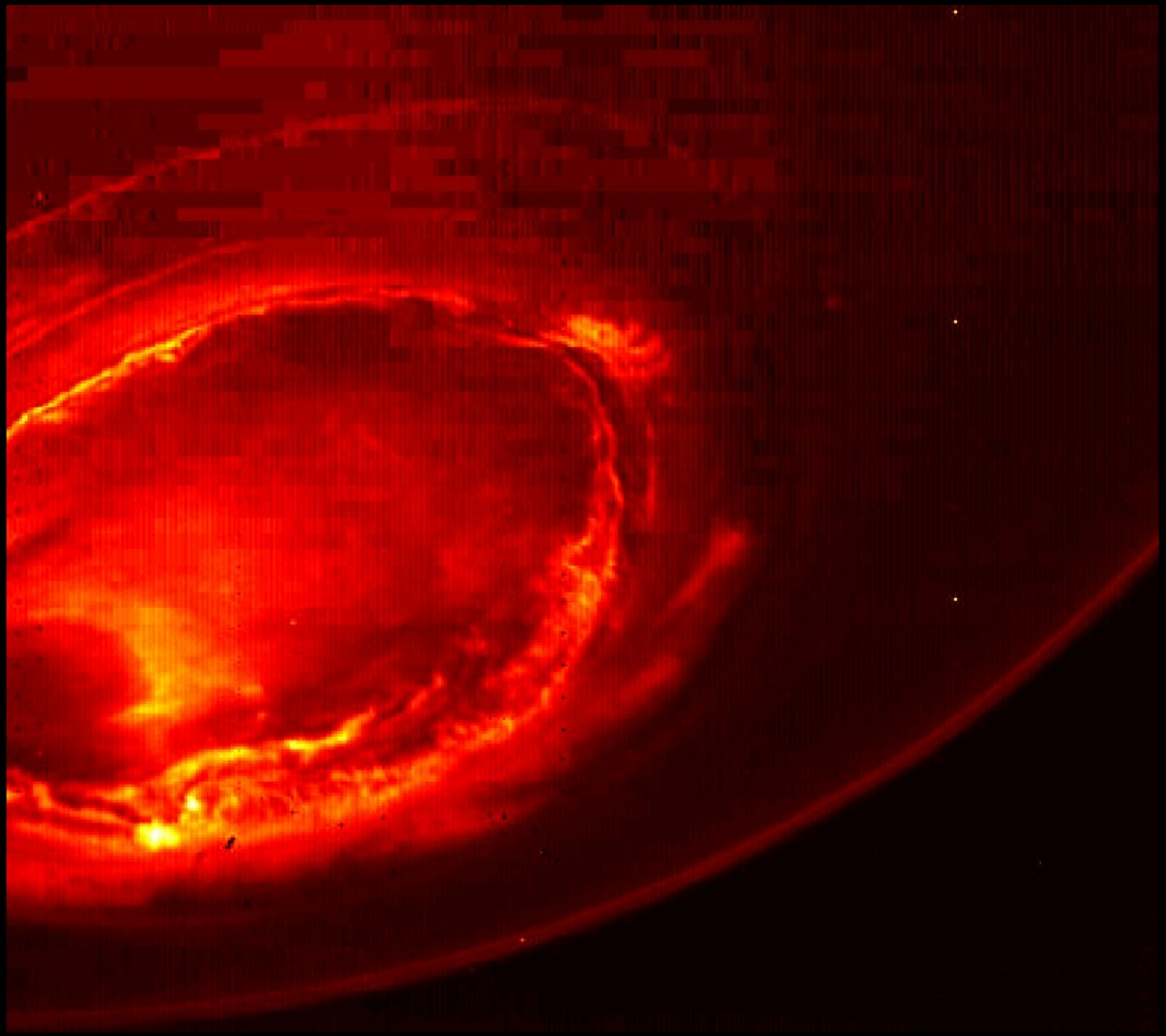
July 30, 1994



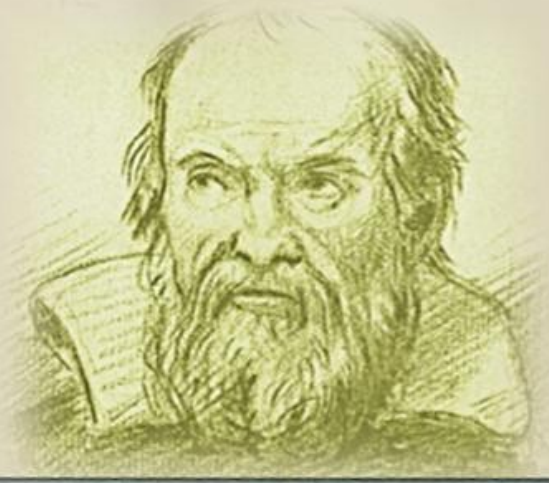
August 24, 1994

Senaste besöket: Juno





Adì 11. era in questa guisa ** ⊛. et la stella più vicina
à Giove era la metà minore dell'altra, et vicinissima all'altra
doue che le altre sere erano le dette stelle apparite tutte tre
di egual grandezza et trà di loro egualm.te lontane; dal che
appare intorno à Giove esser 3. altre stelle errati invisibili ad
ogn'uno sino à questo tẽpo. &c:



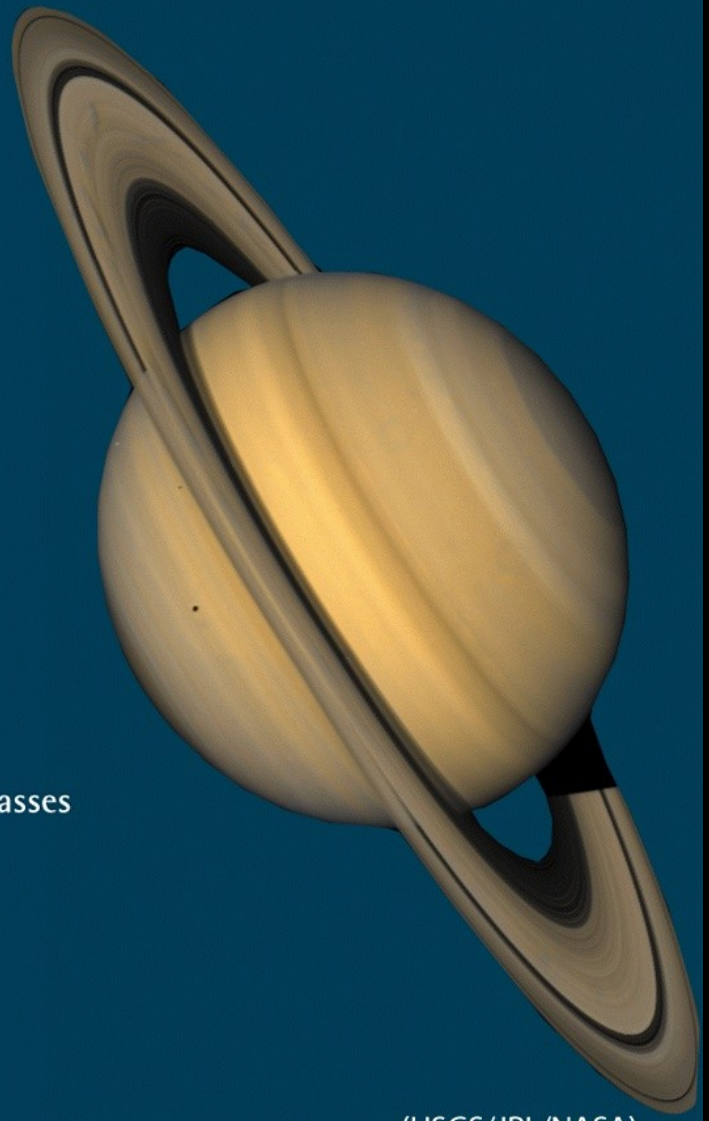
Galileo Galilej

Saturnus

Saturnus fakta

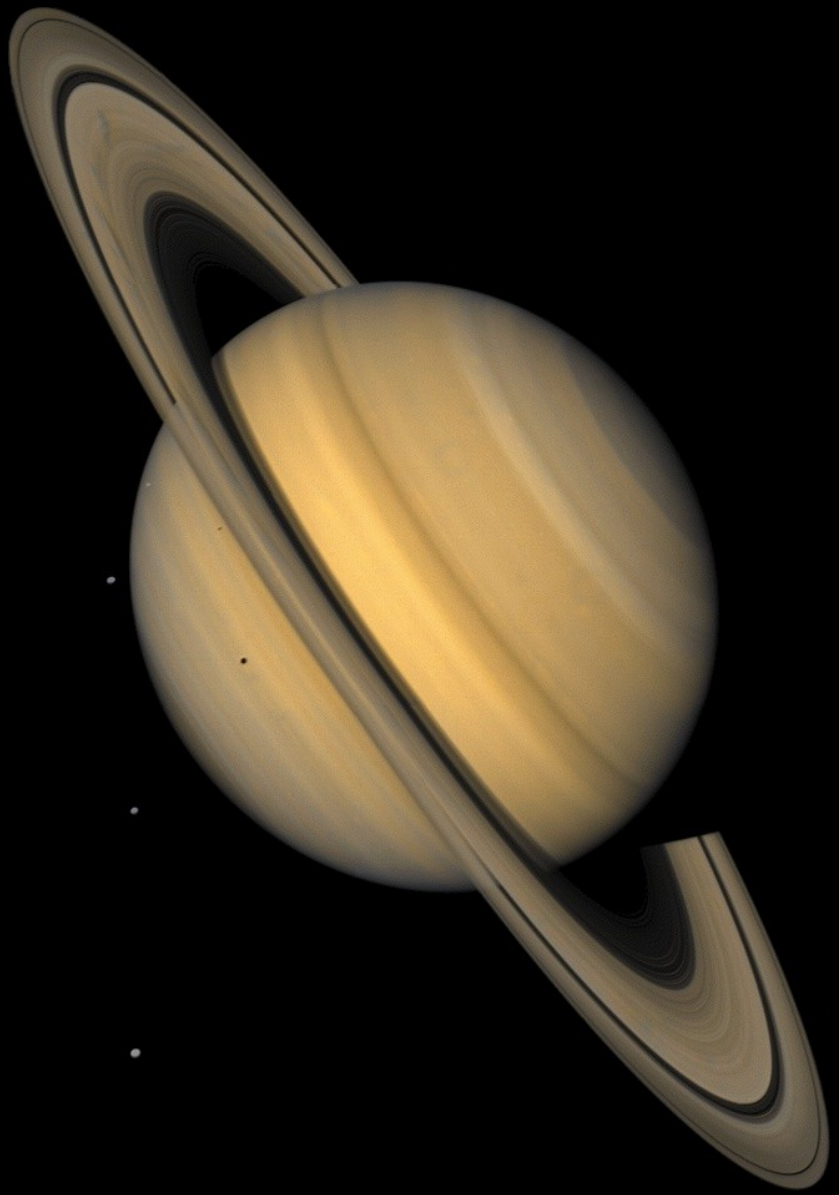
Table 15-1 Saturn Data

Average distance from Sun:	9.572 AU = 1.432×10^9 km
Maximum distance from Sun:	10.081 AU = 1.508×10^9 km
Minimum distance from Sun:	9.063 AU = 1.356×10^9 km
Eccentricity of orbit:	0.053
Average orbital speed:	9.64 km/s
Orbital period:	29.37 years
Rotation period:	$10^h\ 13^m\ 59^s$ (equatorial) $10^h\ 39^m\ 25^s$ (internal)
Inclination of equator to orbit:	26.73°
Inclination of orbit to ecliptic:	2.48°
Diameter:	120,536 km = 9.449 Earth diameters (equatorial)
	108,728 km = 8.523 Earth diameters (polar)
Mass:	5.685×10^{26} kg = 95.16 Earth masses
Average density:	687 kg/m^3
Escape speed:	35.5 km/s
Surface gravity (Earth = 1):	0.92
Albedo:	0.46
Average temperature at cloudtops:	−180°C = −292°F = 93 K

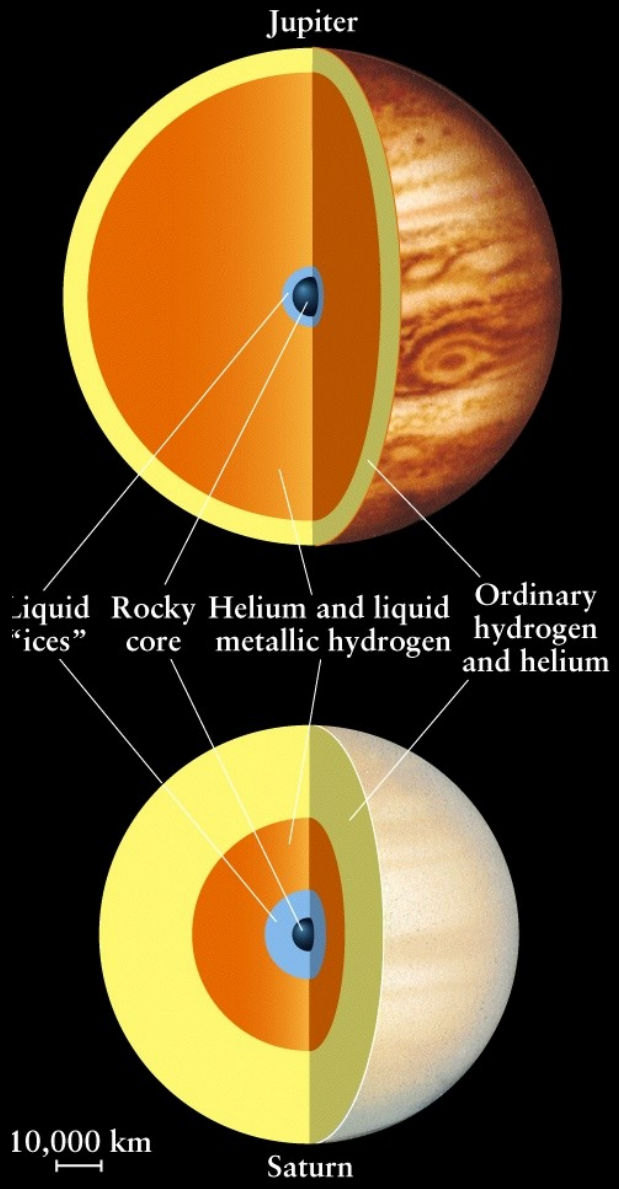


(USGS/JPL/NASA)

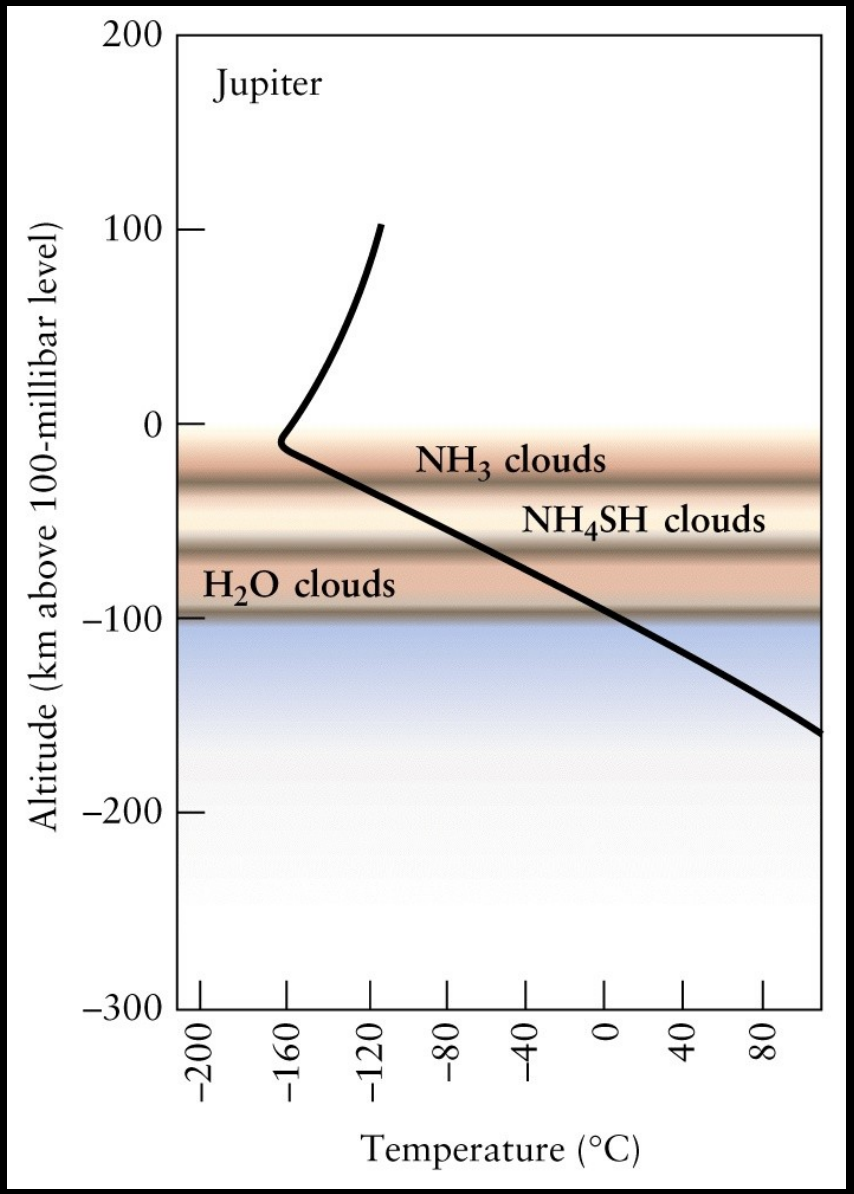
Saturnus –solsystemets vackraste planet?

