

# AE673A

Group Number- 3

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## Sun

Type: **star**

Magnitude: **-26.76**

Absolute Magnitude: 4.83

RA/Dec (J2000.0): 14h16m11.04s/-13°38'40.5"

RA/Dec (on date): 14h16m09.58s/-13°38'29.5"

HA/Dec: 22h59m28.30s/-13°38'29.5"

Az./Alt.: +156°09'32.4"/+51°07'32.7"

Gal. long./lat.: -27°39'40.0"/+44°20'04.6"

Supergal. long./lat.: +135°42'08.4"/+15°06'11.4"

Ecl. long./lat. (J2000.0): +216°22'12.1"/-0°00'03.9"

Ecl. long./lat. (on date): +216°21'48.5"/-0°00'03.8"

Ecliptic obliquity (on date): +23°26'15.9"

Mean Sidereal Time: 13h15m38.8s

Apparent Sidereal Time: 13h15m37.9s

Rise: 6h51m

Transit: 12h31m

Set: 18h10m

Daytime: 11h19m

Parallactic Angle: -22°37'59.1"

IAU Constellation: Vir

Hourly motion: +0°02'28" towards 109.1°

Hourly motion:  $da=+0^{\circ}02'24"$   $d\delta=-0^{\circ}00'50"$

Distance: 0.993 AU (148.563 M km)

Light time: 0h08m15.6s

Sidereal period: 1.00 days (0.003 a)

Apparent diameter: +0°32'12.64"

Diameter: 1392000.0 km

Sidereal day: 654h36m35.9s

Equatorial rotation velocity: 1.856 km/s

## MATLAB Values

RA = -2.543392 rad

dec = -0.239485 rad

## Upon Conversion of Sterillium values,

RA= -2.6226 rad

declination= -0.2381 rad

RA and Declination values from both the sources are nearly same. Hence our MATLAB code is perfectly good for this



Solar Objects	RA	Declination	Altitude	Azimuth
<b>Sun</b>	<b>14h16m09.58s</b>	<b>-13°38'29.5"</b>	<b>+51°07'32.5"</b>	<b>+156°09'32.4"</b>

Mercury

Type: planet  
Magnitude: -0.09  
Absolute Magnitude: -0.60  
RA/Dec (J2000.0): 15h47m01.54s/-22°58'33.6"  
RA/Dec (on date): 15h46m59.96s/-22°58'23.7"  
HA/Dec: 21h28m37.93s/-22°58'23.7"  
Az./Alt.: +138°25'59.7"/+31°38'46.4"  
Gal. long./lat.: -15°34'55.3"/+24°21'31.2"  
Supergal. long./lat.: +155°28'41.2"/+29°55'10.0"  
Ecl. long./lat. (J2000.0): +239°38'33.8"/-2°58'19.1"  
Ecl. long./lat. (on date): +239°38'10.2"/-2°58'19.0"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 8h41m  
Transit: 14h02m  
Set: 19h23m  
Parallactic Angle: -43°48'44.2"  
IAU Constellation: Lib  
Hourly motion: +0°01'37" towards 100.7°  
Hourly motion: dα=+0°01'43" dδ=-0°00'20"  
Elongation: +23°26'43.5"  
Phase angle: +9°00'10.8"  
Illuminated: 49.9%  
Distance from Sun: 0.395 AU (59.109 M km)  
Distance: 0.911 AU (136.225 M km)  
Light time: 0h07m34.4s  
Orbital velocity: 46.890 km/s  
Sidereal period: 87.97 days (0.241 a)  
Synodic period: 115.88 days (0.317 a)  
Apparent diameter: +0°00'07.39"  
Equatorial diameter: 4879.4 km  
Sidereal day: 1407h30m33.8s  
Mean solar day: 4222h27m52.5s  
Albedo: 0.060

Solar Objects

Mercury

15hr46m59.96s

Declination

-22°58'23.7"

Altitude

+31°38'49.4"

Azimuth

+138°25'59.7"