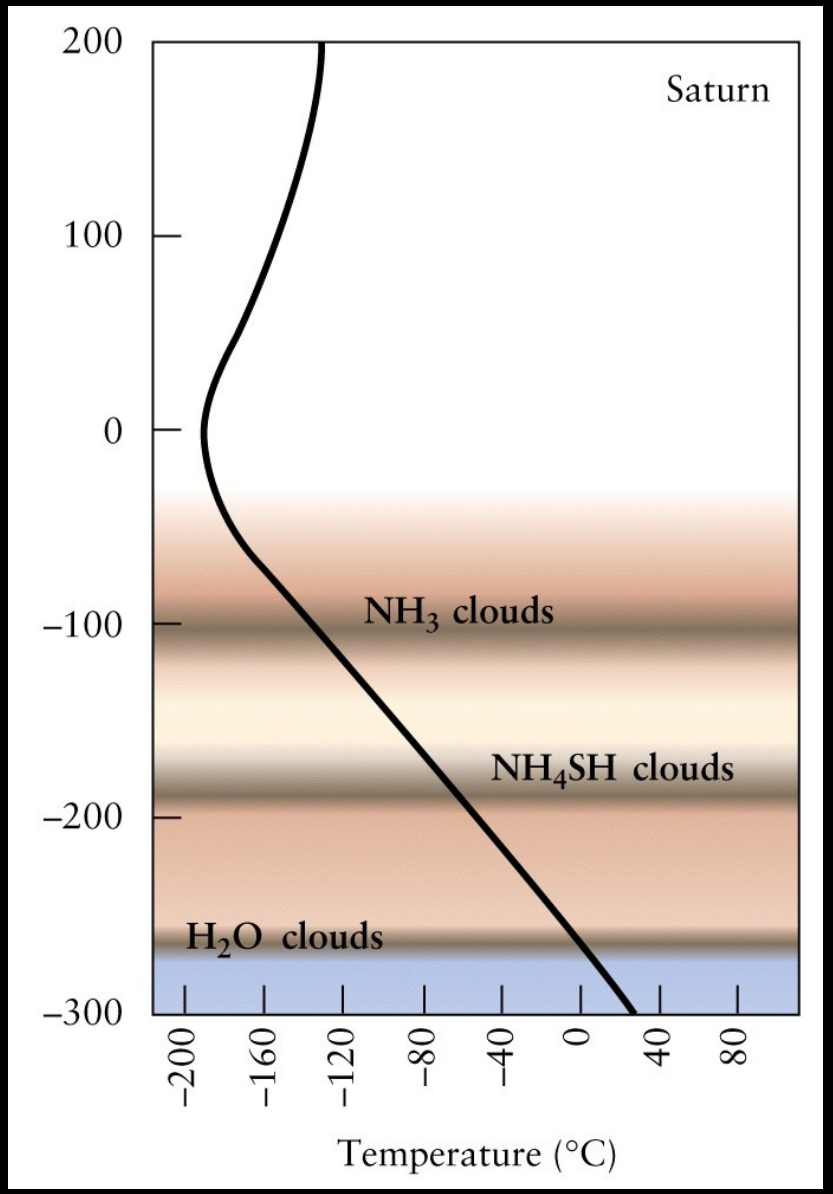


Jupiters och Saturnus inre strukturer

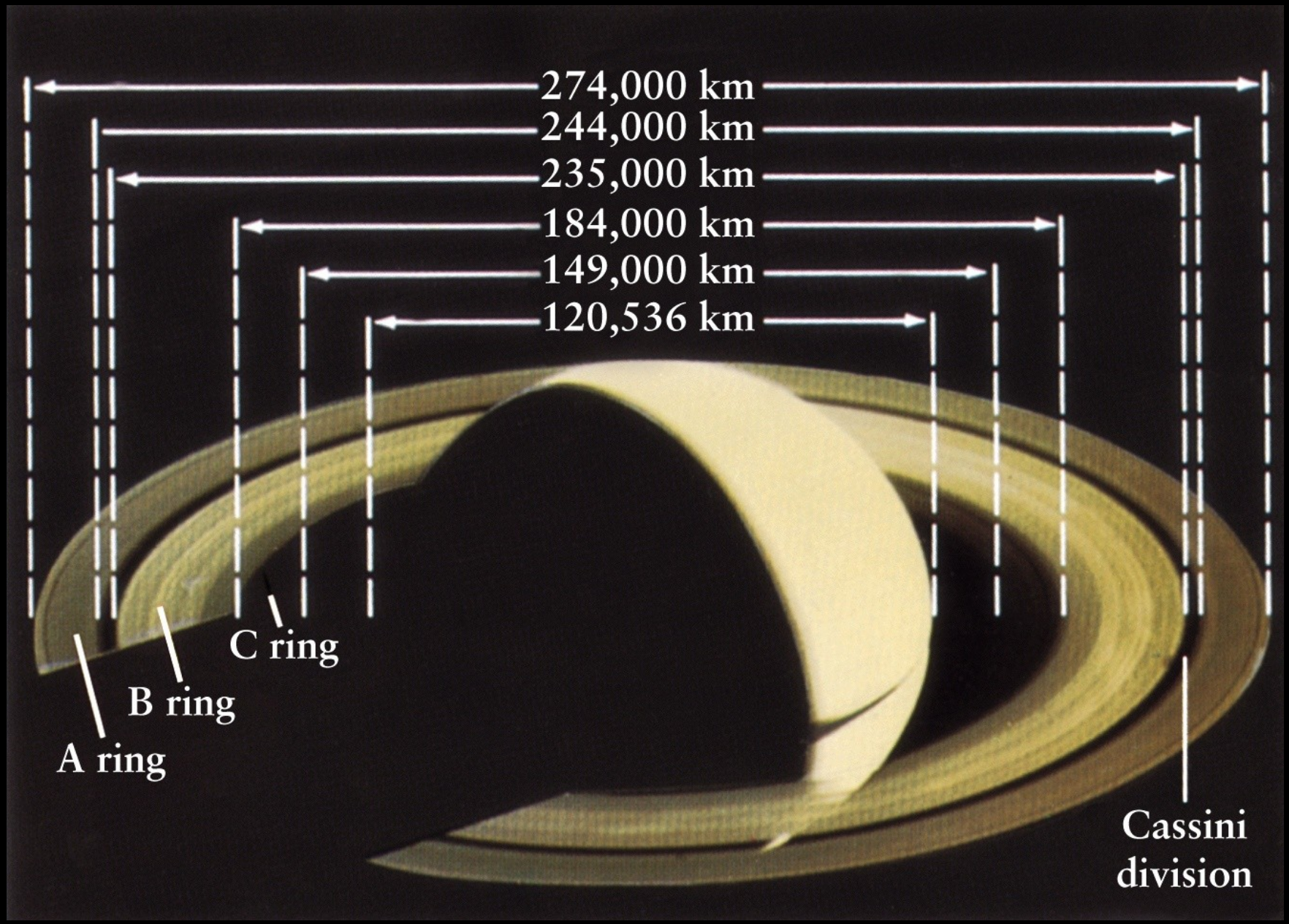


Jupiters och Saturnus atmosfärer

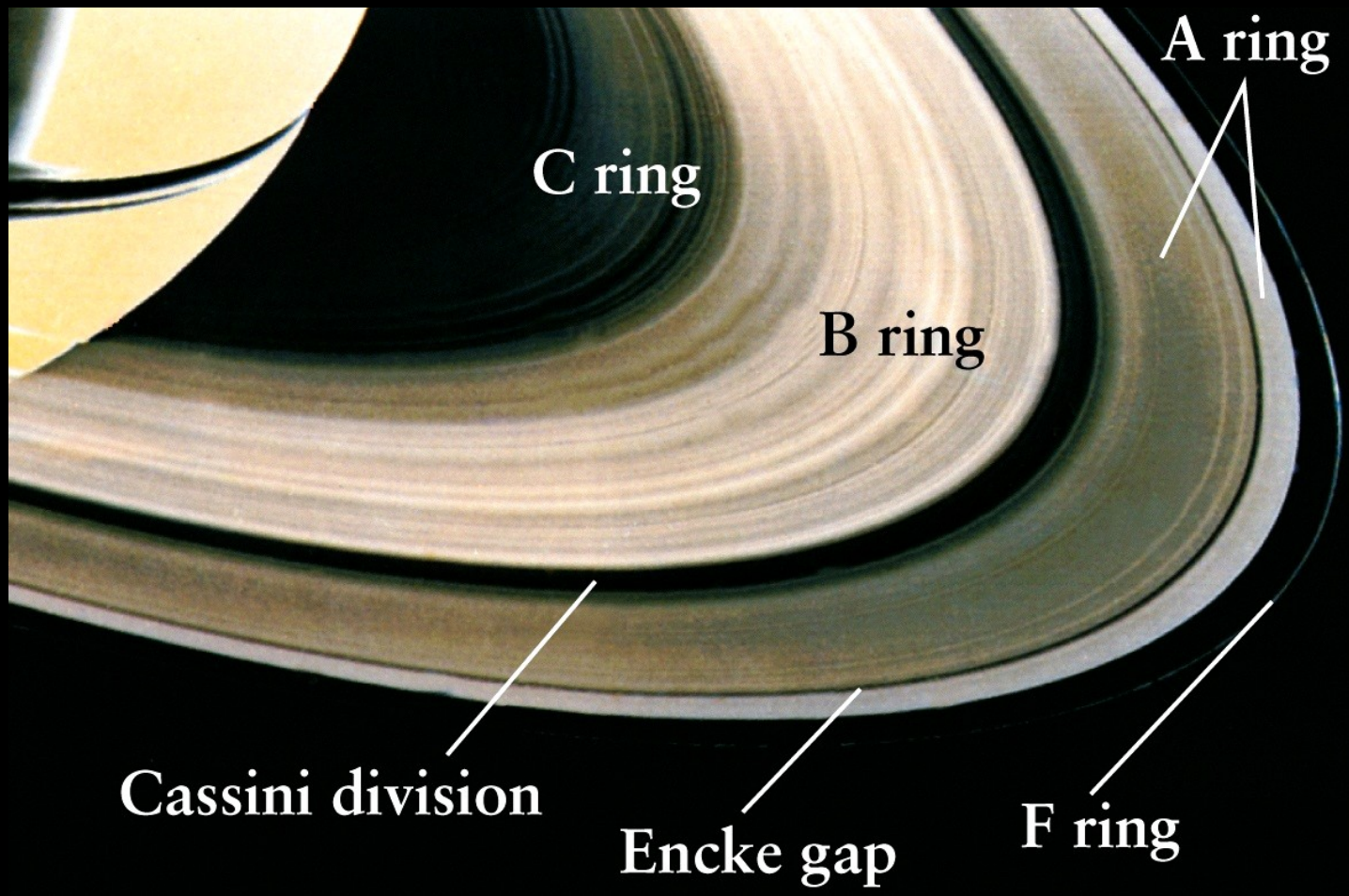




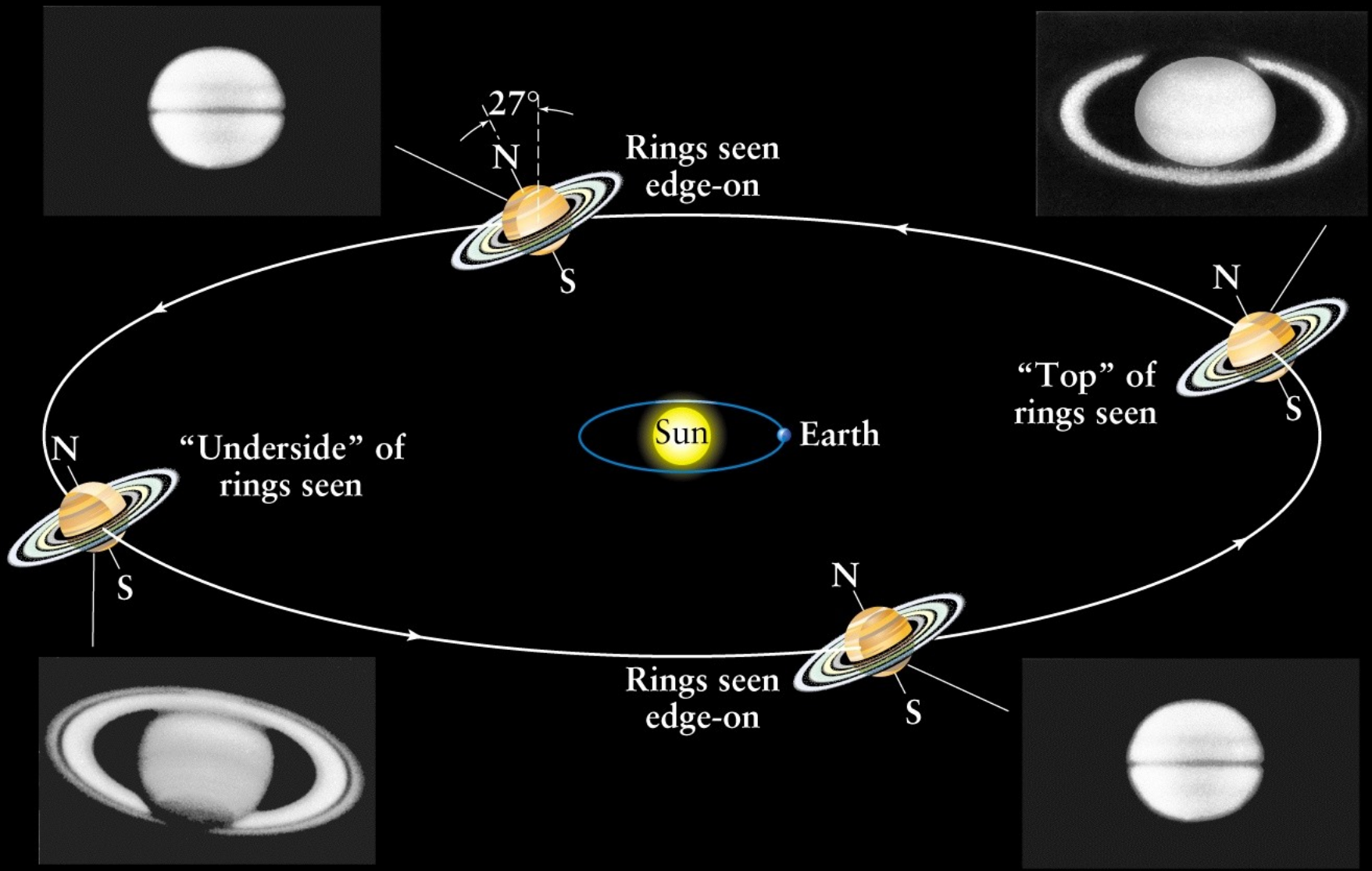
Ringsystemets storlek



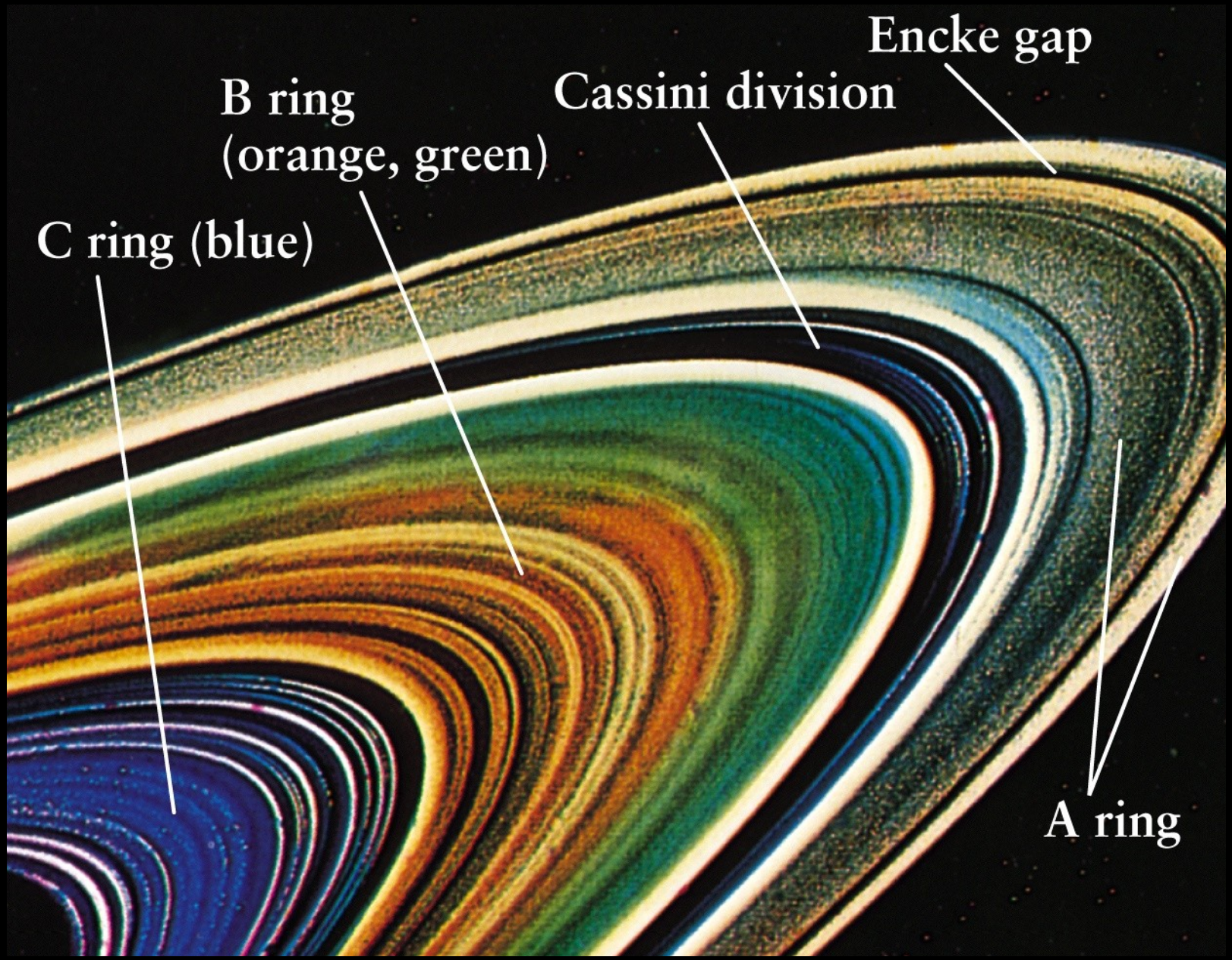
Detaljer i ringarna



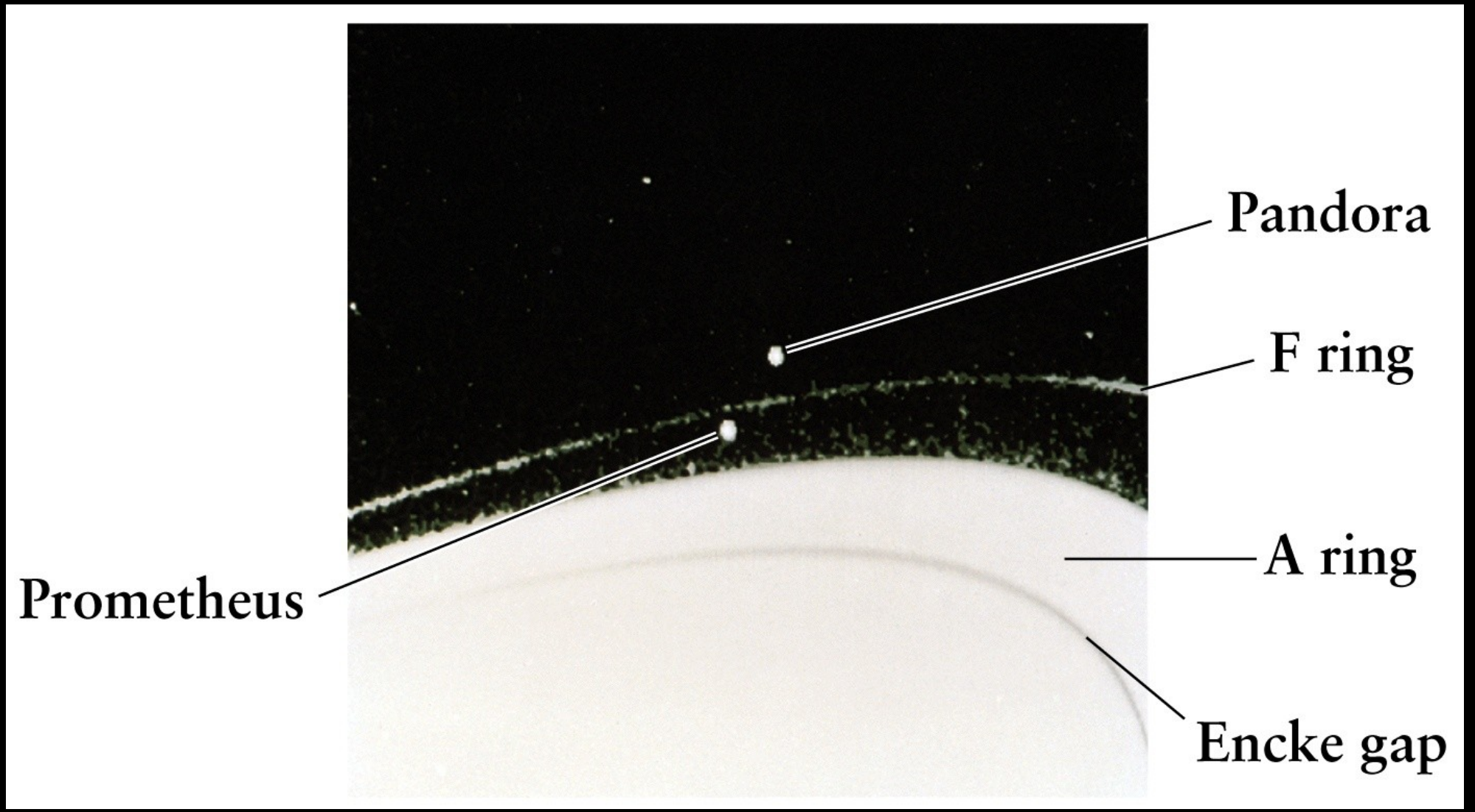
Ringarnas varierande lutning



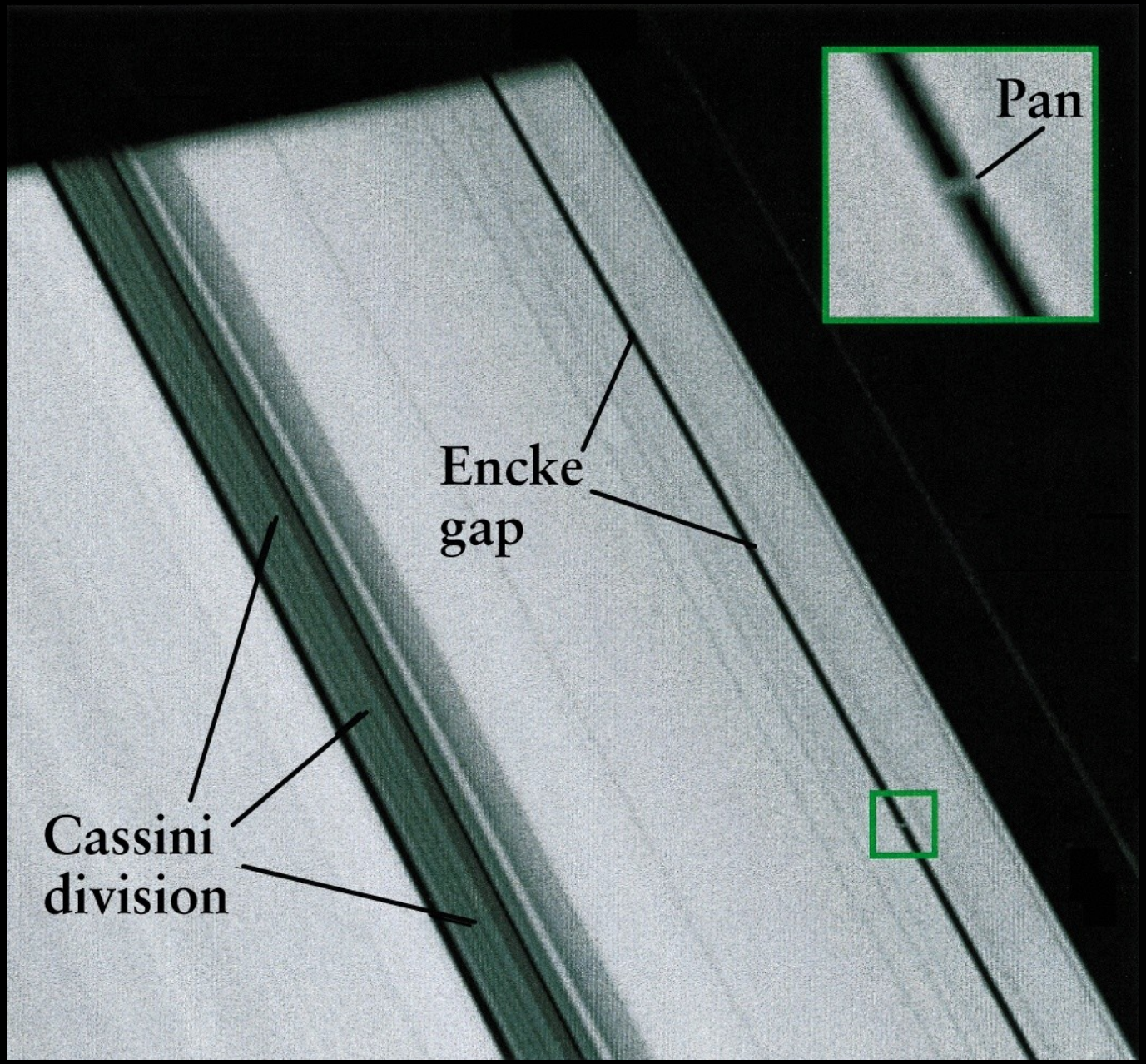
Färgvariationer



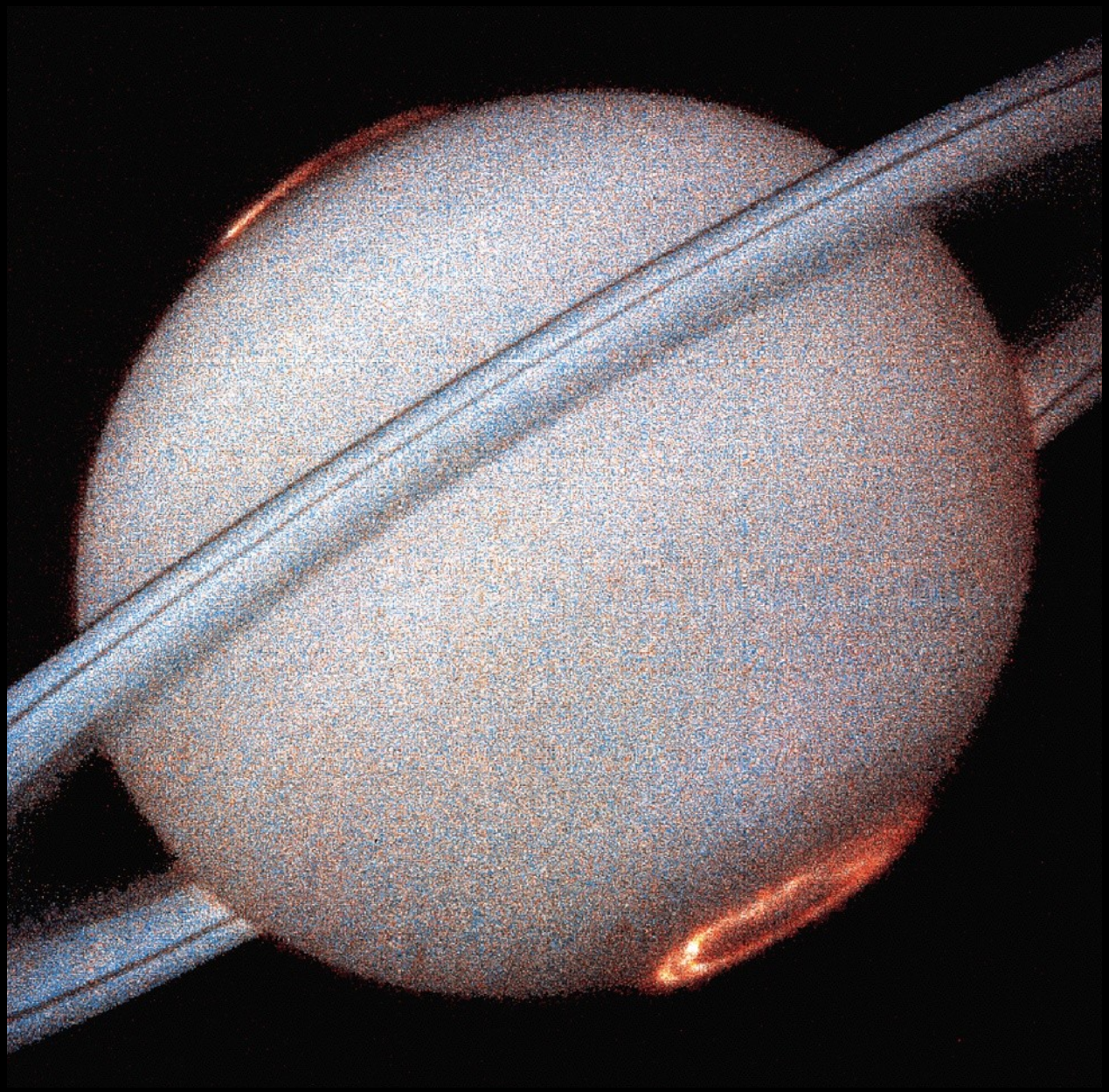
Herdemånar



Månen Pan i Enckes lucka

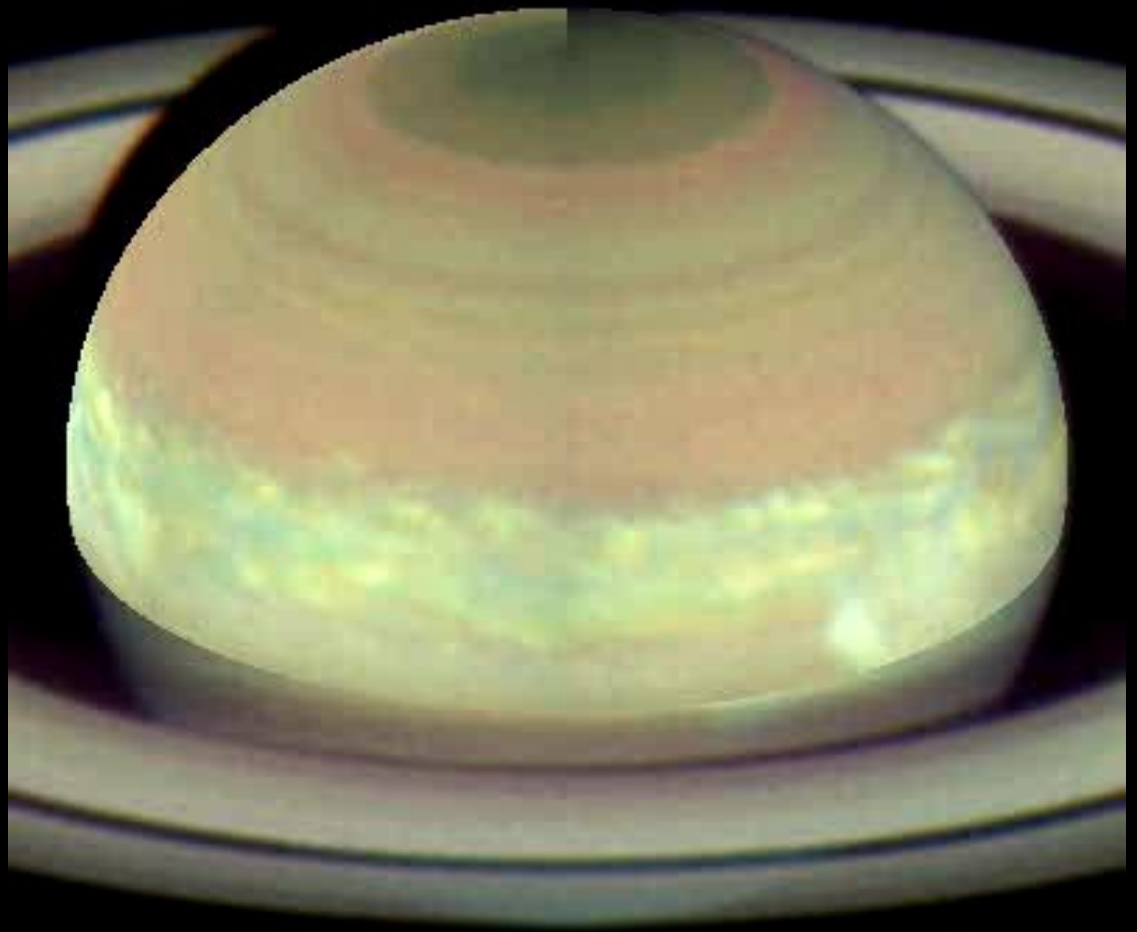


Norrsken på Saturnus



Storm på Saturnus

Vädersystem på Saturnus



Cassini-rymdsonden

Huygens landar på Titan

Uranus och Neptunus

Fakta: Uranus

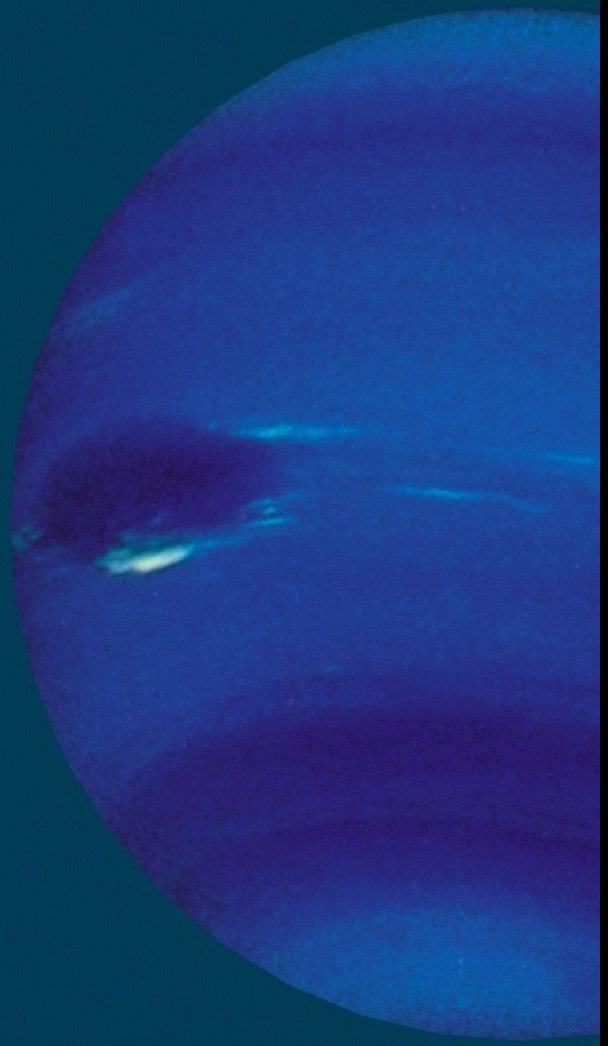
Table 16-1 Uranus Data

Average distance from Sun:	19.194 AU = 2.871×10^9 km
Maximum distance from Sun:	20.017 AU = 2.995×10^9 km
Minimum distance from Sun:	18.371 AU = 2.748×10^9 km
Eccentricity of orbit:	0.0429
Average orbital speed:	6.83 km/s
Orbital period:	84.099 years
Rotation period (internal):	17.24 hours
Inclination of equator to orbit:	97.86°
Inclination of orbit to ecliptic:	0.77°
Diameter:	51,118 km = 4.007 Earth diameters (equatorial)
Mass:	8.682×10^{25} kg = 14.53 Earth masses
Average density:	1318 kg/m^3
Escape speed:	21.3 km/s
Surface gravity (Earth = 1):	0.90
Albedo:	0.56
Average temperature at cloudtops:	−218°C = −360°F = 55 K

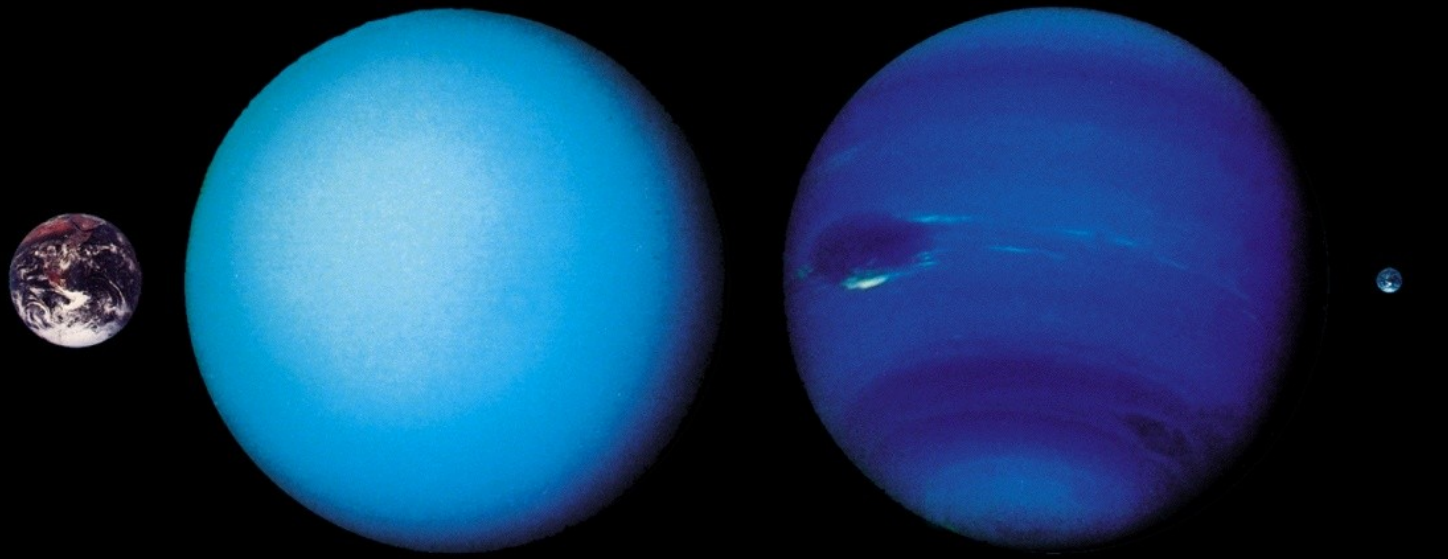
Fakta: Neptunus

Table 16-2 Neptune Data

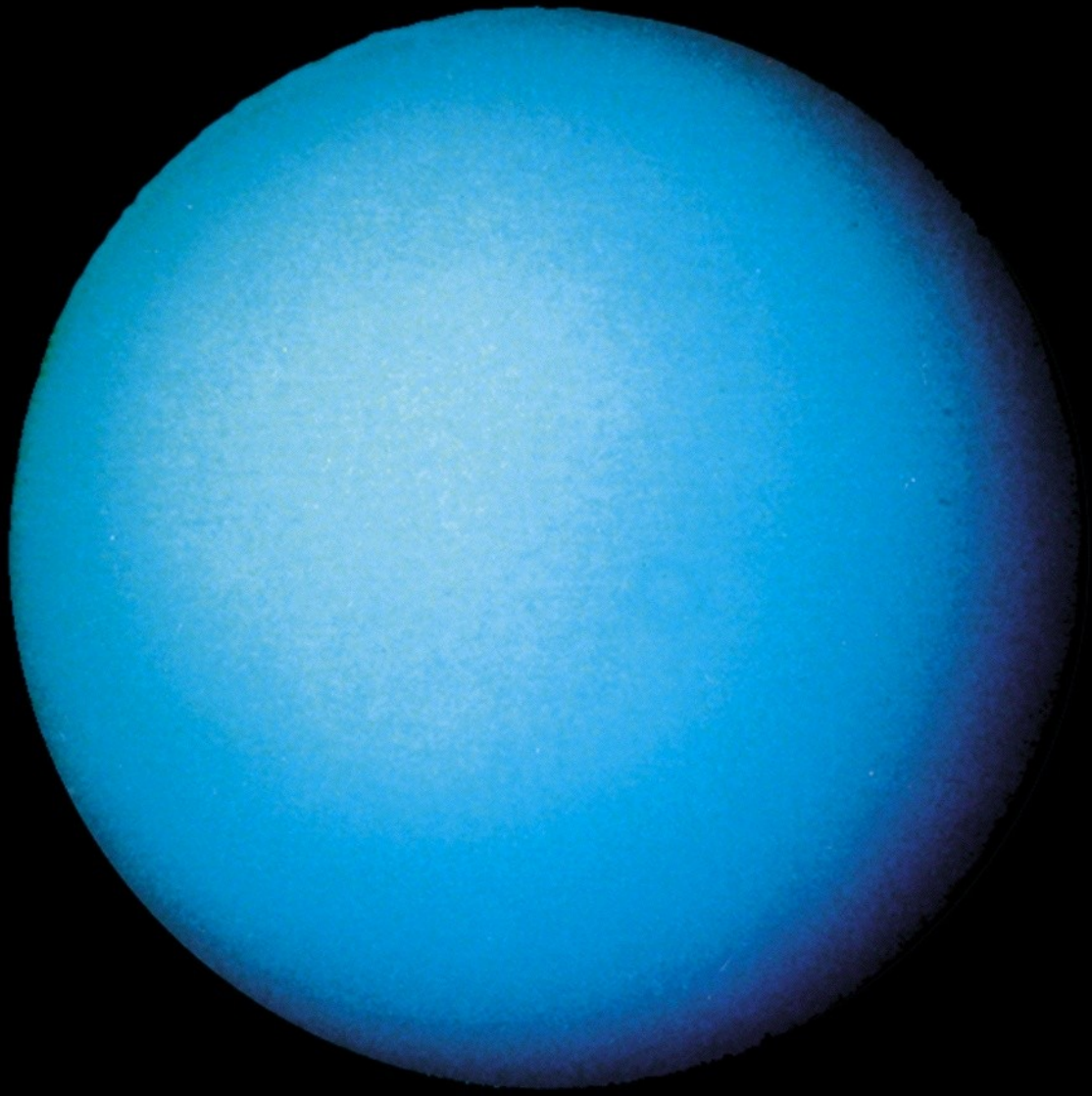
Average distance from Sun:	30.066 AU = 4.498×10^9 km
Maximum distance from Sun:	30.367 AU = 4.543×10^9 km
Minimum distance from Sun:	29.765 AU = 4.453×10^9 km
Eccentricity of orbit:	0.010
Average orbital speed:	5.5 km/s
Orbital period:	164.86 years
Rotation period (internal):	16.11 hours
Inclination of equator to orbit:	29.56°
Inclination of orbit to ecliptic:	1.77°
Diameter:	49,528 km = 3.883 Earth diameters (equatorial)
Mass:	1.024×10^{26} kg = 17.15 Earth masses
Average density:	1638 kg/m^3
Escape speed:	23.5 km/s
Surface gravity (Earth = 1):	1.1
Albedo:	0.51
Average temperature at cloudtops:	−218°C = −360°F = 55 K



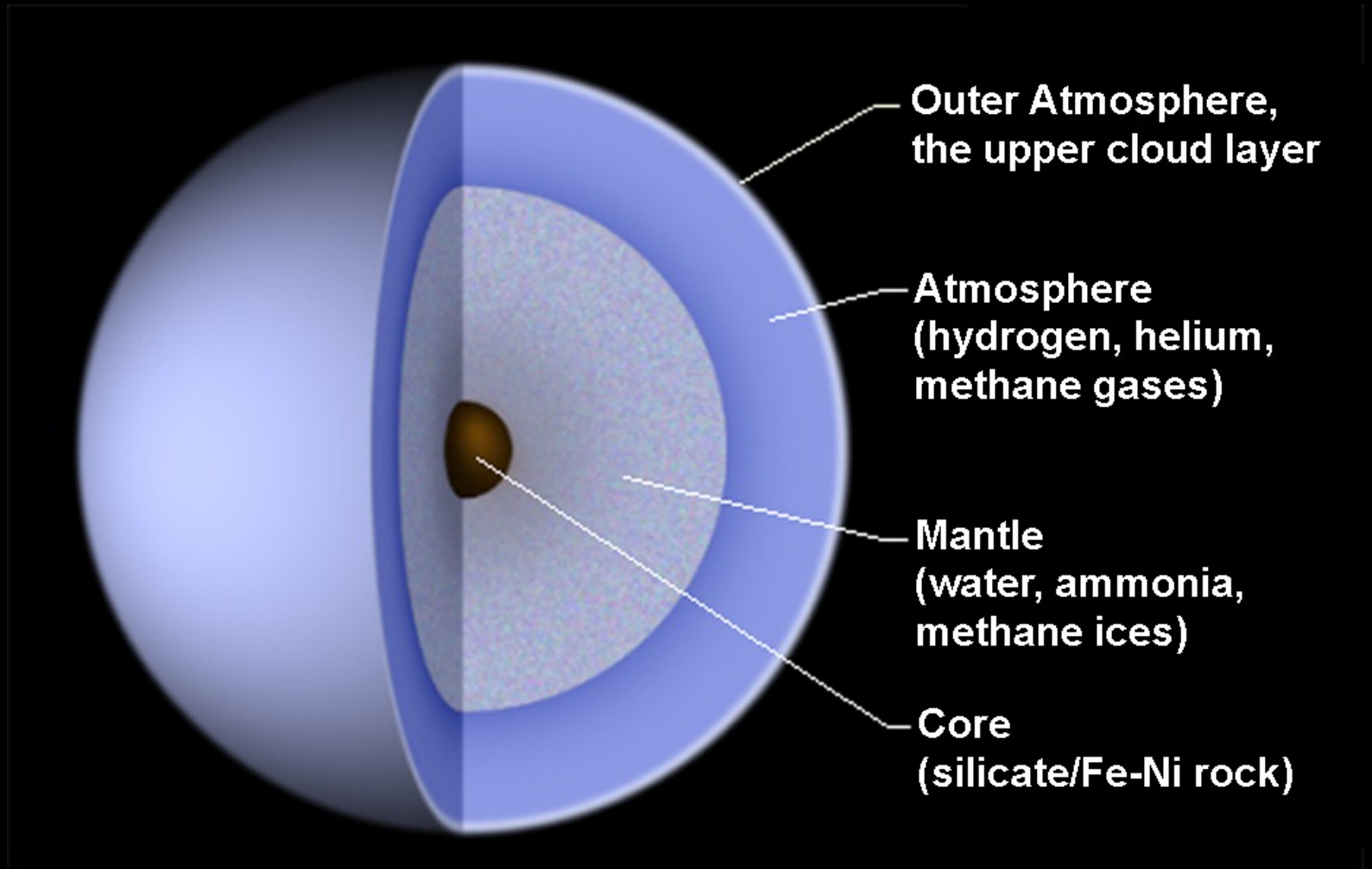
Storleksjämförelse



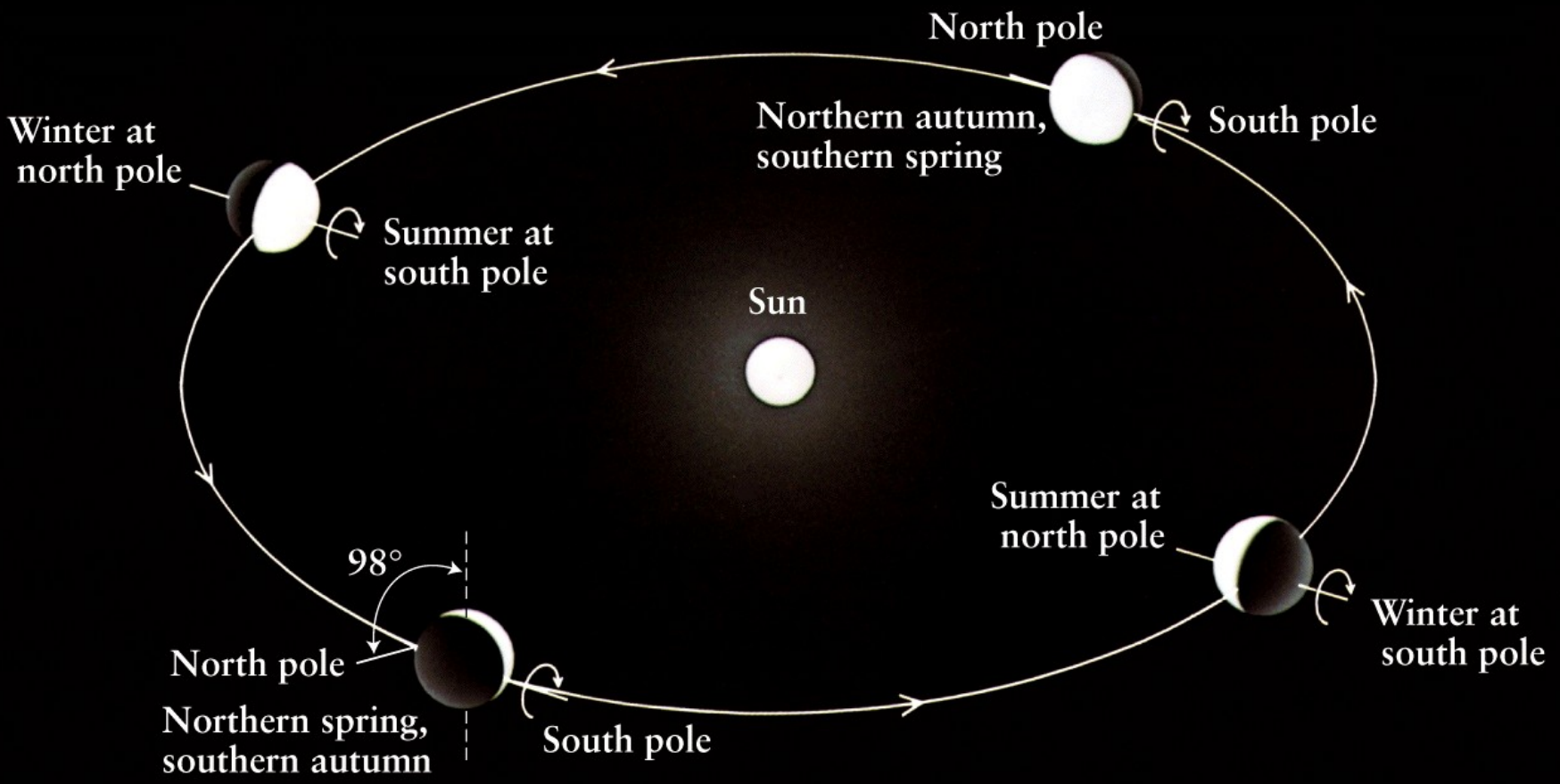
Uranus: solsystemets tråkigaste planet?



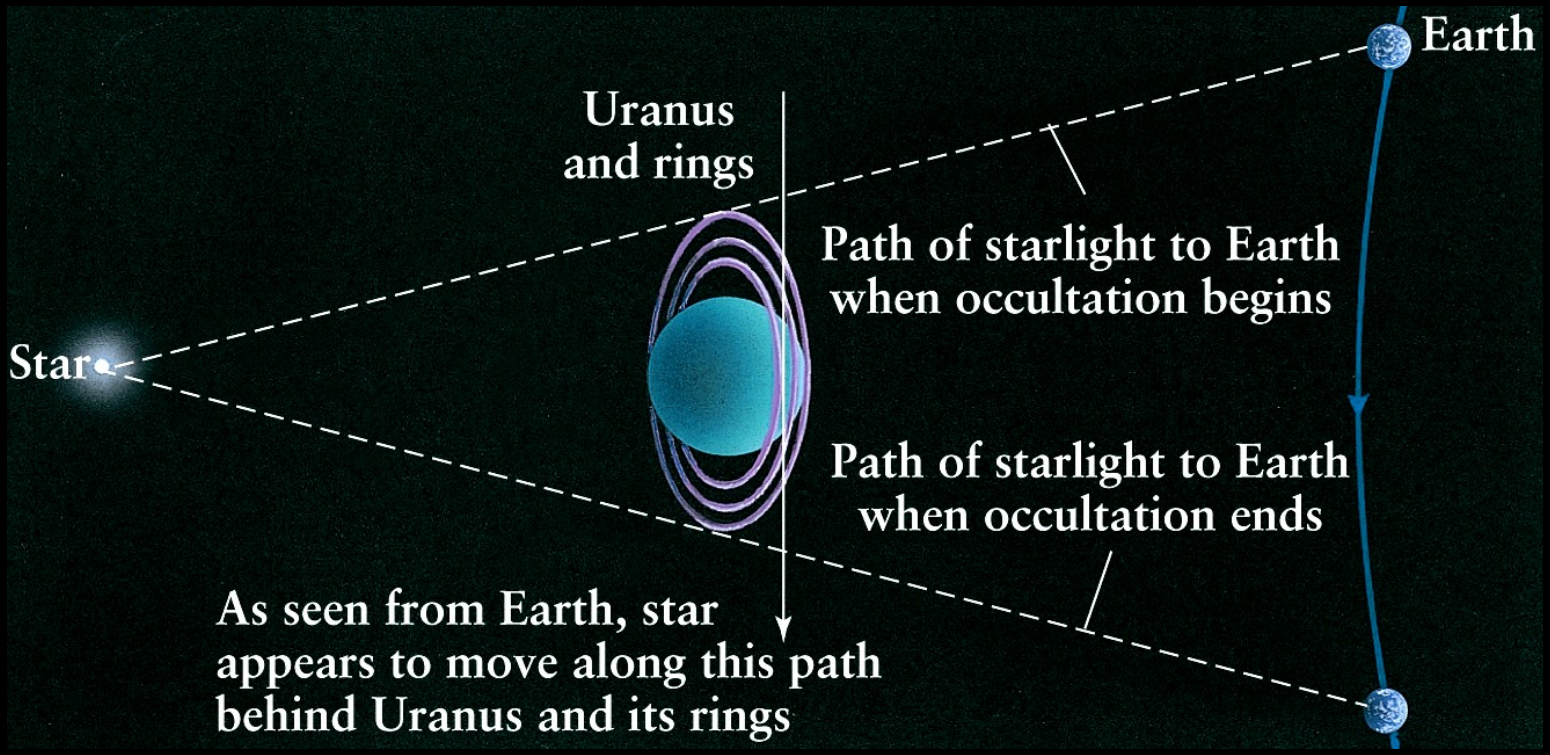
Uranus – en isplanet

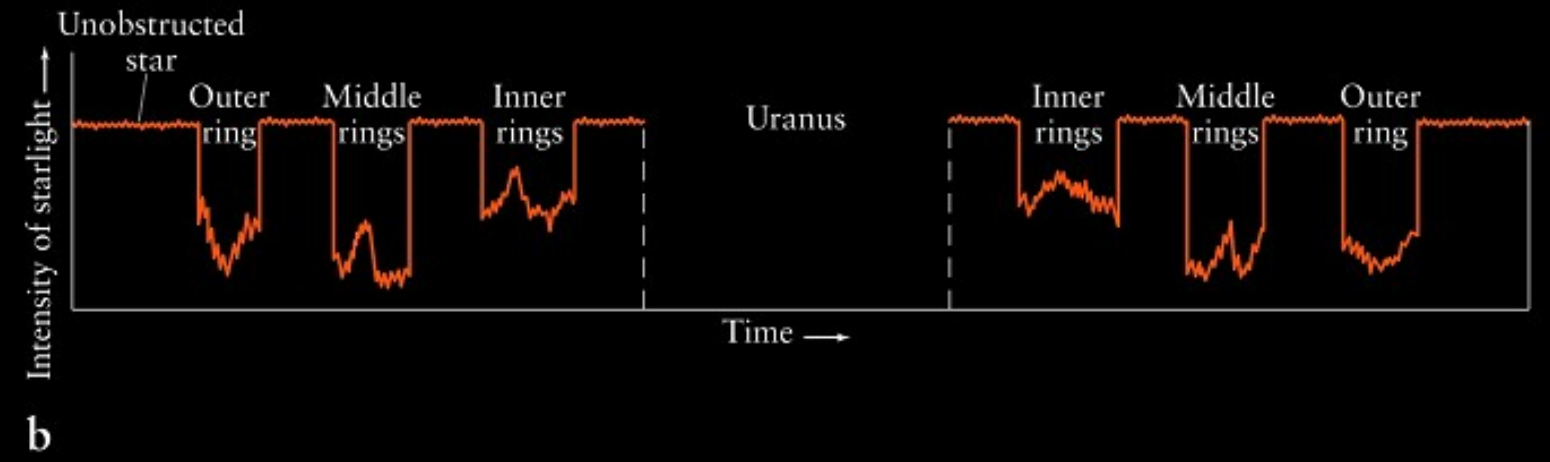


Uranus rörelser

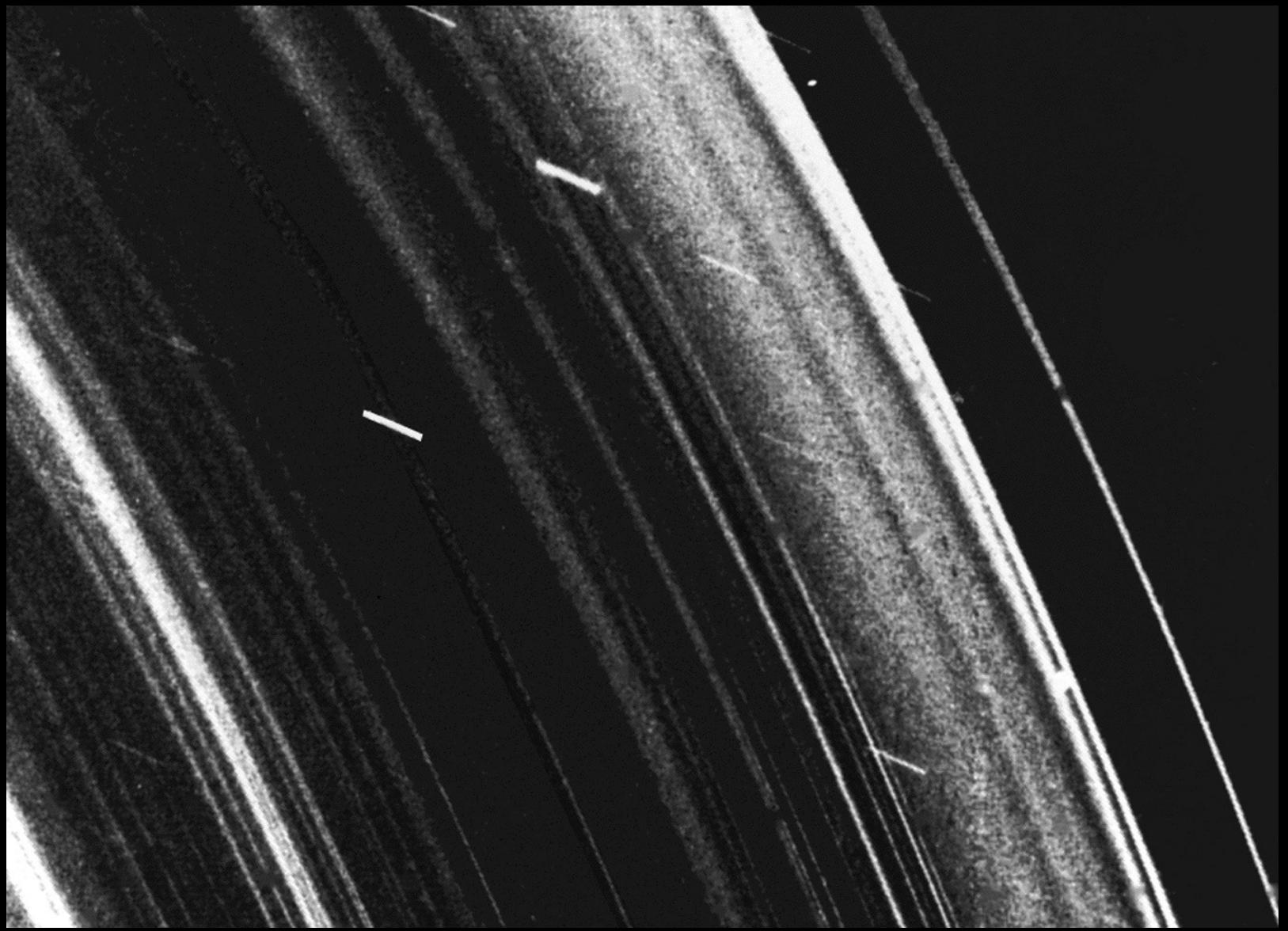


Uranus ringar

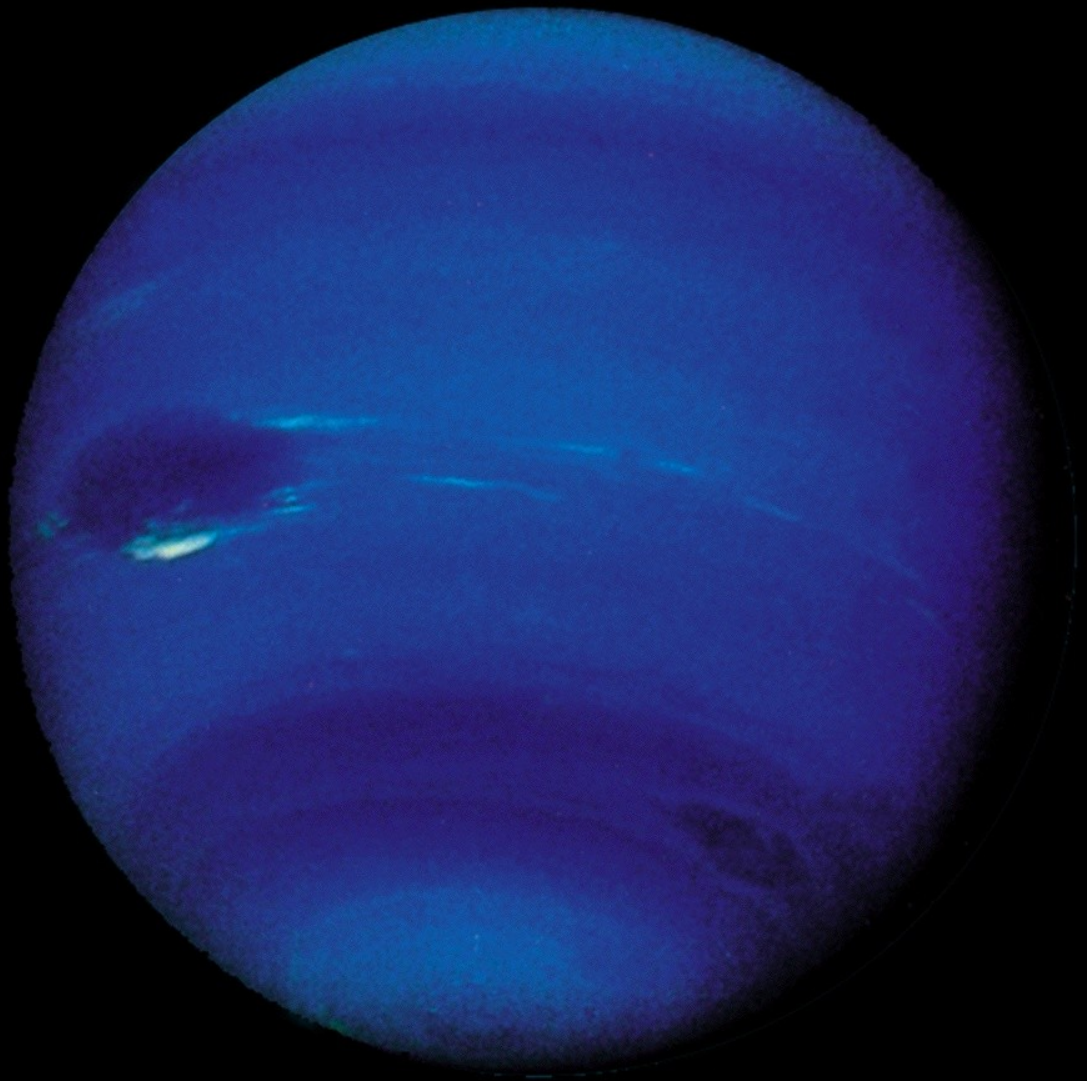




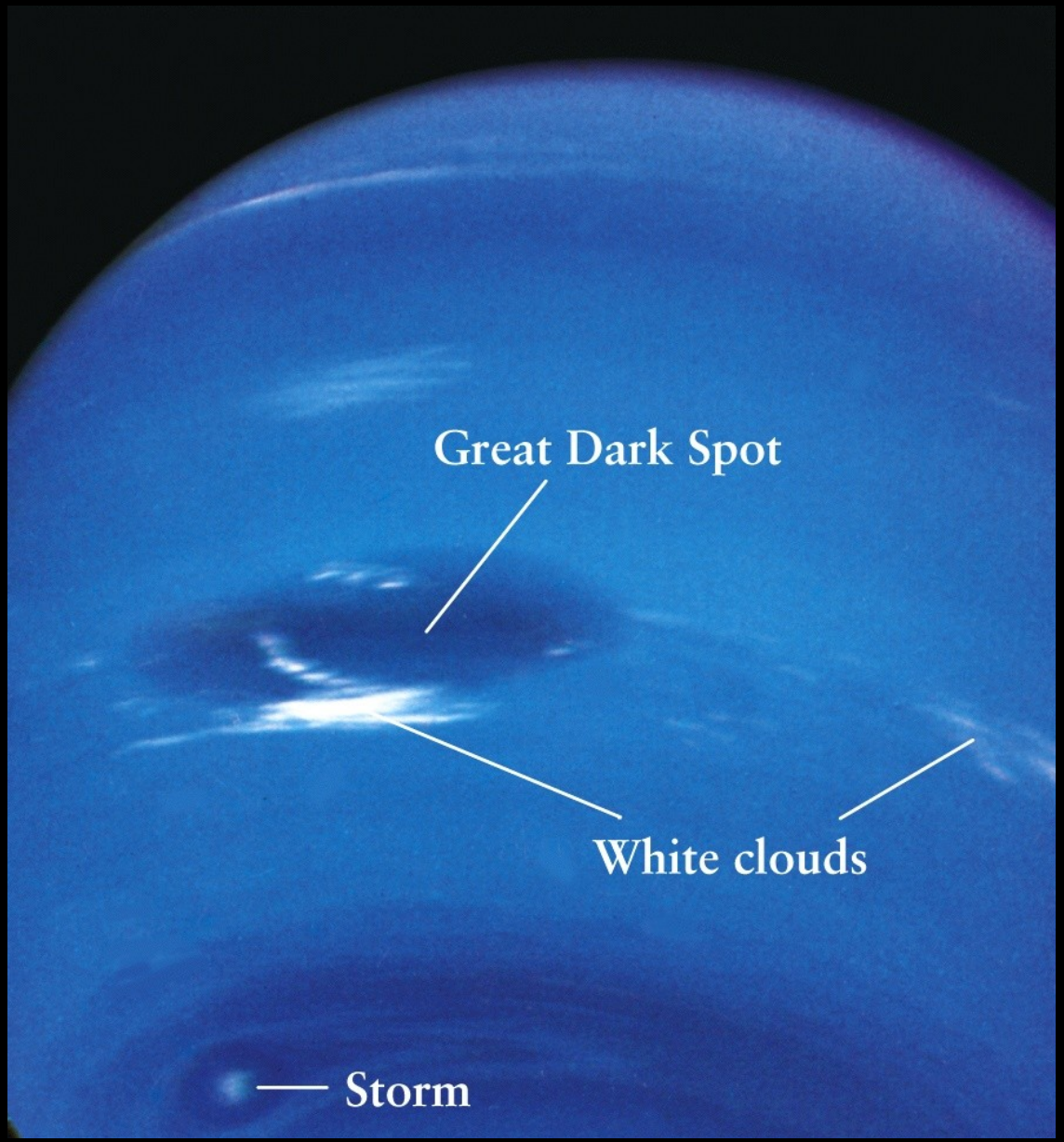
Uranus ring



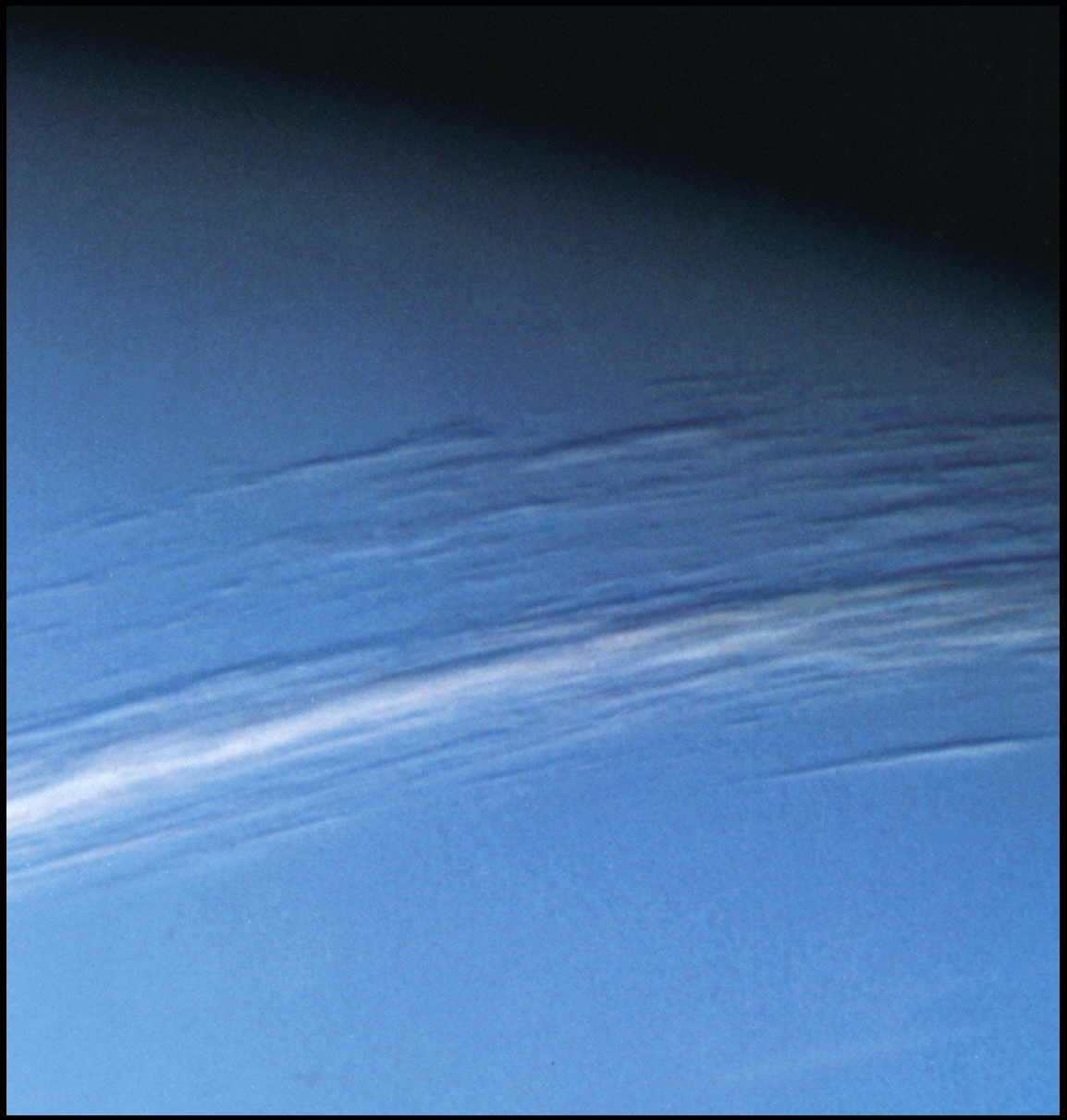
Neptunus



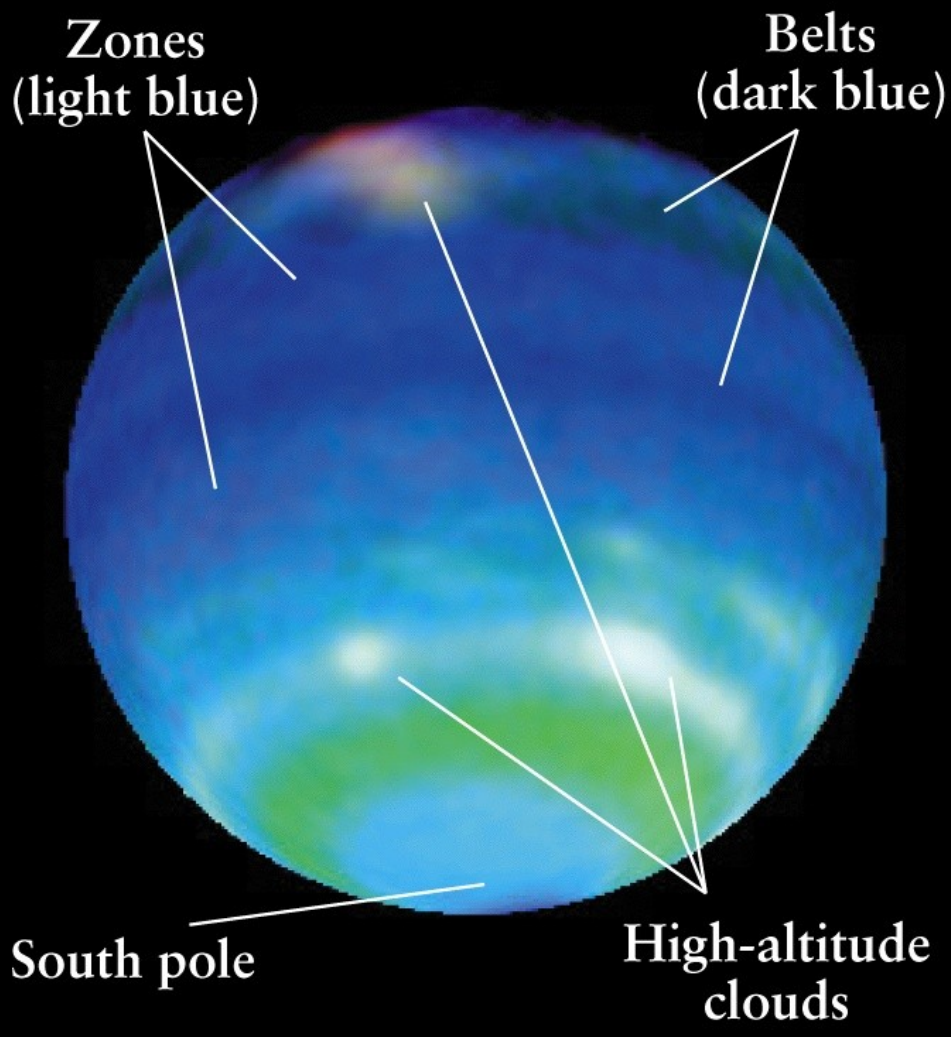
Neptunus: atmosfärsformationer



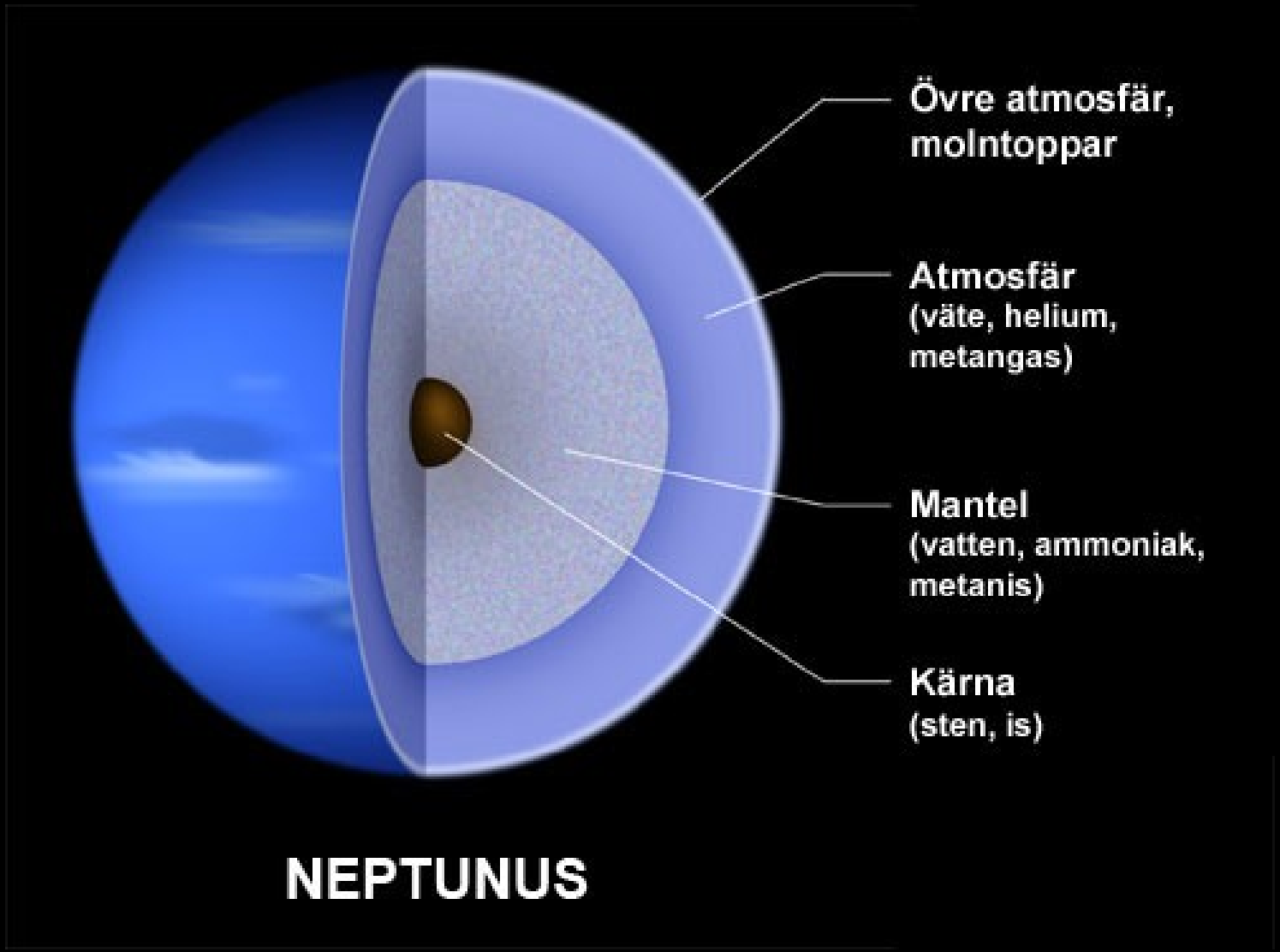
Neptunus: Cirrusmoln



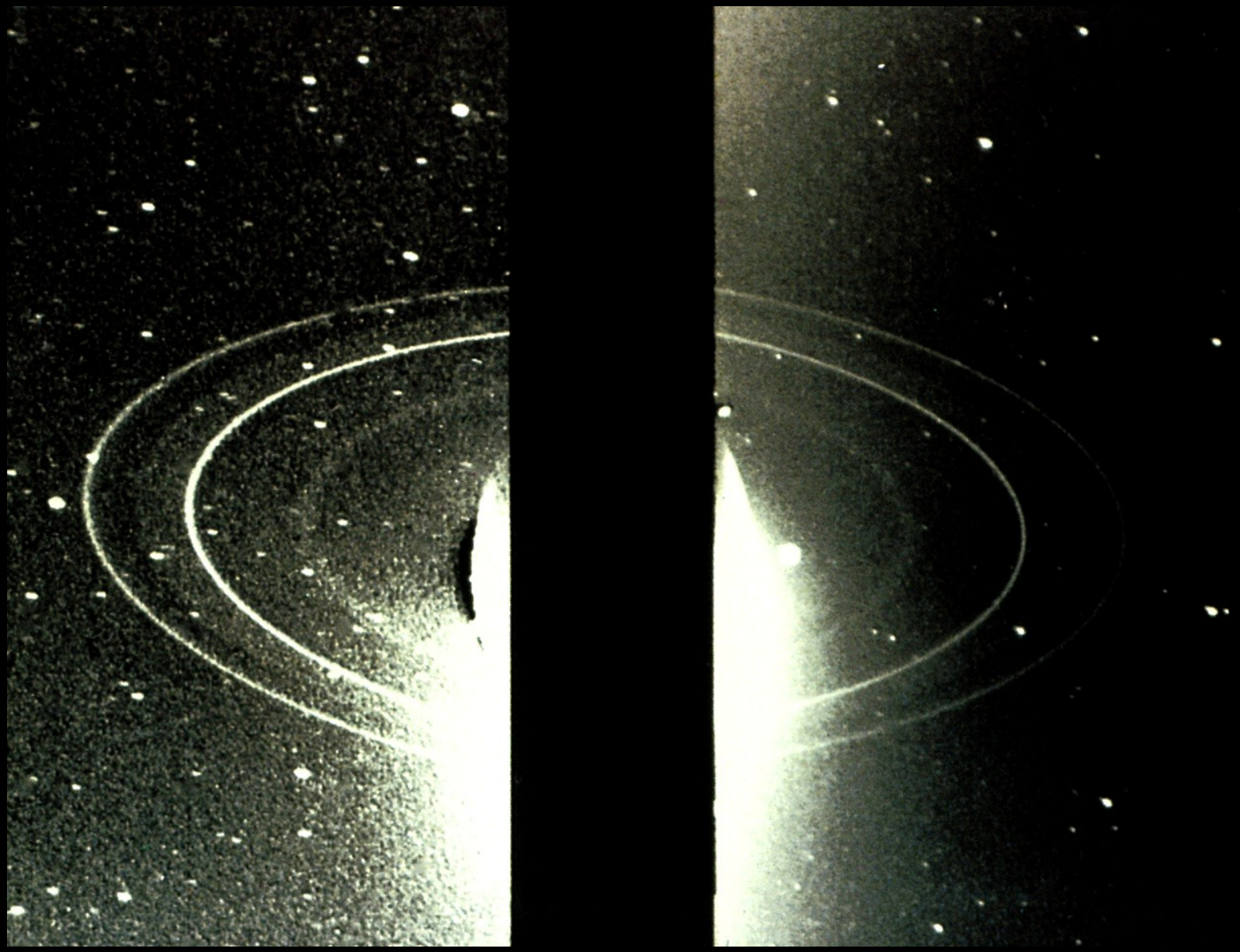
Neptunus: Bälten i atmosfären



Inre struktur i Neptunus



Neptunus ringsystem

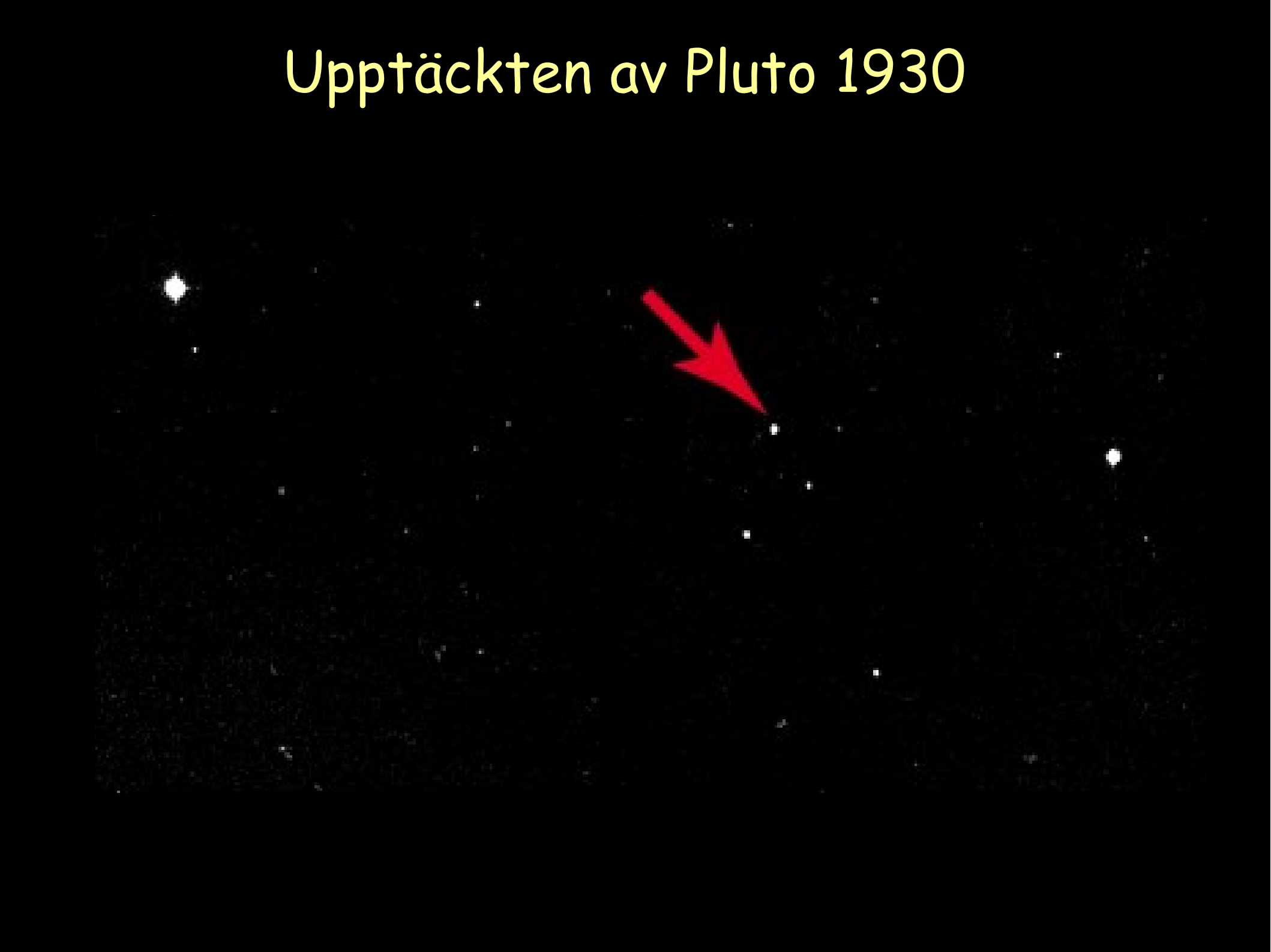


Vad är en dvärgplanet? (2006)

- En himlakropp som ligger i en bana kring solen
- Har en tillräckligt stor massa för att göras rund av sin egen gravitation
- Men som samtidigt inte har rensat undan alla planetesimaler kring sin egen omloppsbana och som inte är en måne

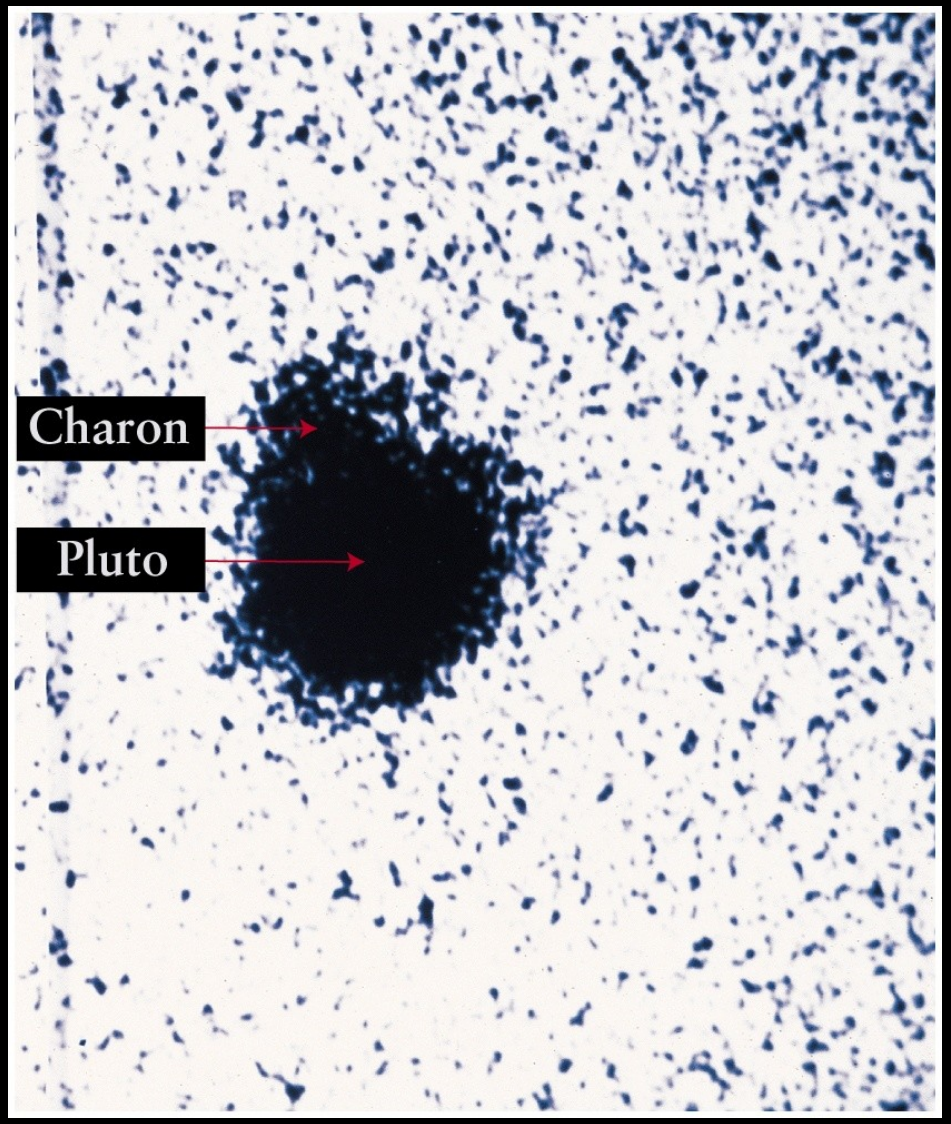
Pluto

Upptäckten av Pluto 1930



Upptäckten av Pluto 1930

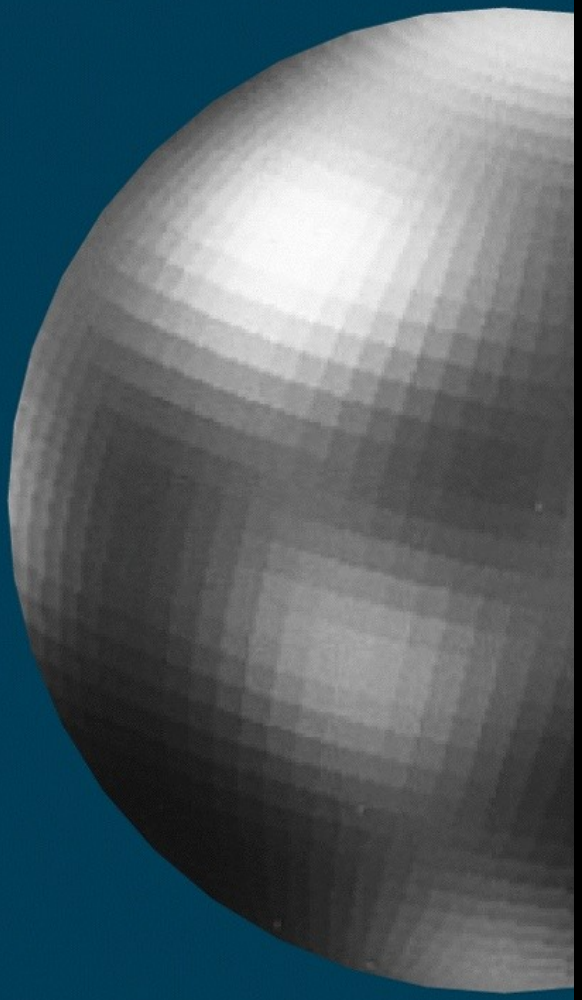
Pluto med måne (markbaserad obs.)



Fakta: Pluto (+video)

Table 16-5 Pluto Data

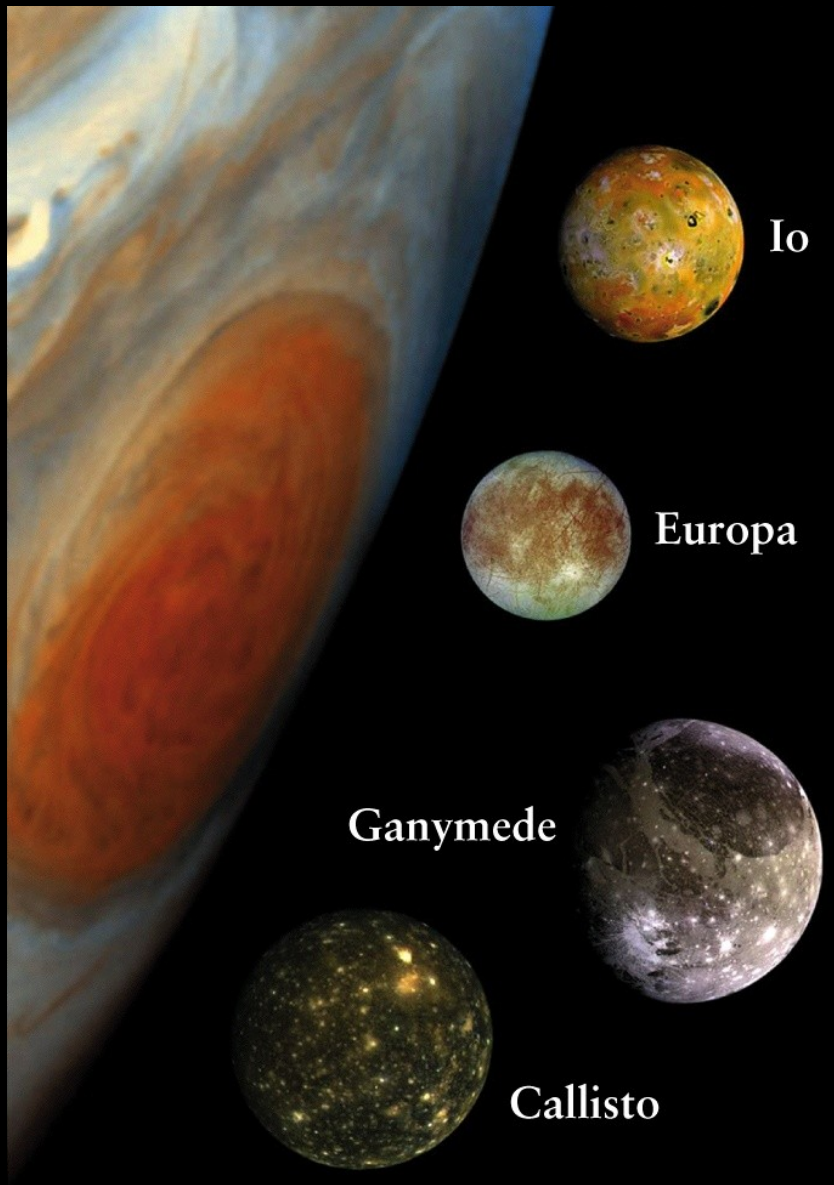
Average distance from Sun:	39.537 AU = 5.915×10^9 km
Maximum distance from Sun:	49.425 AU = 7.394×10^9 km
Minimum distance from Sun:	29.649 AU = 4.435×10^9 km
Eccentricity of orbit:	0.2501
Average orbital speed:	4.7 km/s
Orbital period:	248.60 years
Rotation period:	6.387 days
Inclination of equator to orbit:	122.52°
Inclination of orbit to ecliptic:	17.146°
Diameter:	about 2300 km = 0.18 Earth diameter
Mass:	1.3×10^{22} kg = 0.0021 Earth mass
Average density:	about 1900 kg/m^3
Escape speed:	1.2 km/s
Surface gravity (Earth = 1):	0.07
Albedo:	0.5
Average surface temperature:	−233°C = −387°F = 40 K



Solsystemets månar

Marsmånen Phobos (+video)

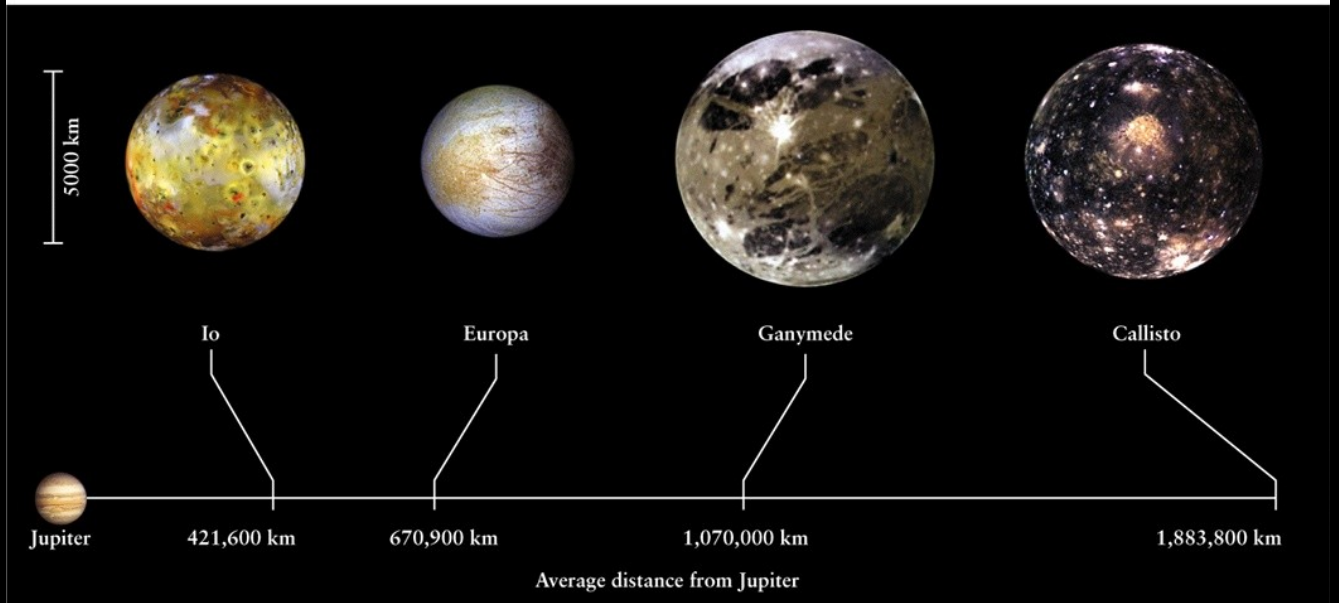
De galileiska månarna



Galileiska månarna vs mindre planeter

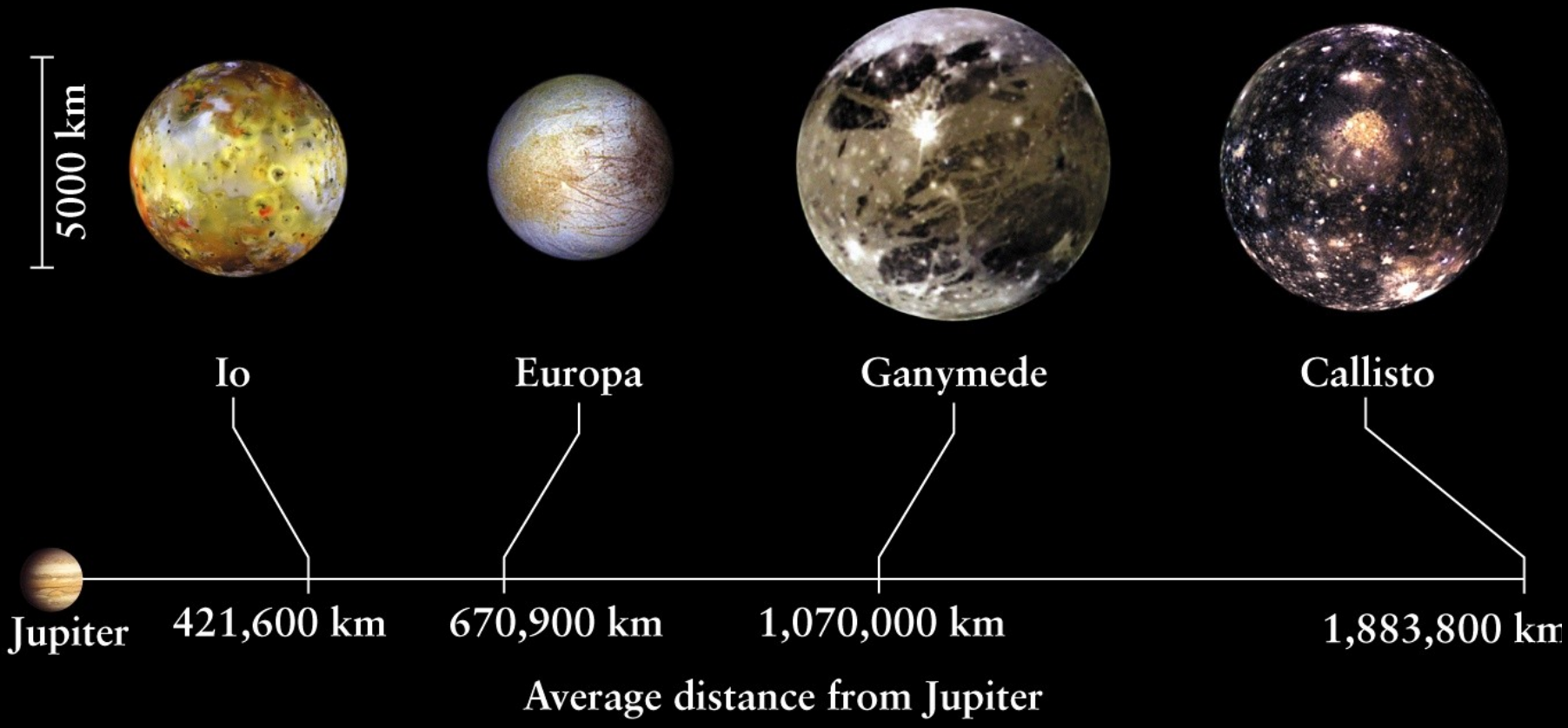
Table 14-1 The Galilean Satellites Compared with the Moon, Mercury, and Mars

	Average distance from Jupiter (km)	Orbital period (days)	Diameter (km)	Mass (kg)	Mass (Moon = 1)	Average density (kg/m^3)	Albedo
Io	421,600	1.769	3642	8.932×10^{22}	1.22	3529	0.63
Europa	670,900	3.551	3120	4.791×10^{22}	0.65	3018	0.64
Ganymede	1,070,000	7.155	5268	1.482×10^{23}	2.02	1936	0.43
Callisto	1,883,000	16.689	4800	1.077×10^{23}	1.47	1851	0.17
Moon	—	—	3476	7.349×10^{22}	1.00	3344	0.11
Mercury	—	—	4880	3.302×10^{23}	4.49	5430	0.12
Mars	—	—	6794	6.419×10^{23}	8.73	3934	0.15



Note: Jupiter is shown to the same scale as the distances of the satellites from Jupiter. Compared to this scale, the images of the satellites themselves have been enlarged 74×.

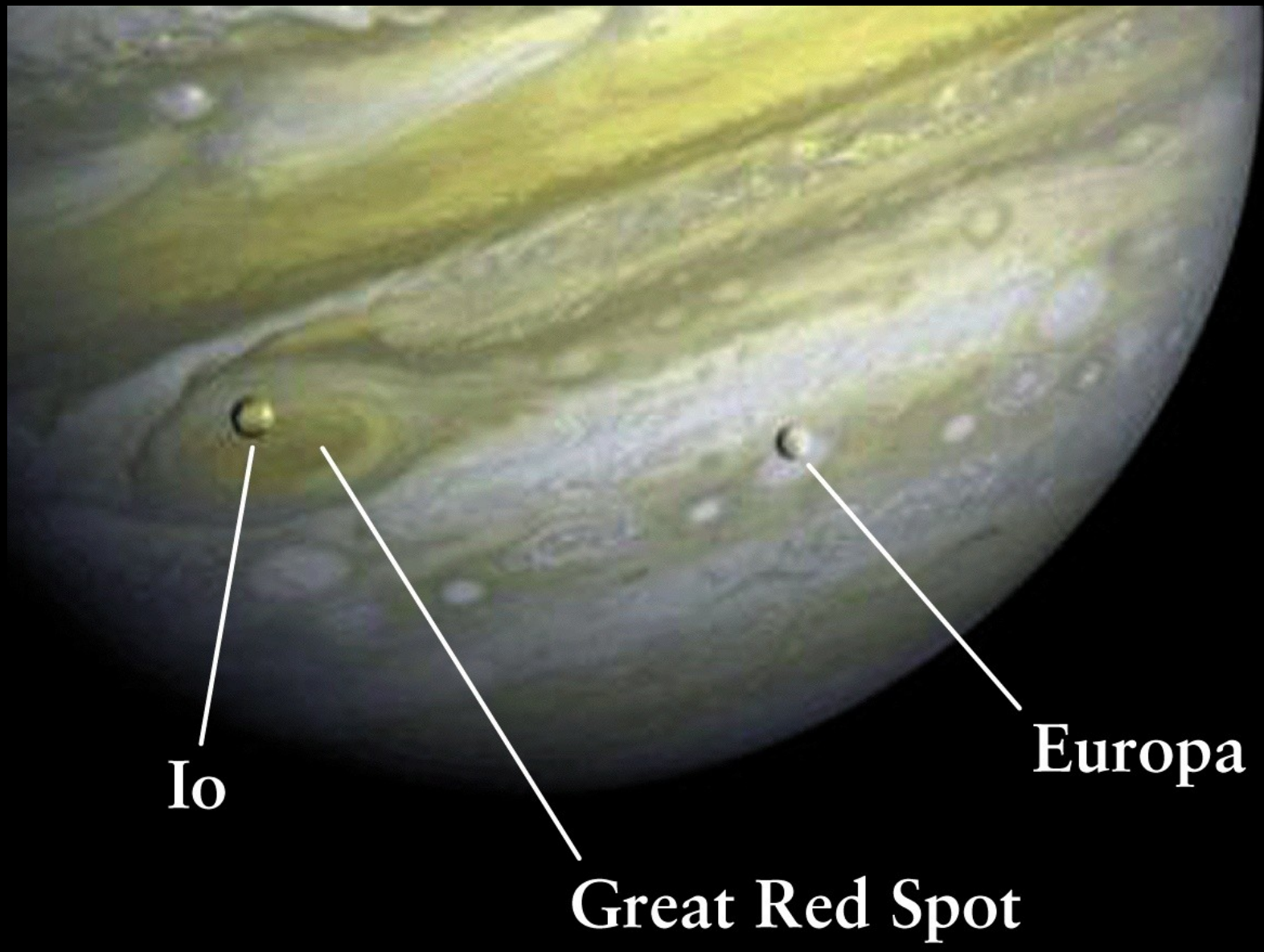
Galileiska månarnas dimensioner



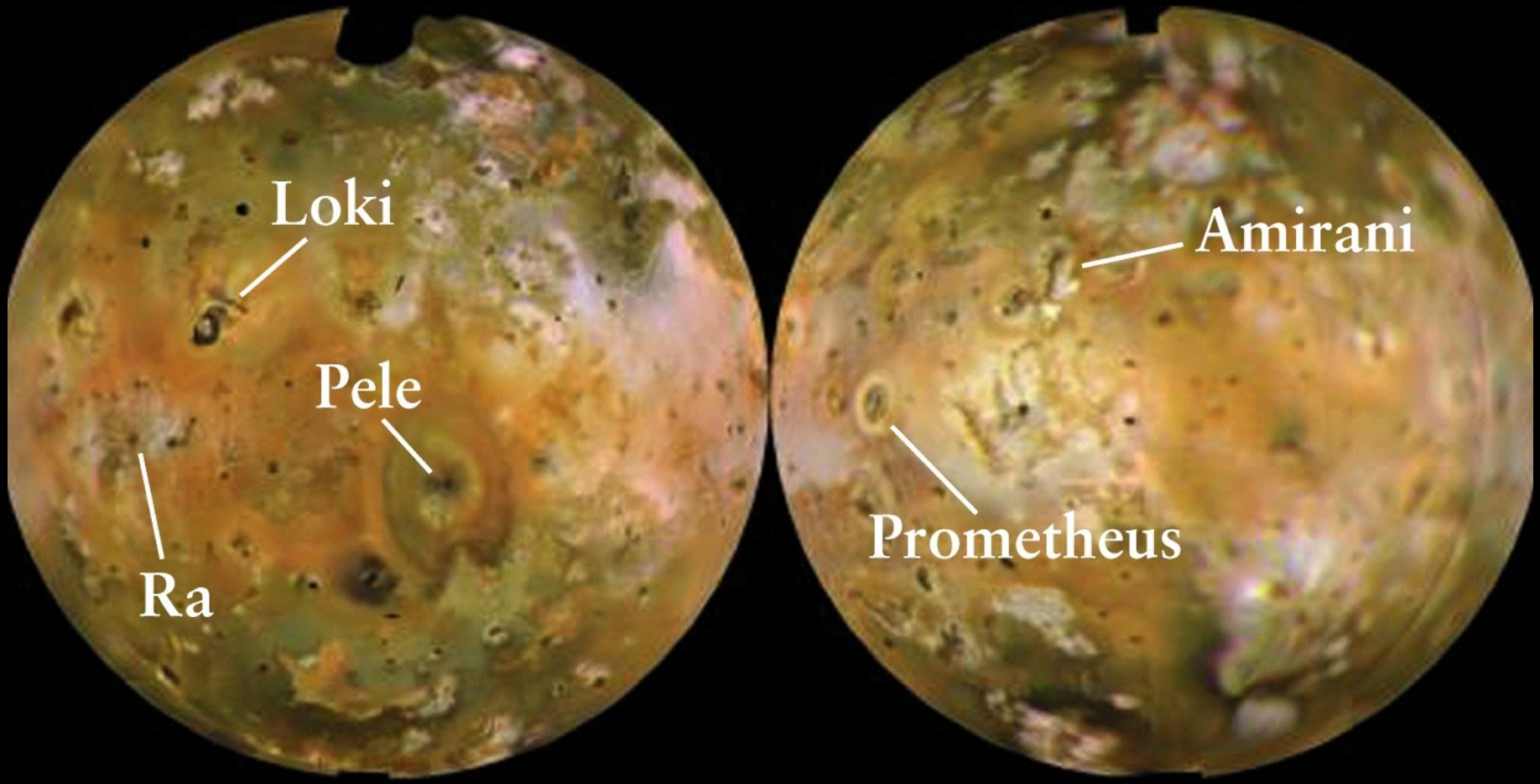
Note: Jupiter is shown to the same scale as the distances of the satellites from Jupiter. Compared to this scale, the images of the satellites themselves have been enlarged 74×.

Utsikt i ett litet teleskop

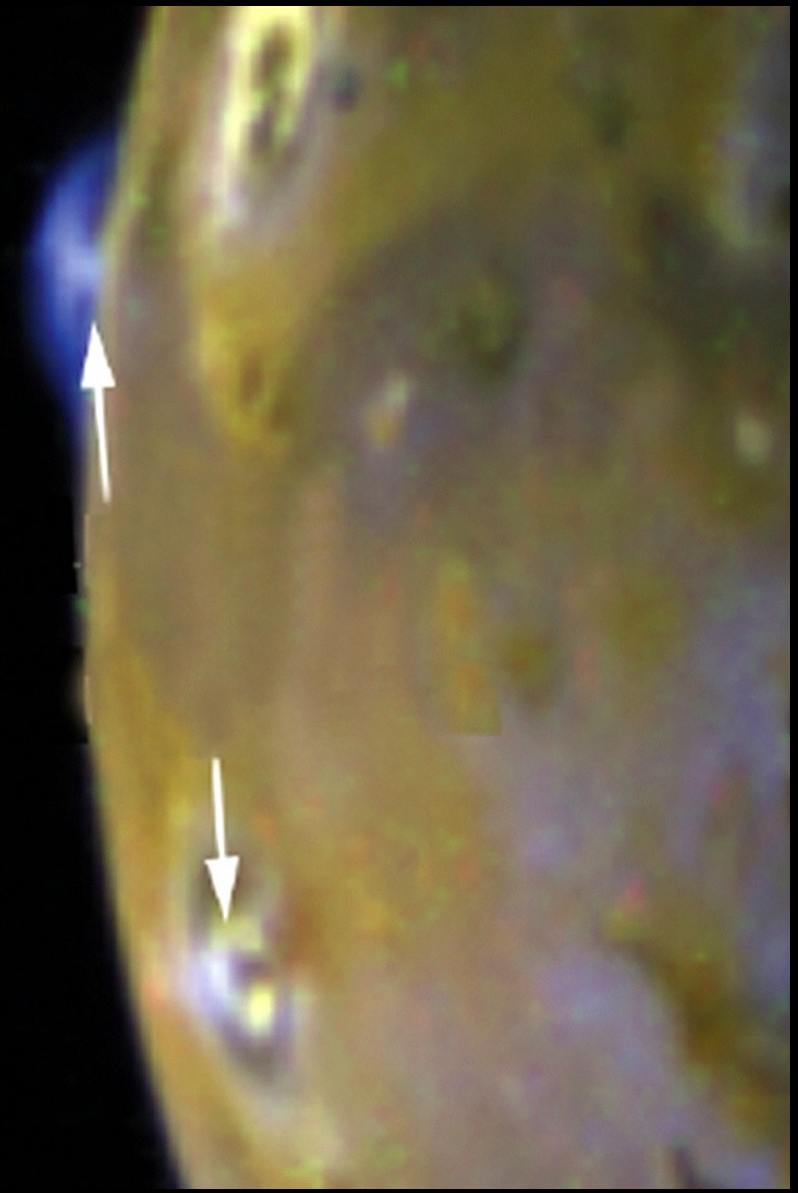
Utsikt från Voyager 1



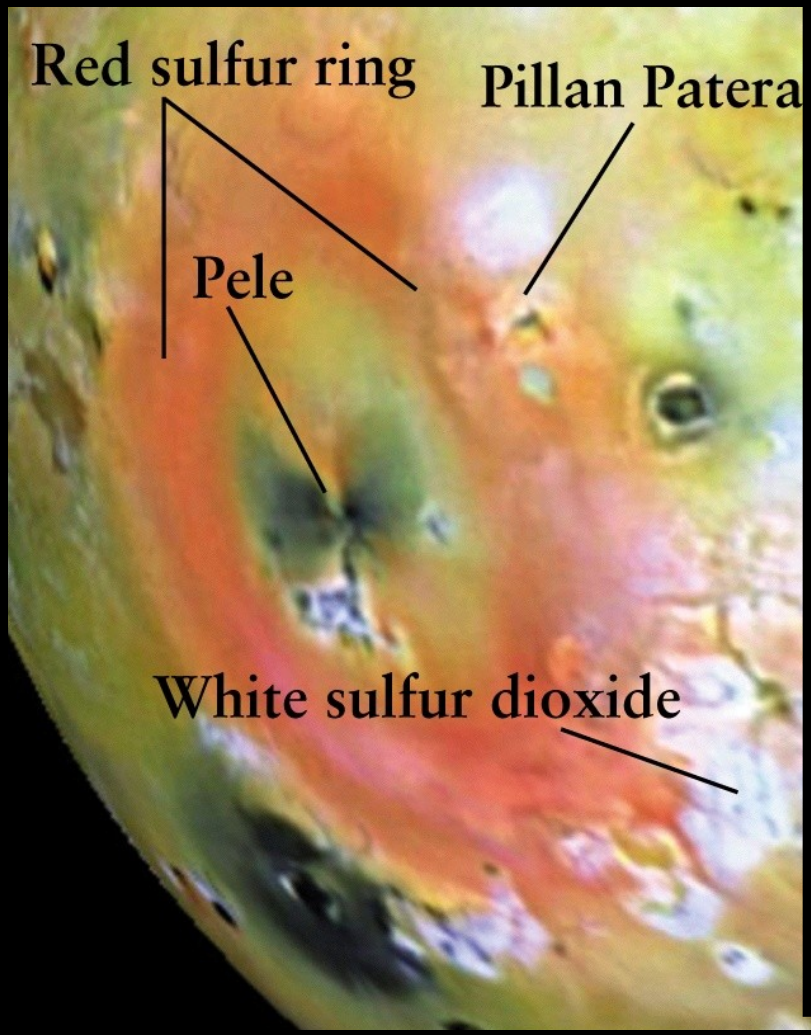
Karta över Io

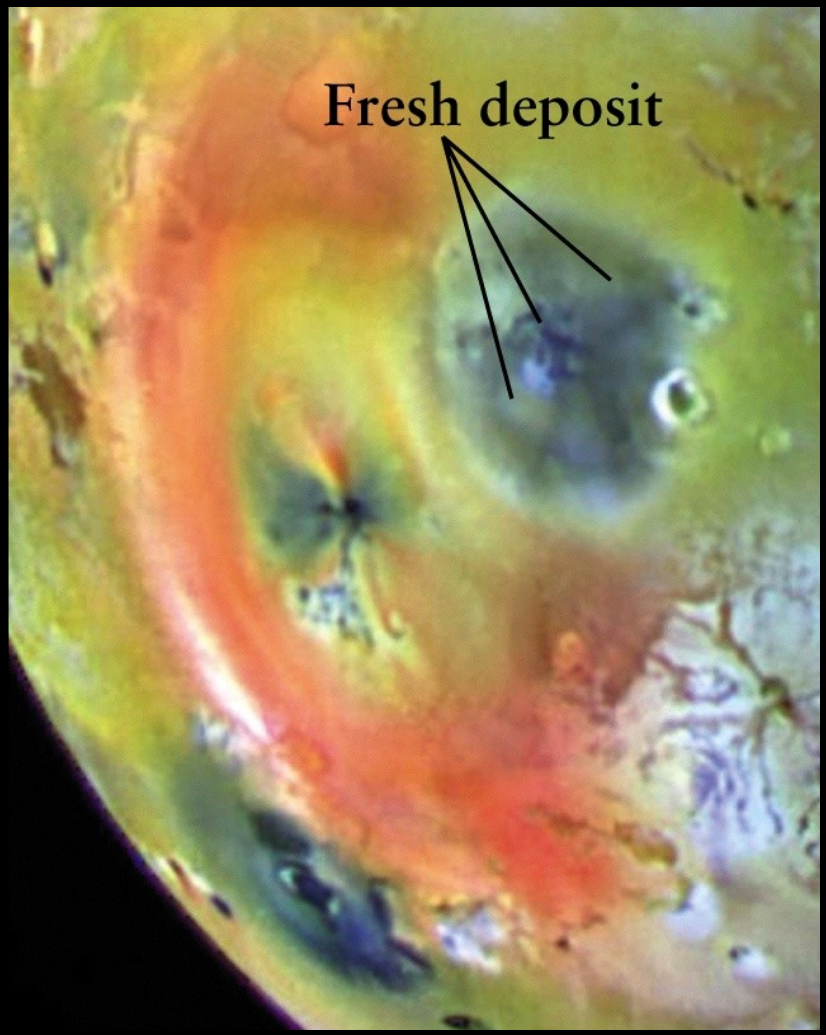


Vulkaniska eruptioner på Io

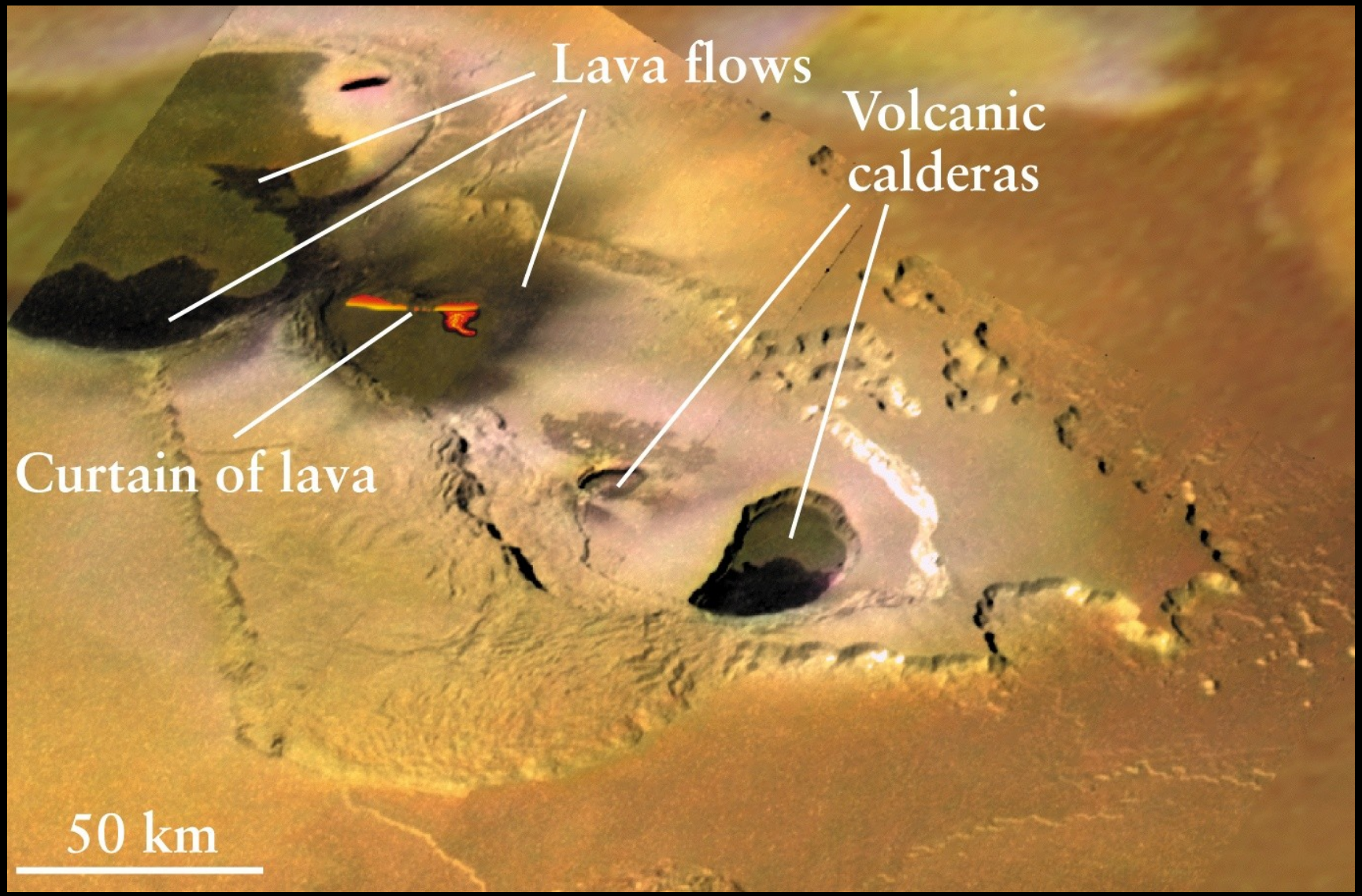


Vulkaniska eruptioner på Io

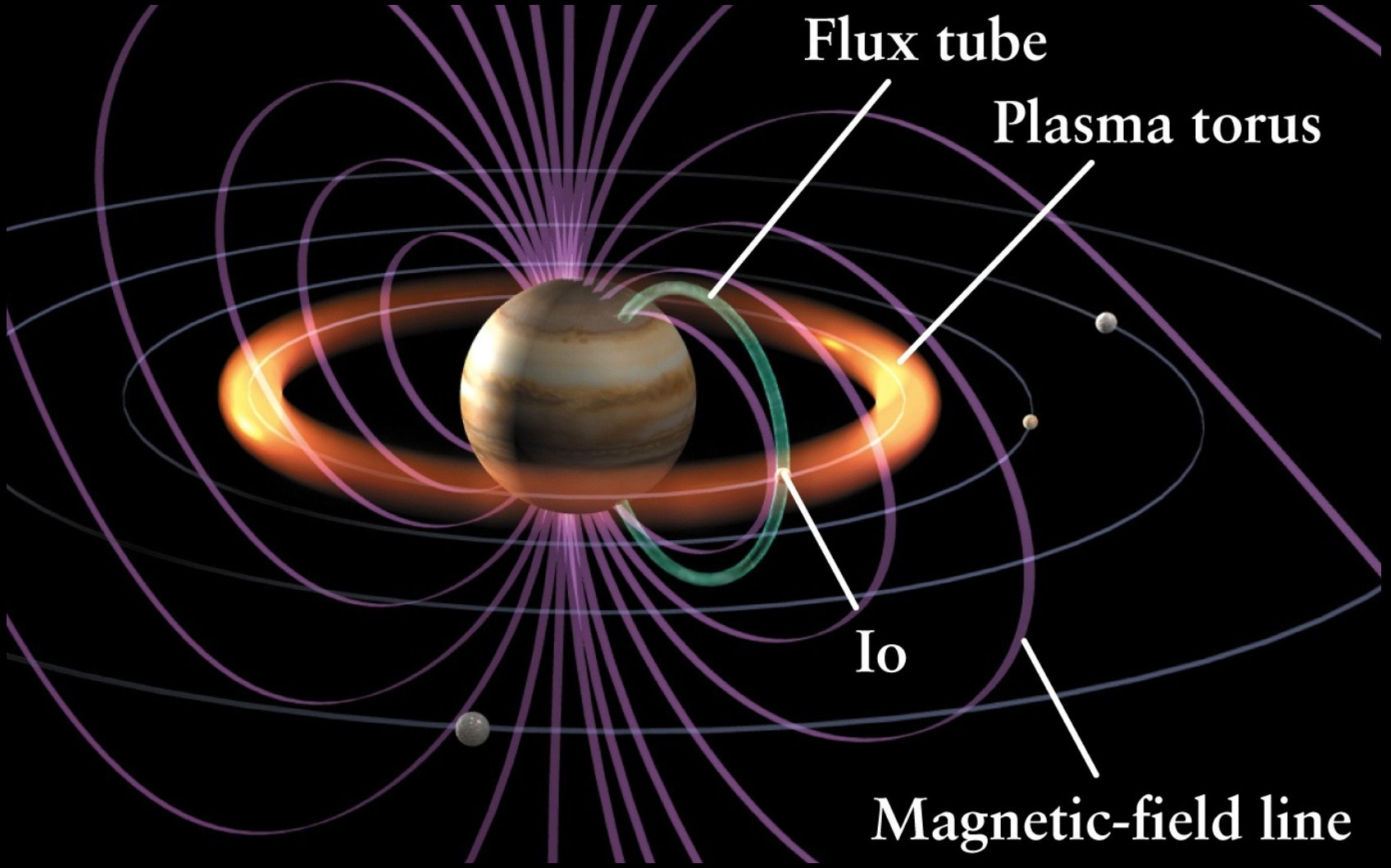




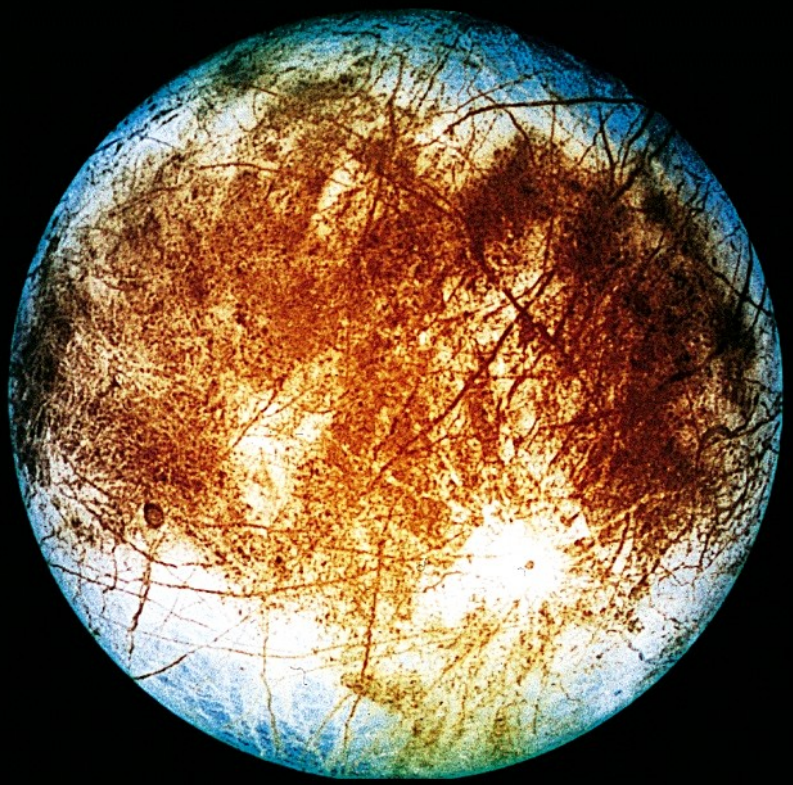
Io:s aktiva vulkaner



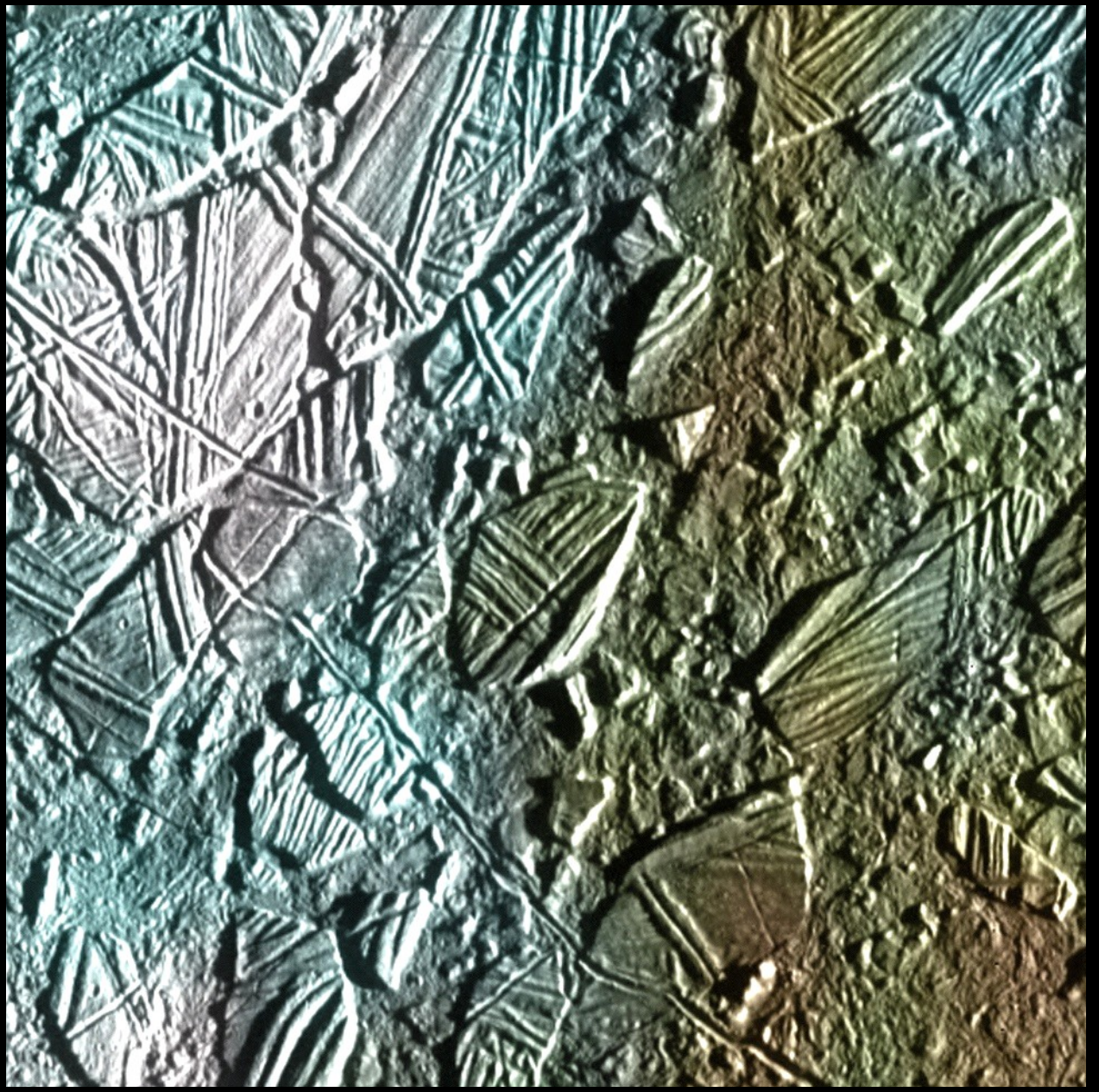
Magnetisk påverkan mellan Jupiter och Io



Europa

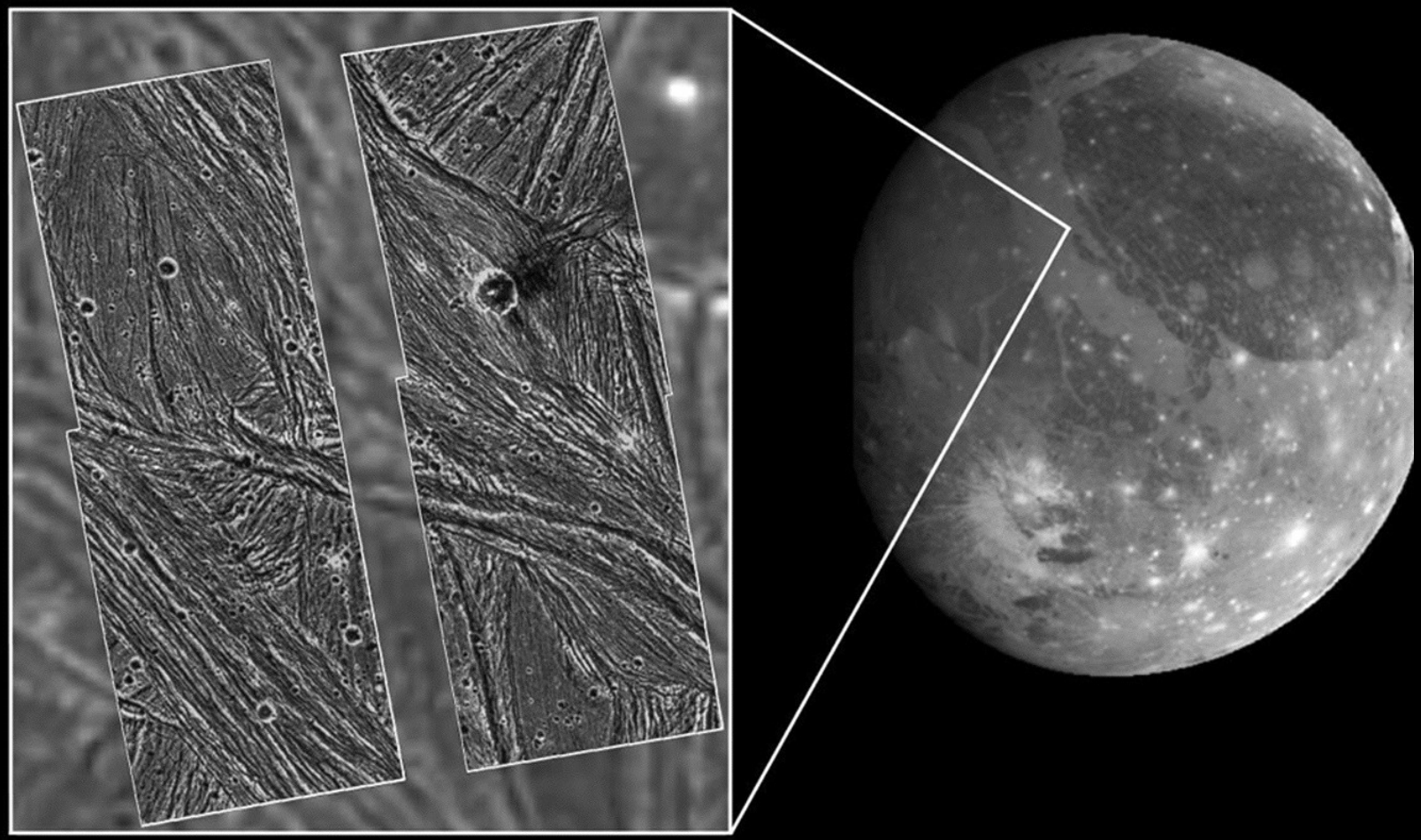


Europa i närbild

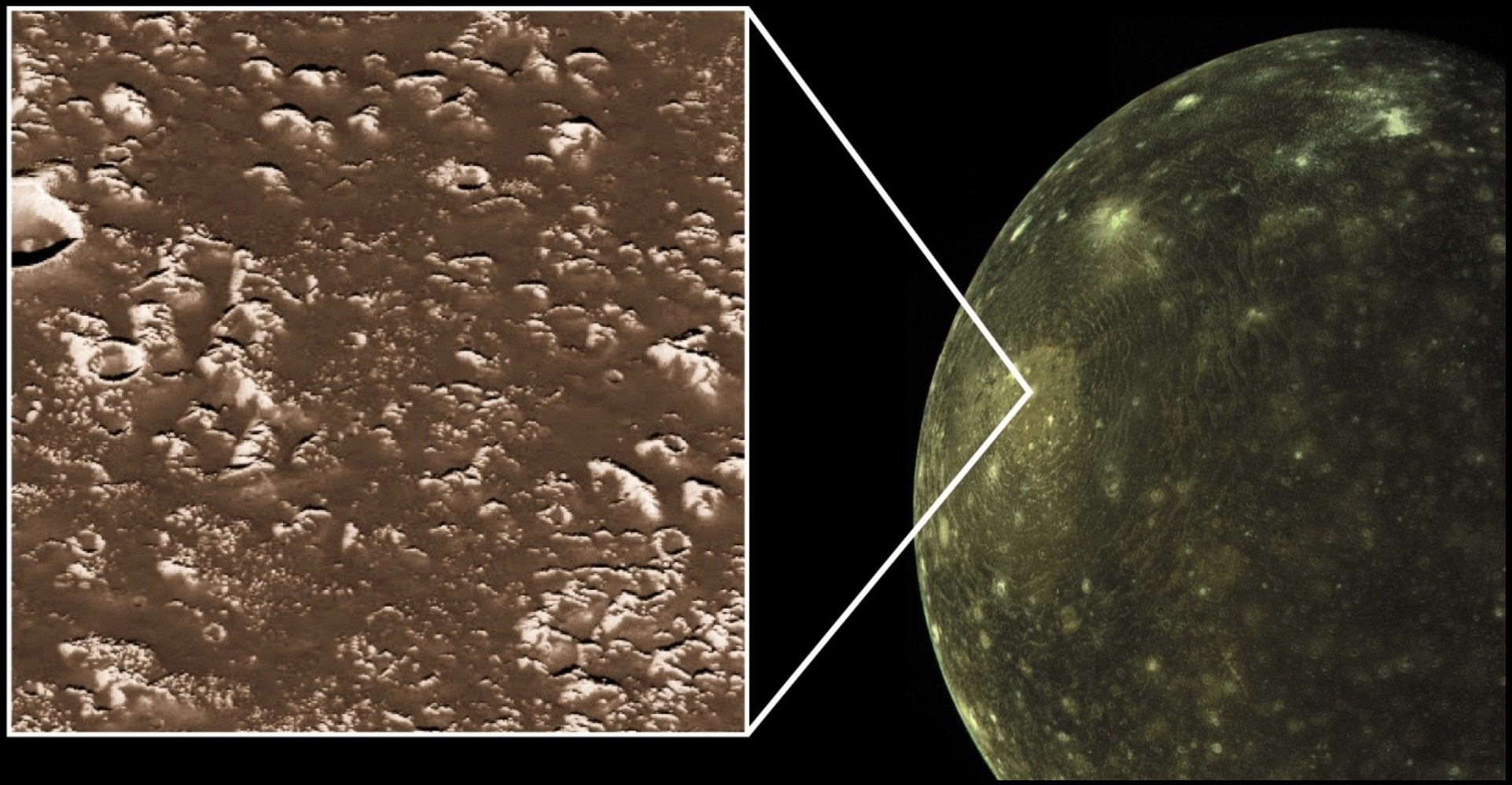


Ganymedes

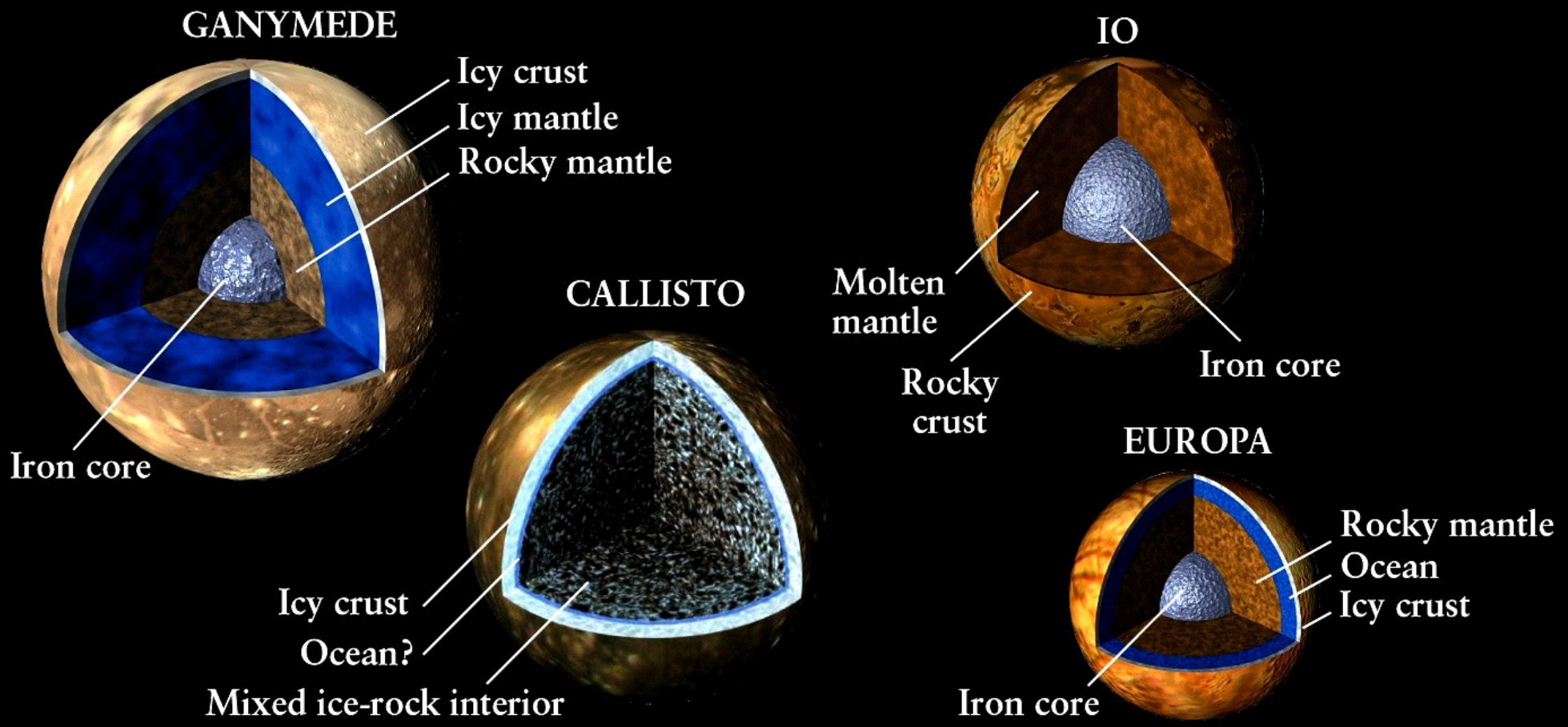
Ljus terräng på Ganymedes



Callisto

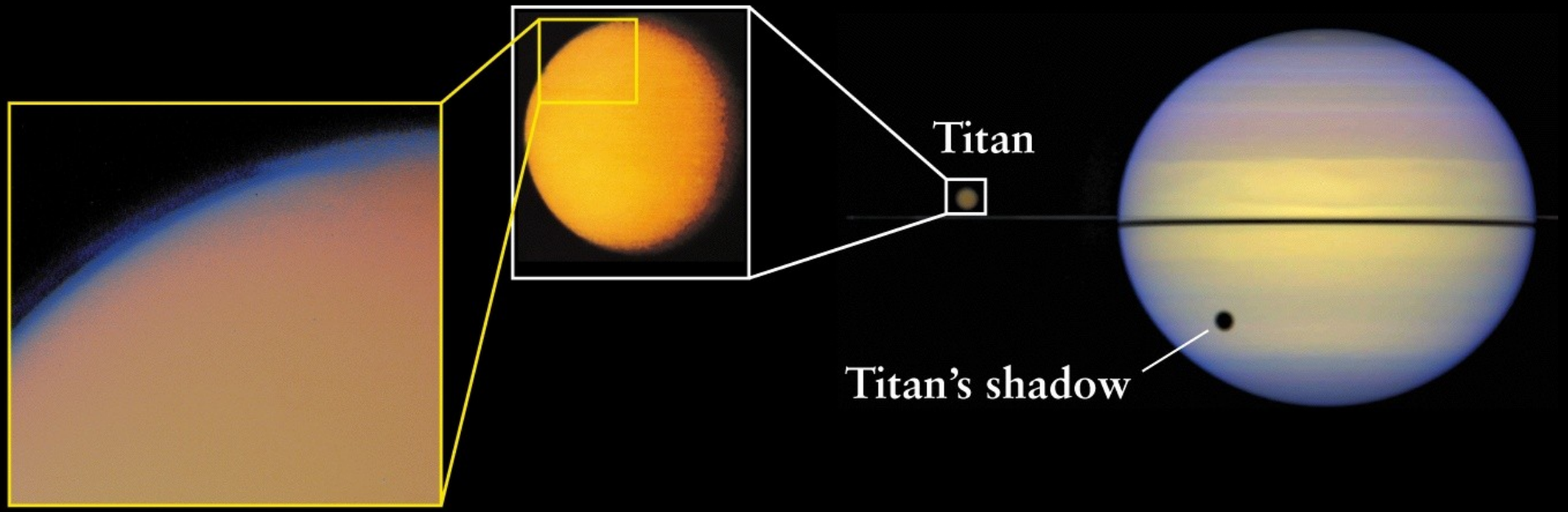


Det inre av de galileiska månarna



Jupiters inre månar

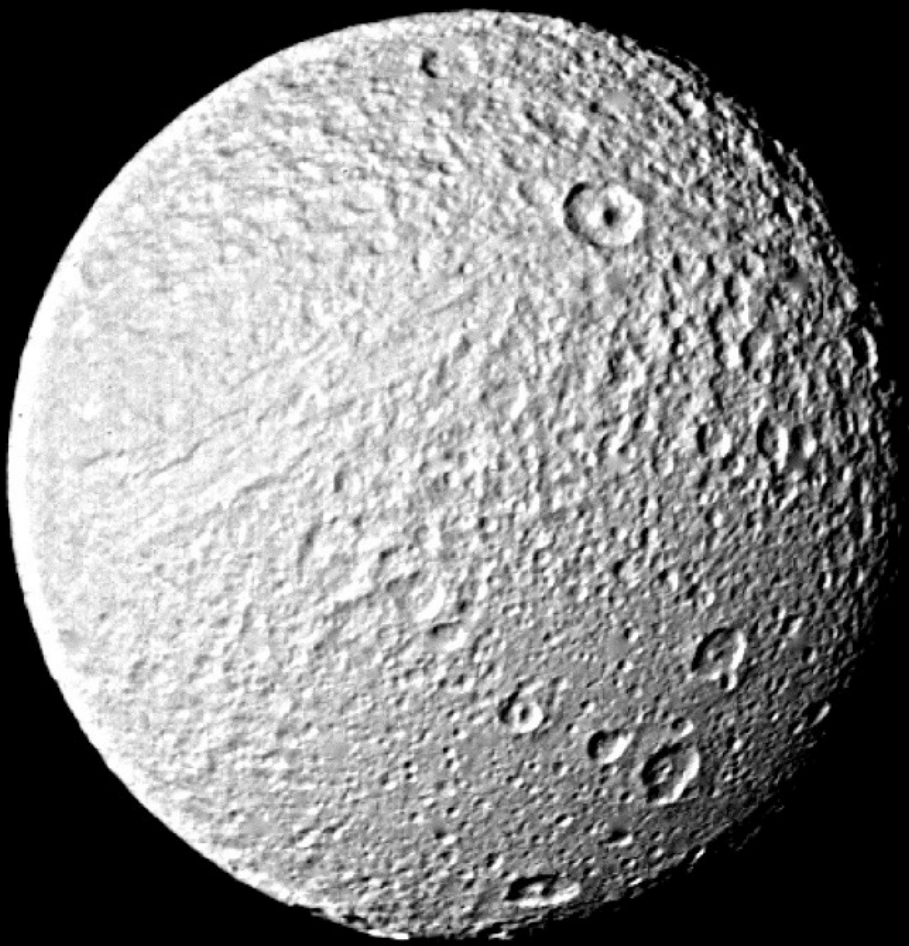
Titan



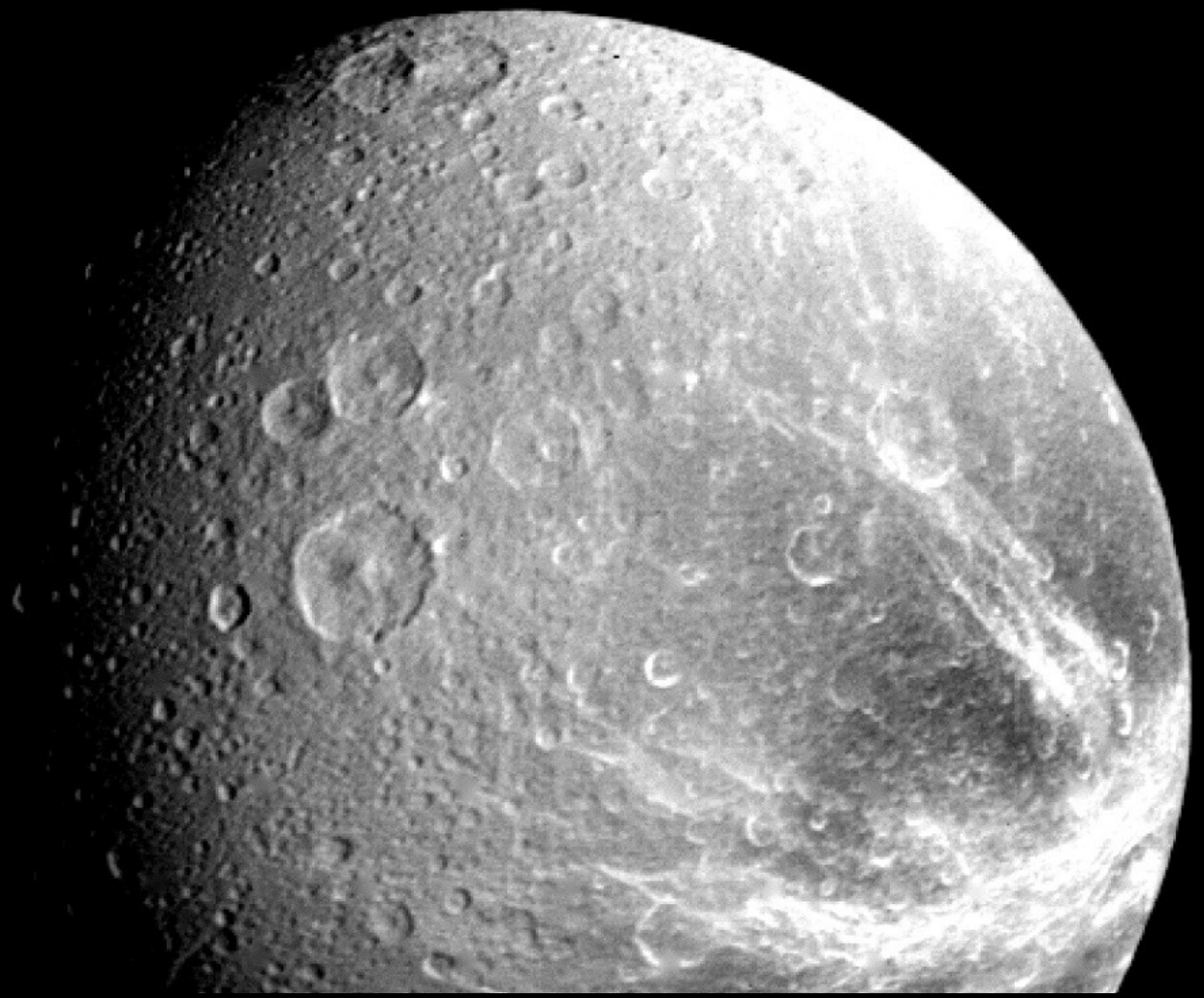
Mimas

Enceladus

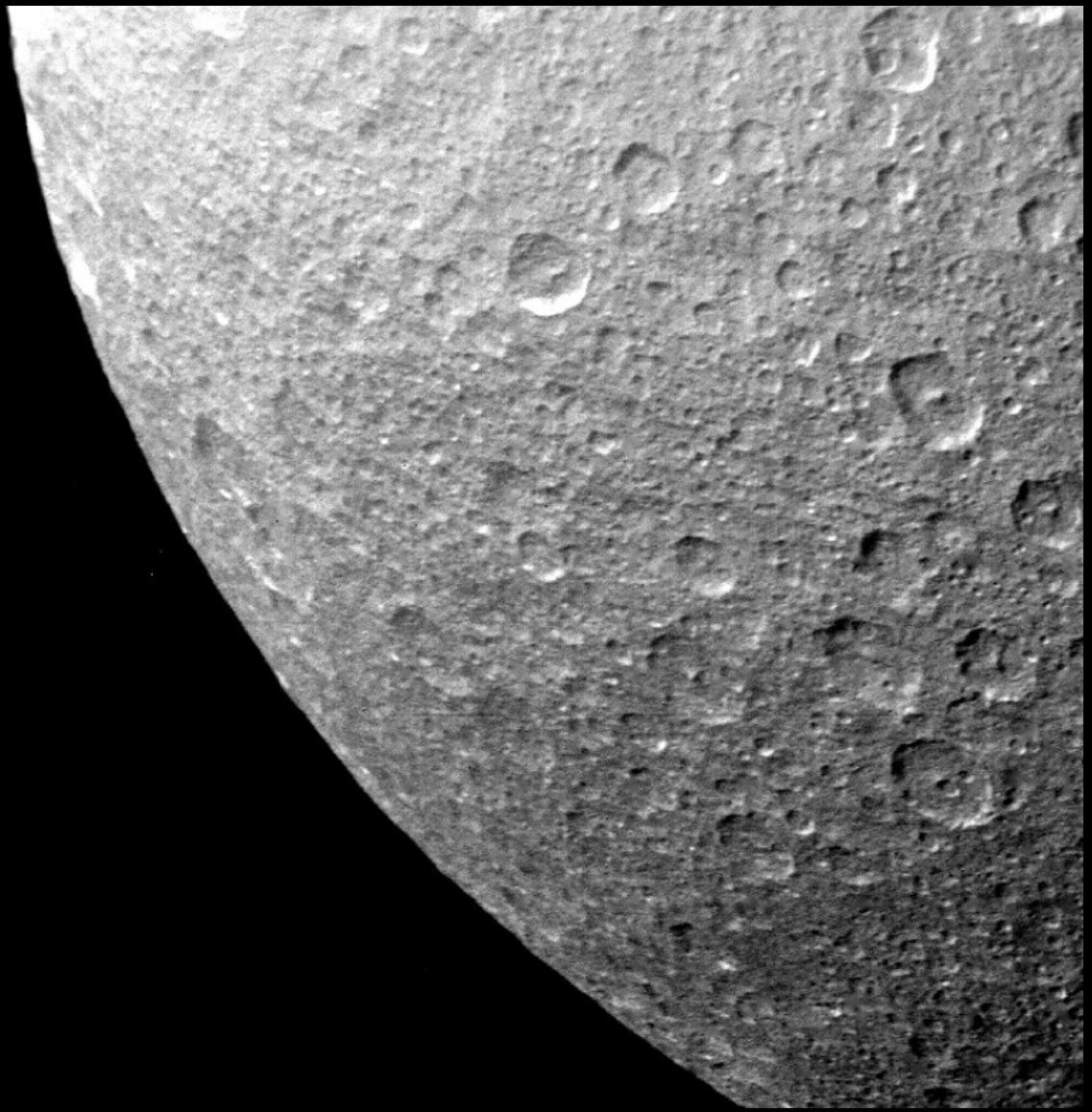
Tethys



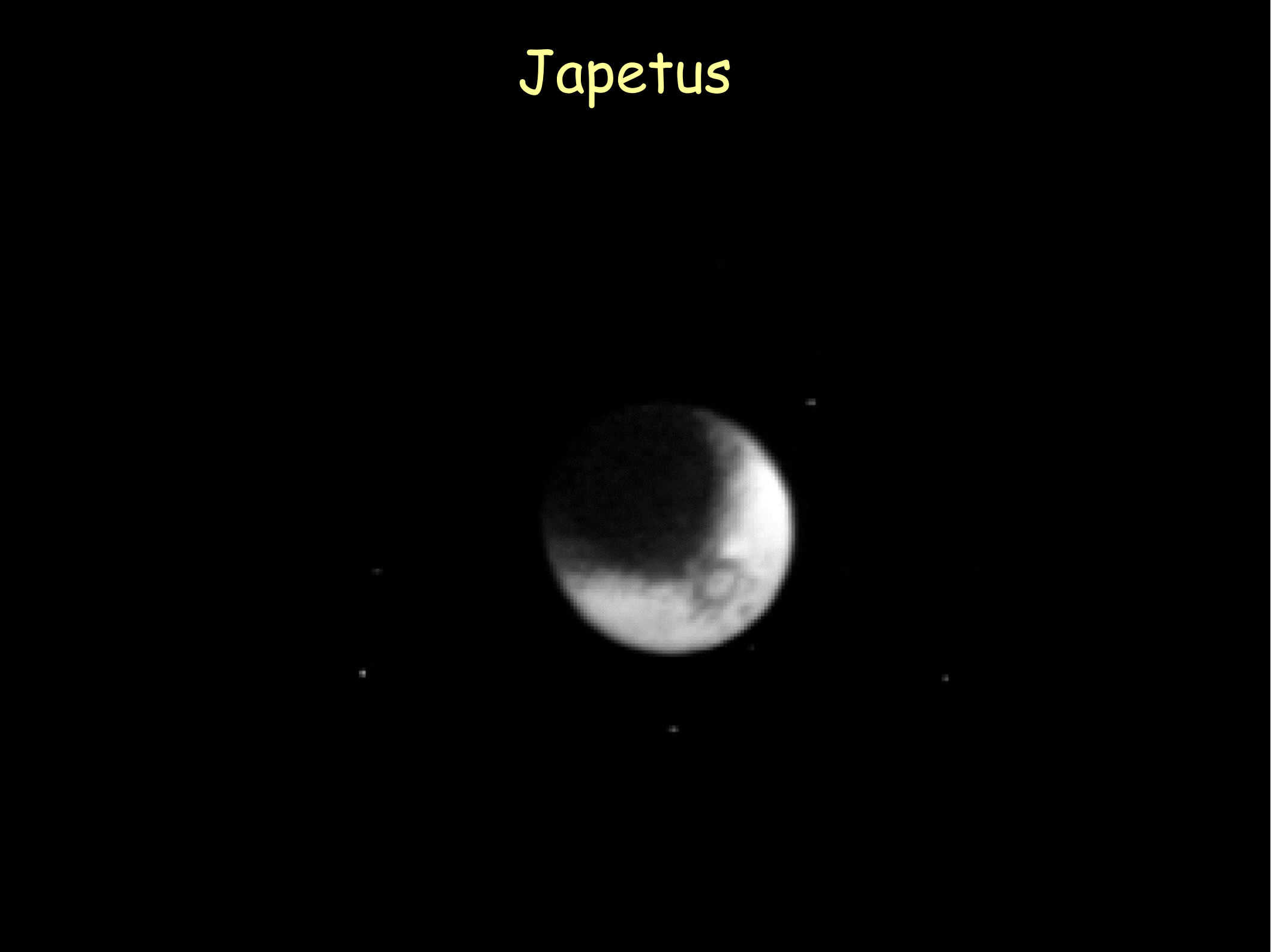
Dione



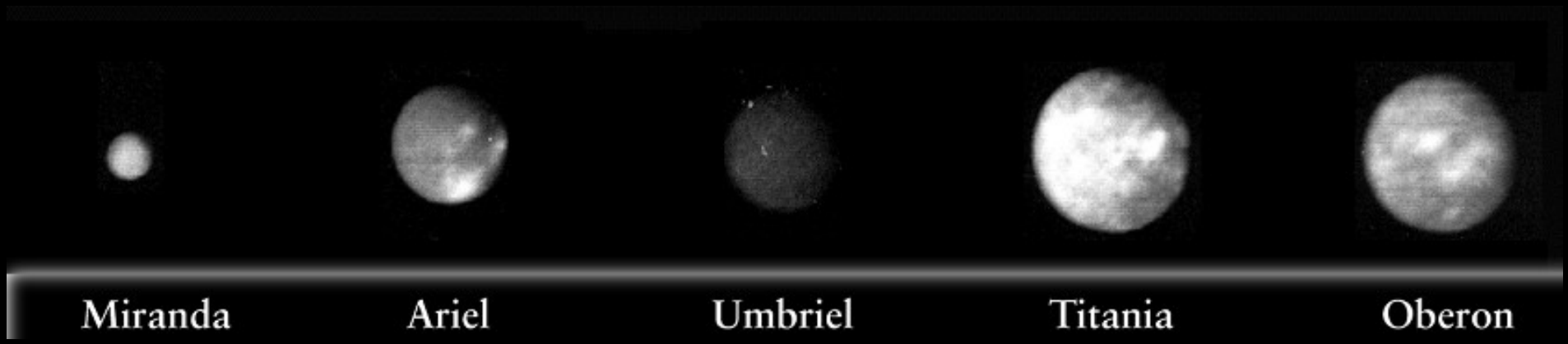
Rhea



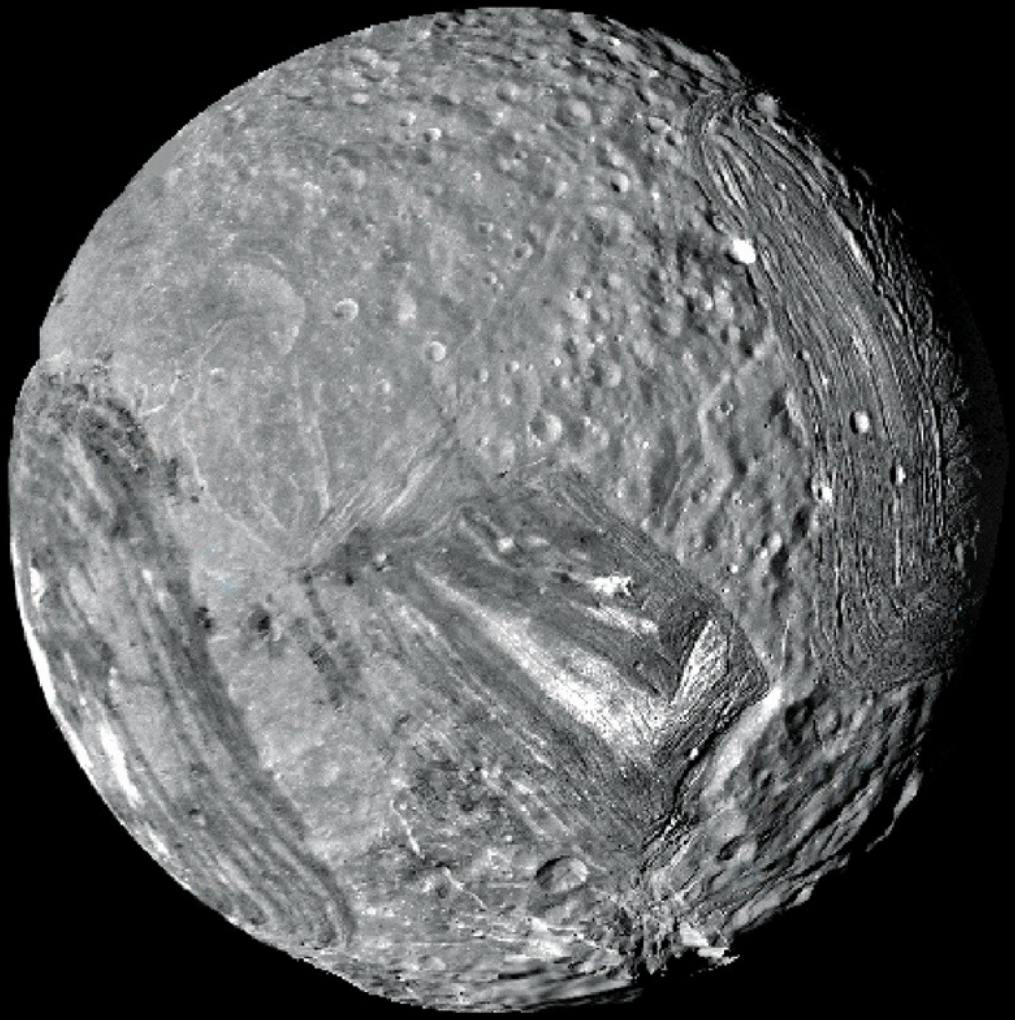
Japetus



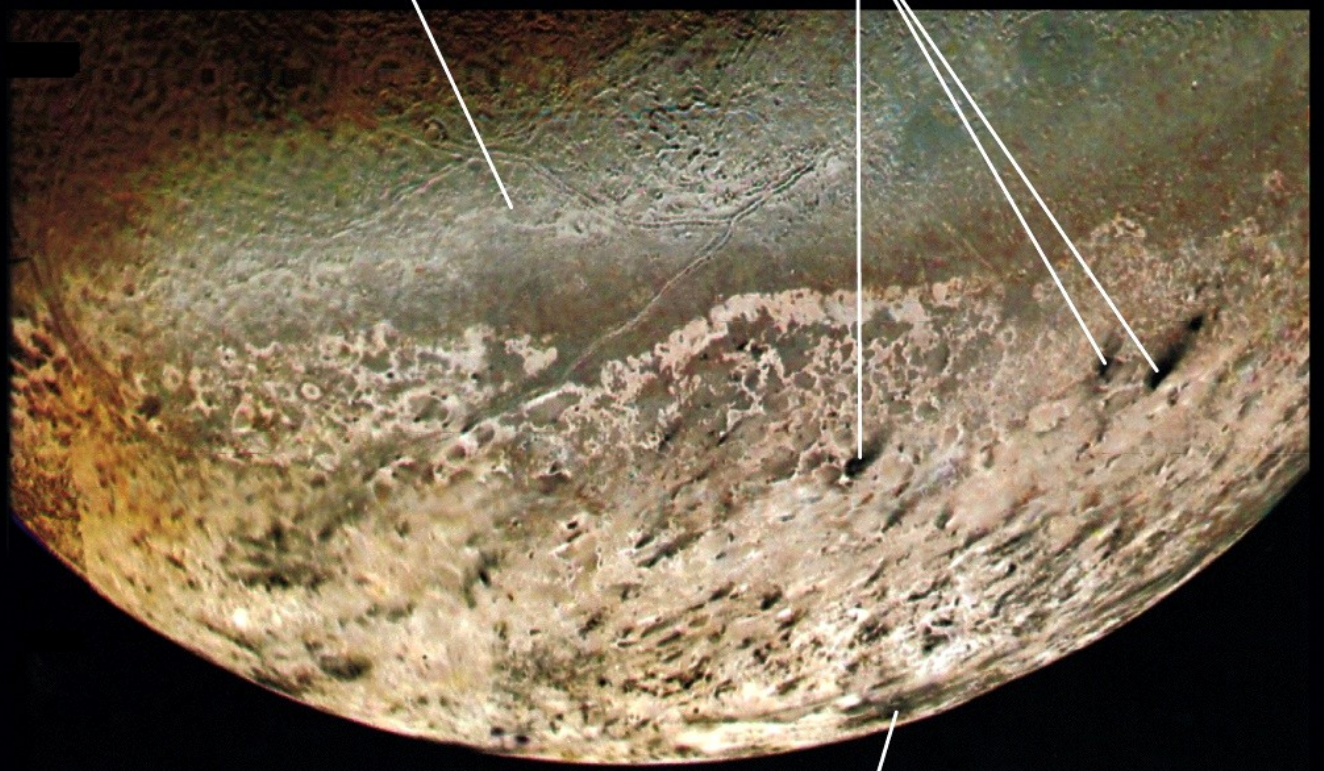
Uranus större månar



Uranus: Miranda



Neptunus: Triton



Asteroider

Är rymden mellan planeterna tom?

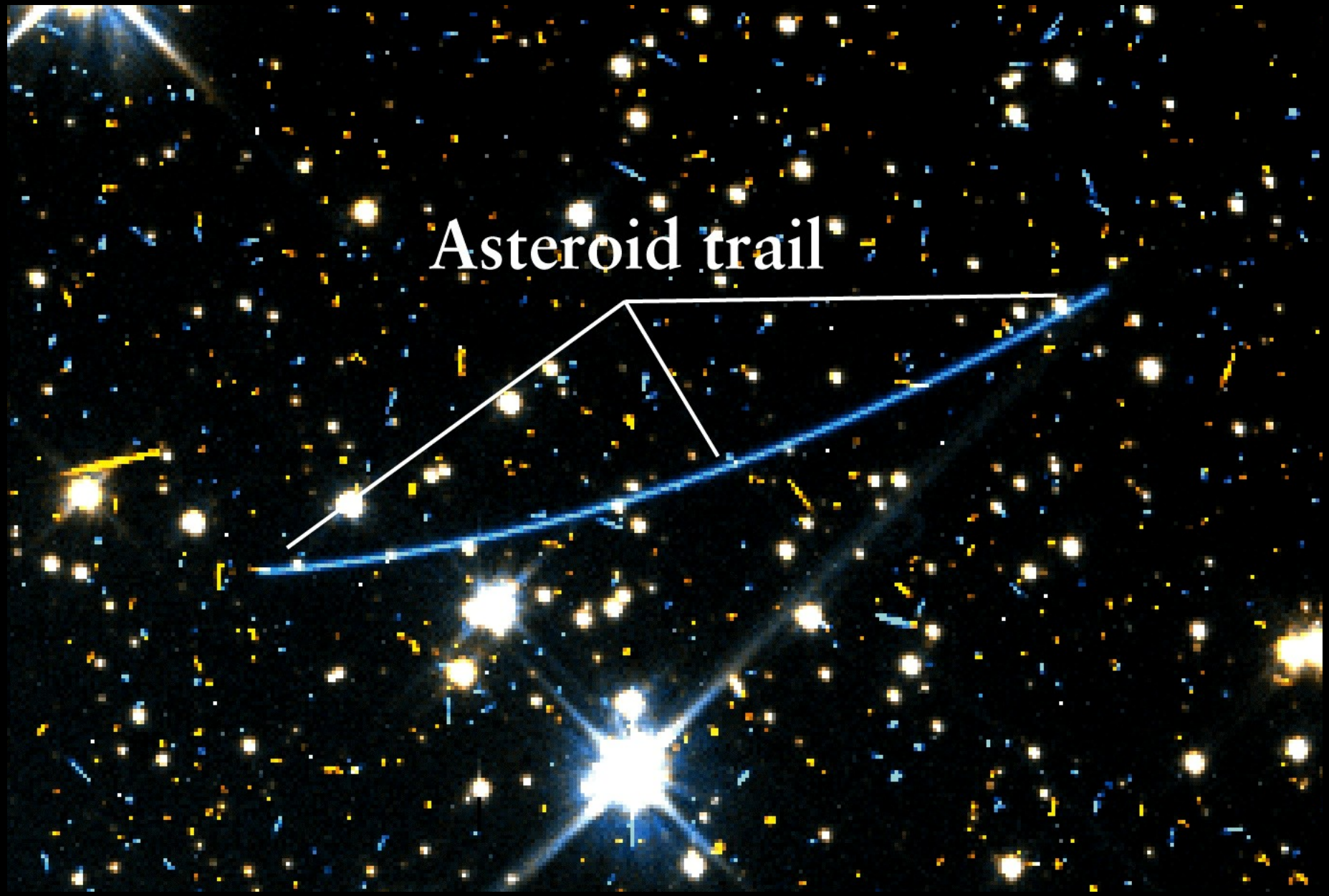
Asteroid, måne eller planet?

Earth

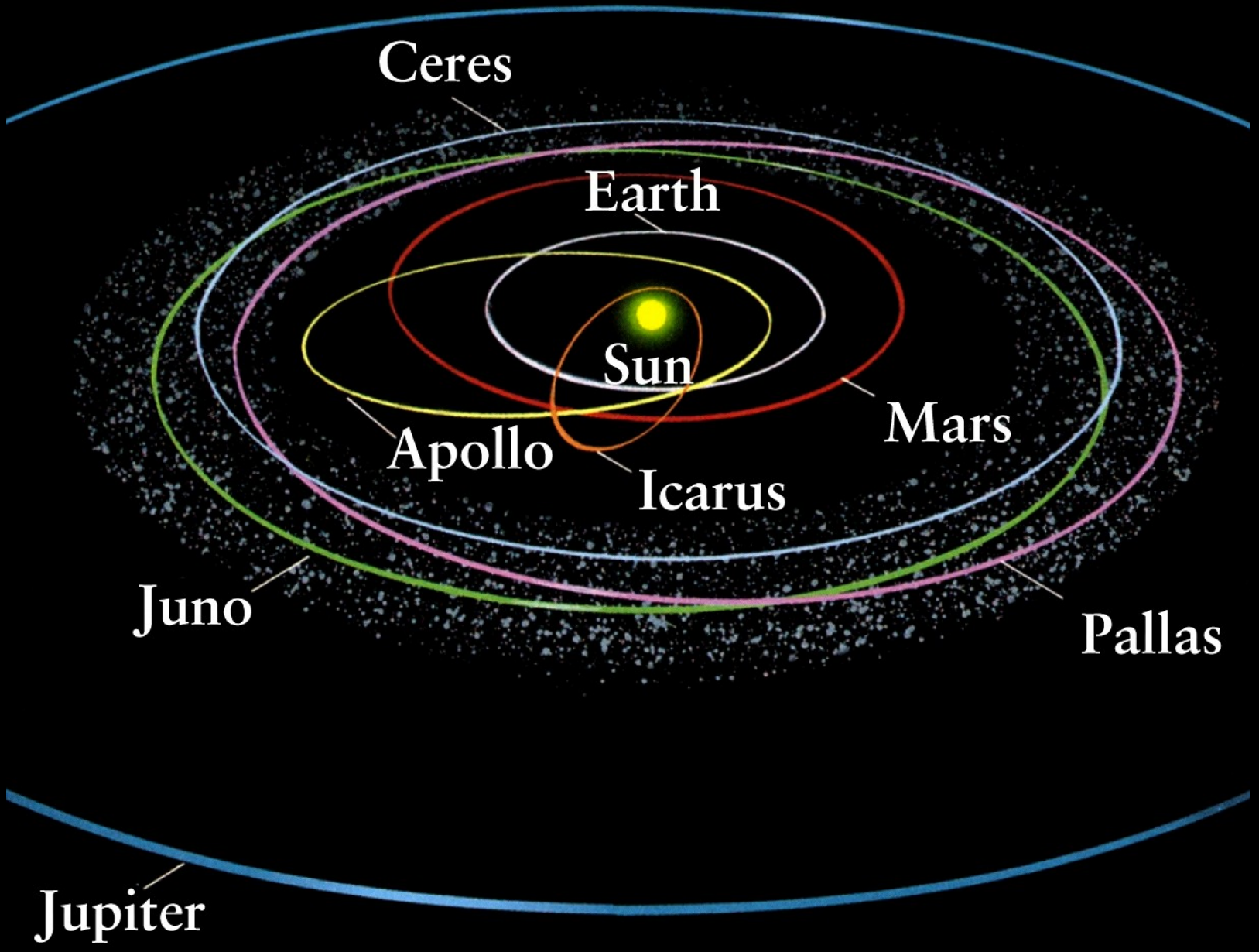
Moon

Ceres

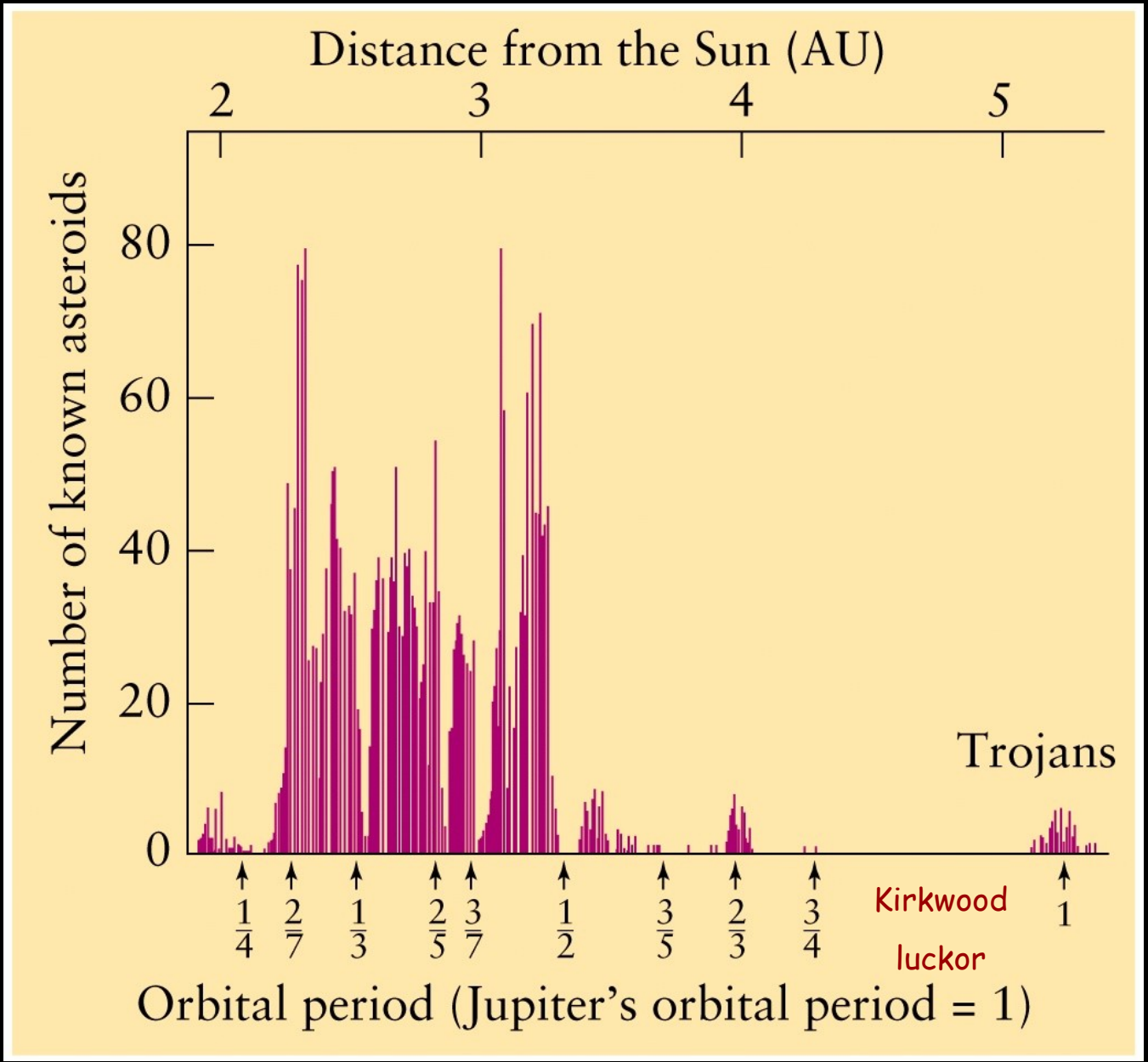
Spår efter asteroid (HST)



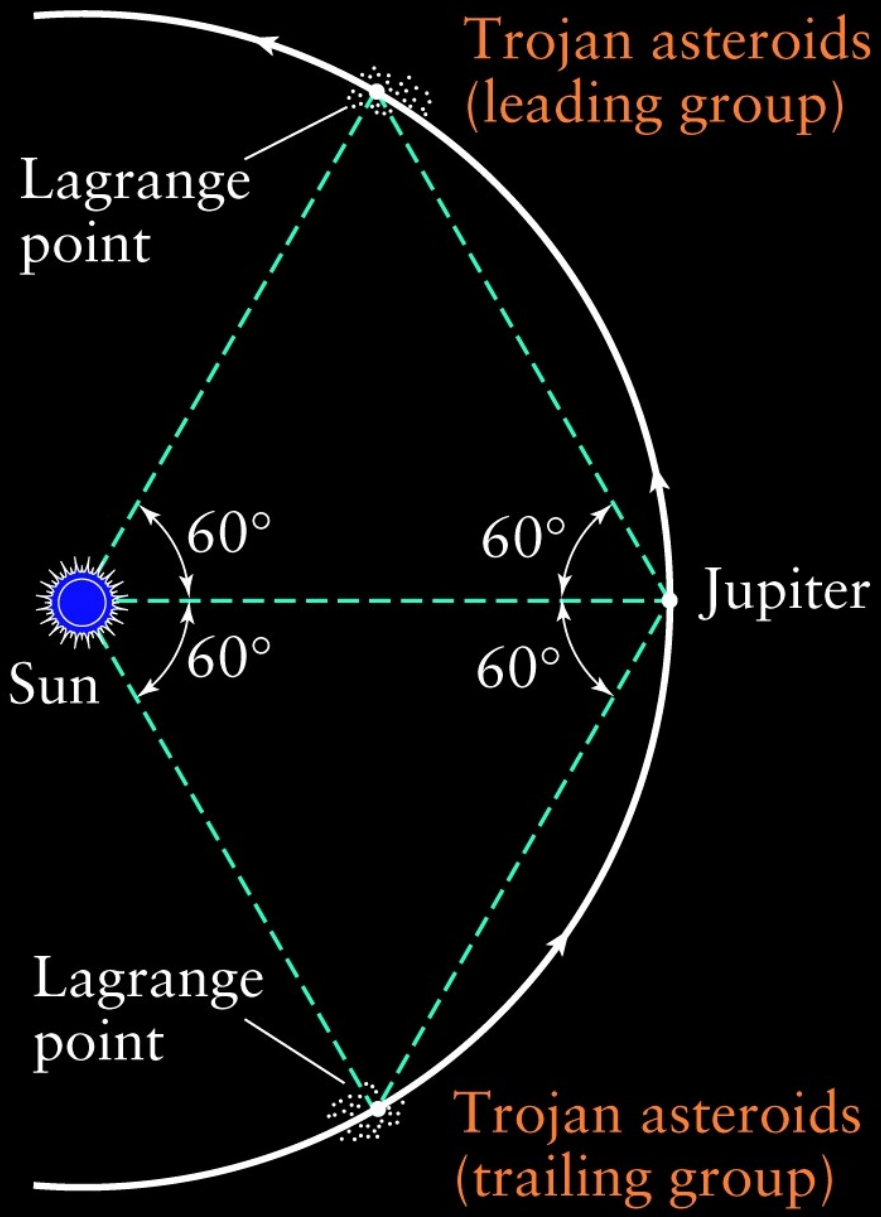
Asteroidbältet



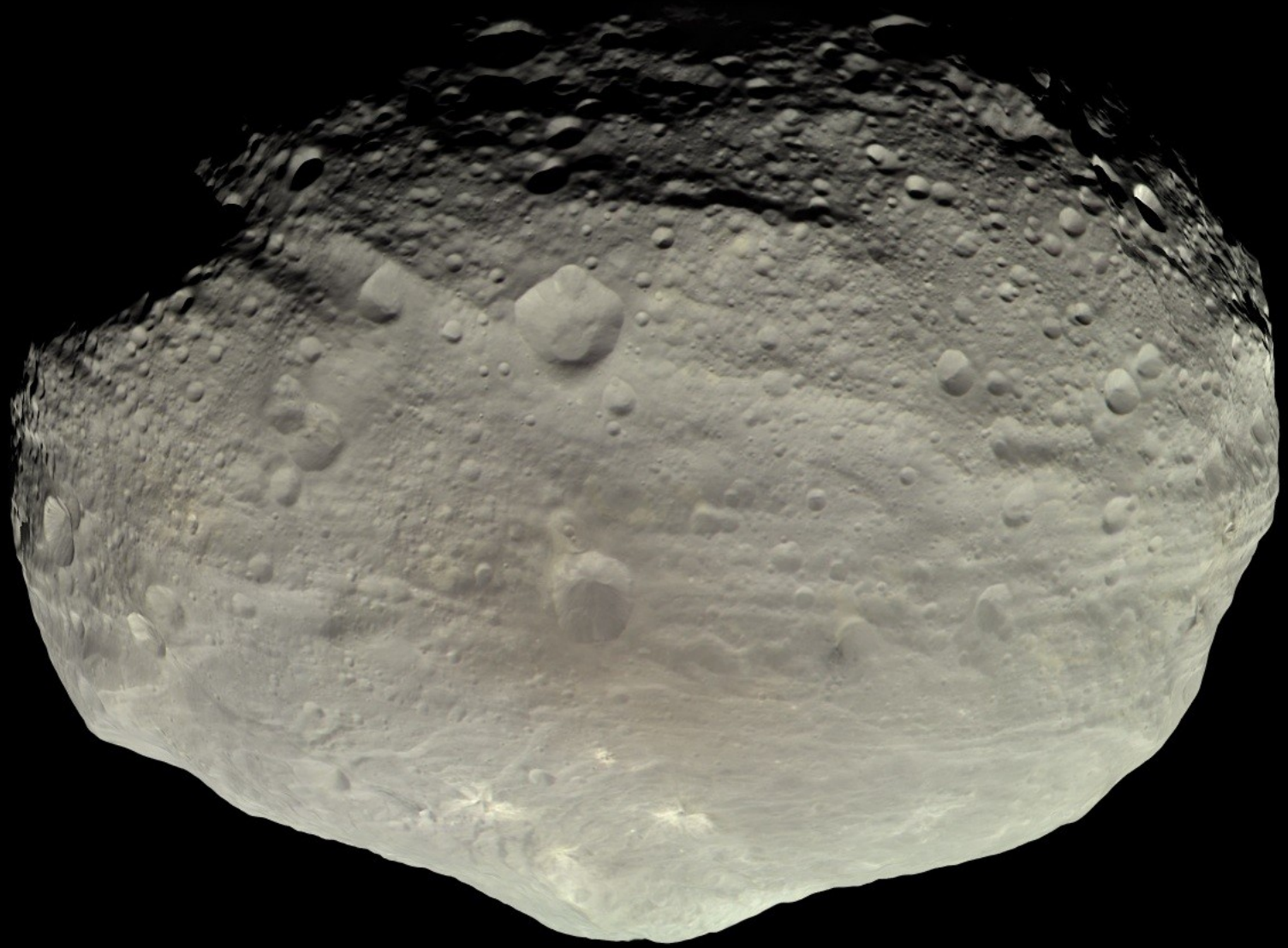
Asteroidernas rumsliga fördelning



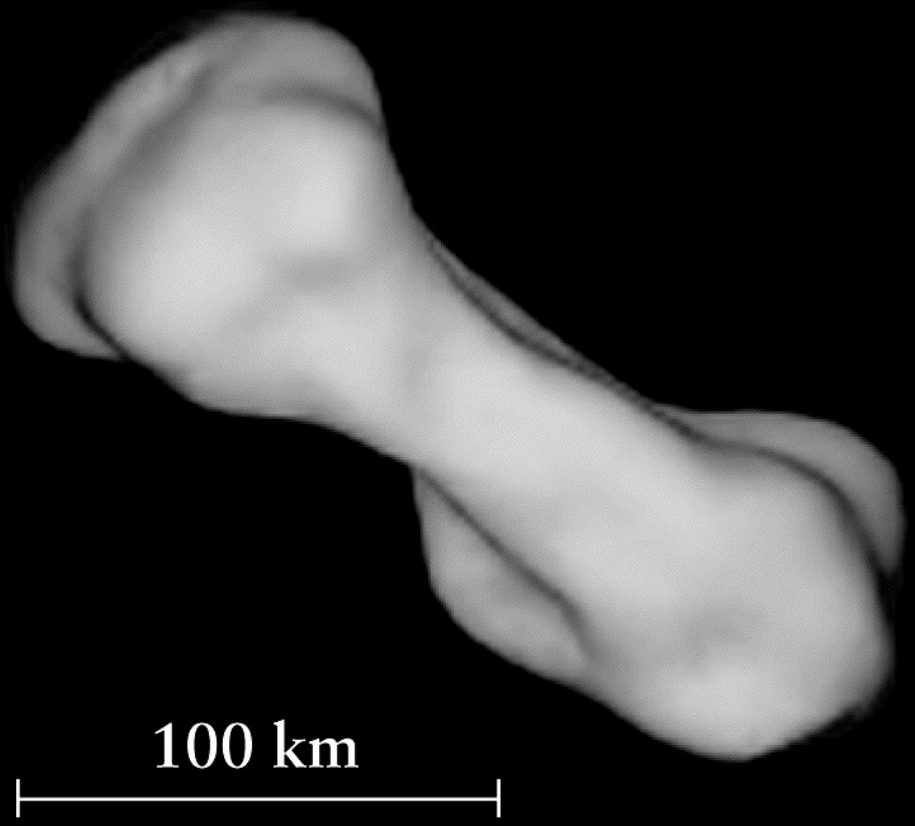
Trojanerna


Trojan asteroids
(leading group)
Lagrange
point
60°
60°
Sun
Jupiter
60°
60°
Lagrange
point
Trojan asteroids
(trailing group)

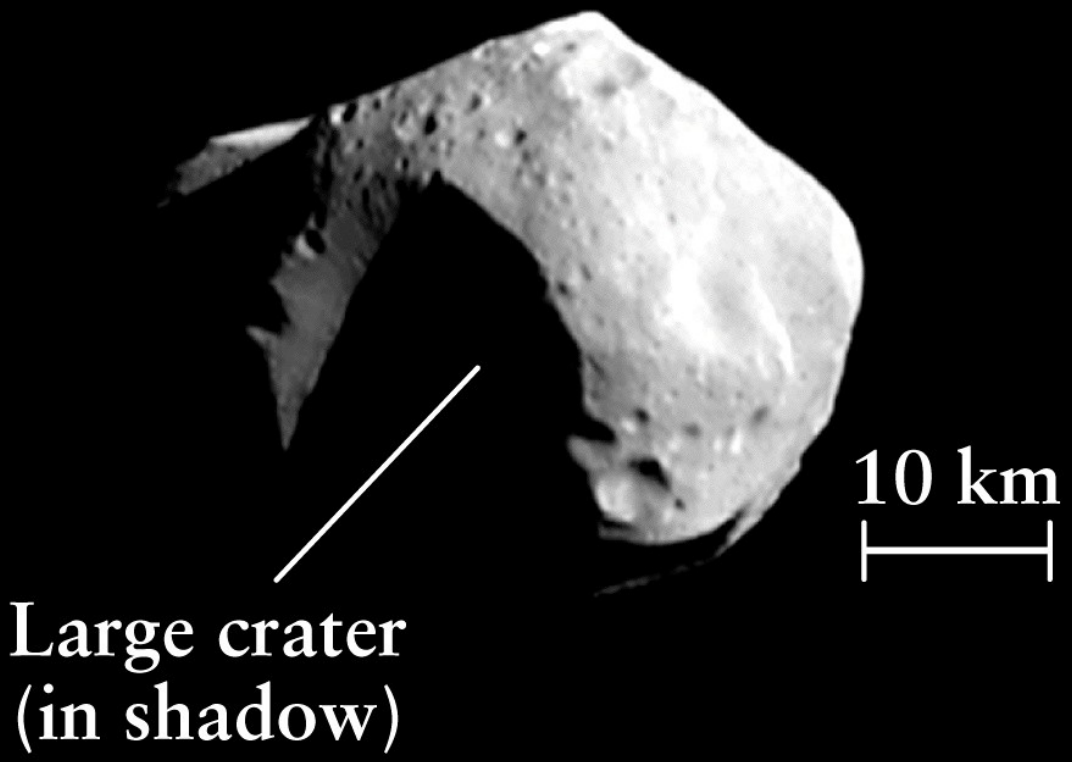
Asteroiden Vesta, 530km (HST)



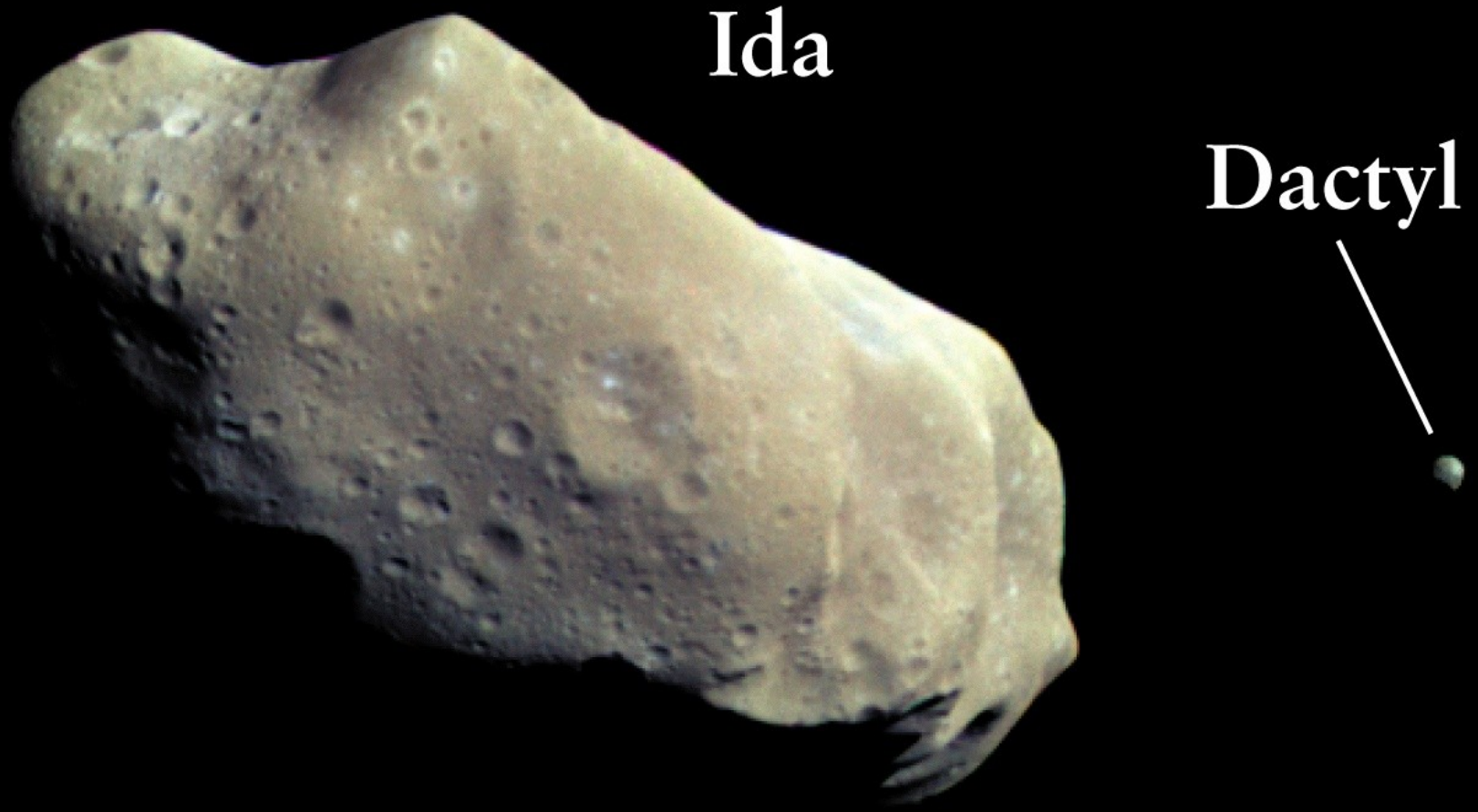
Radarbild av 216 Kleopatra



253 Mathilde (NEAR)

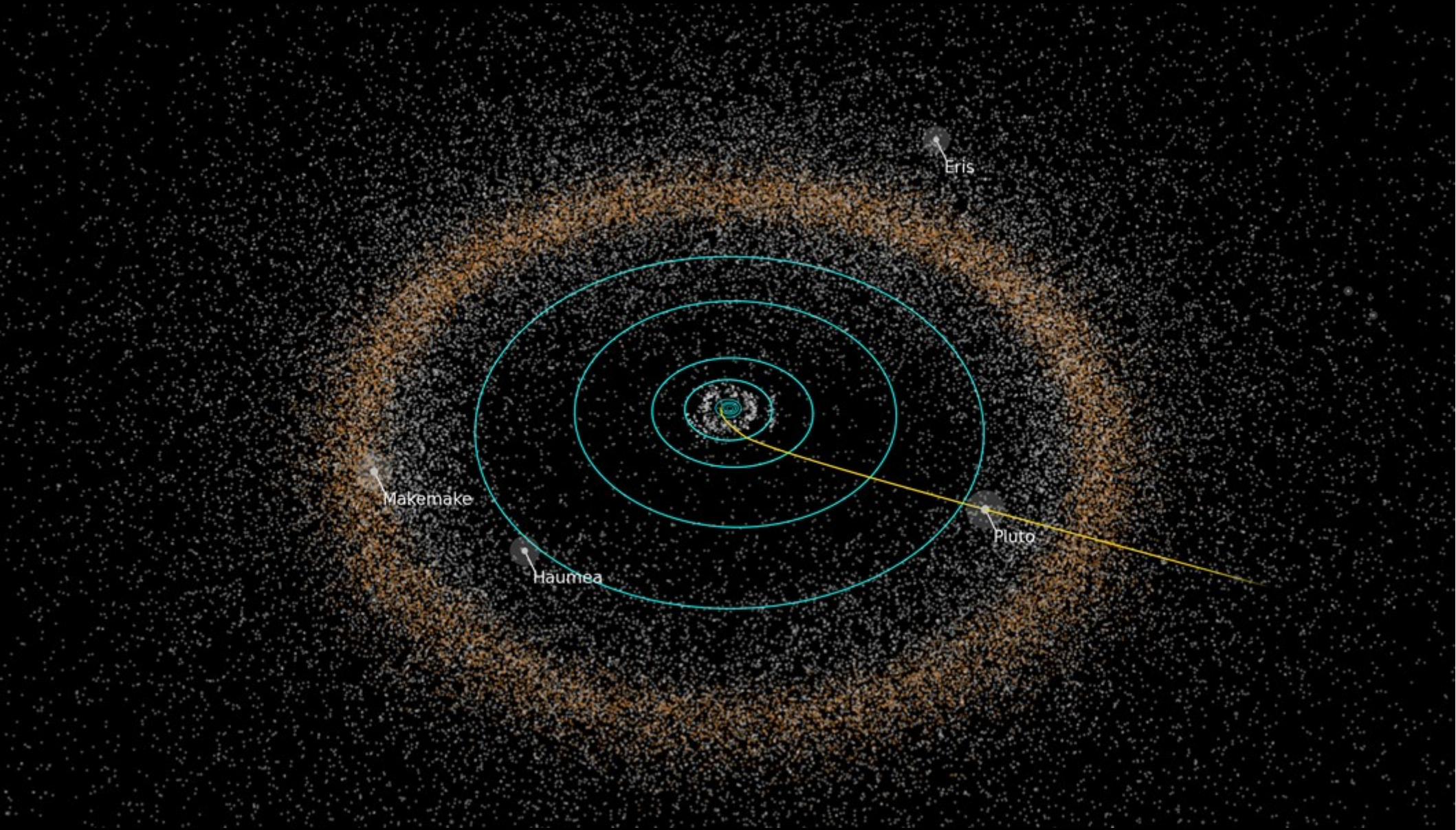


243 Ida (Galileo)

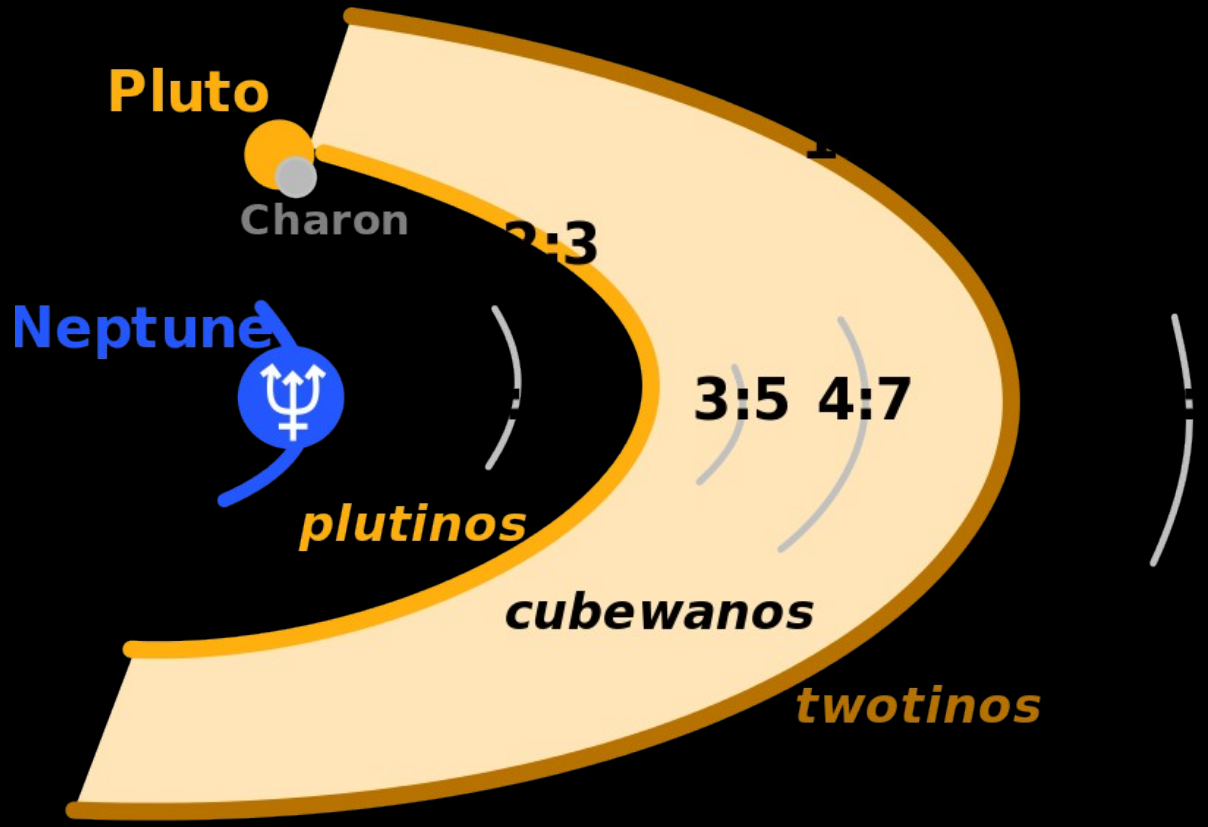


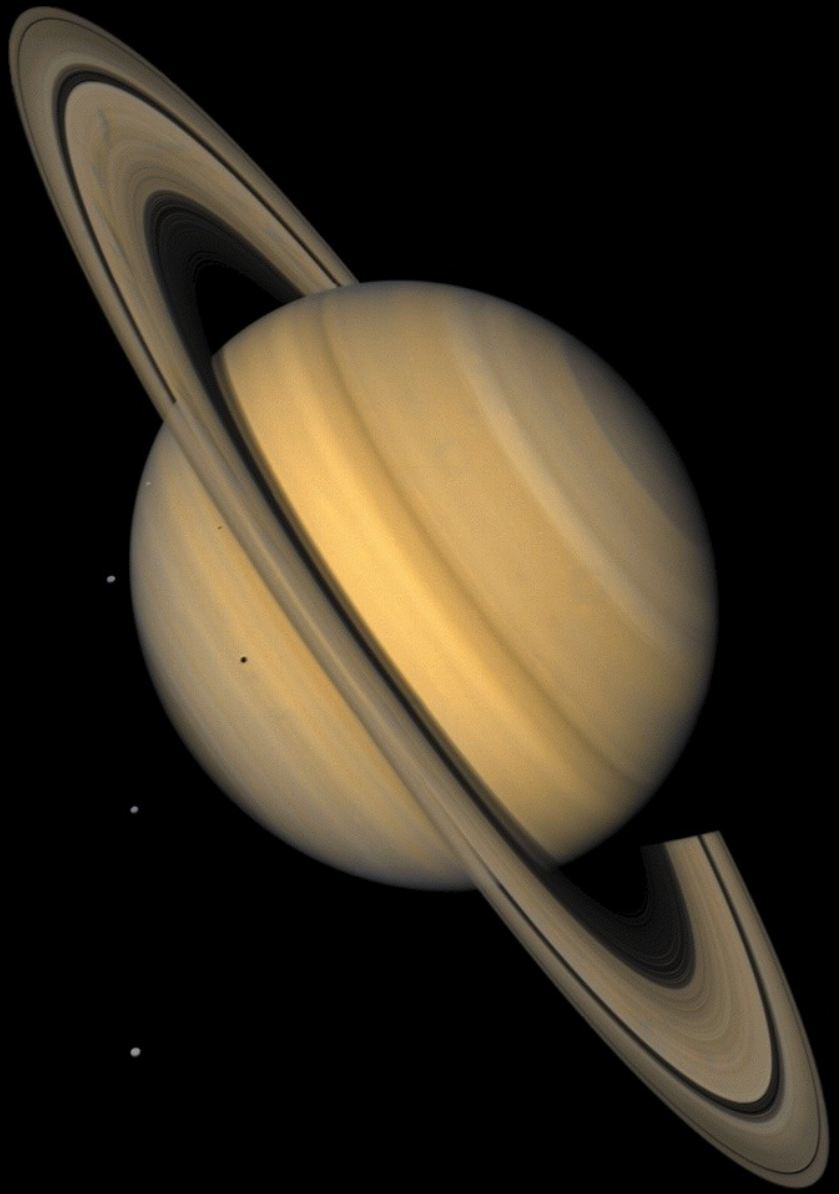
Asteroiden Toutatis

Kuiperbältet



Kuiperbältet



Largest known trans-Neptunian objects (TNOs)

Saturnusvideo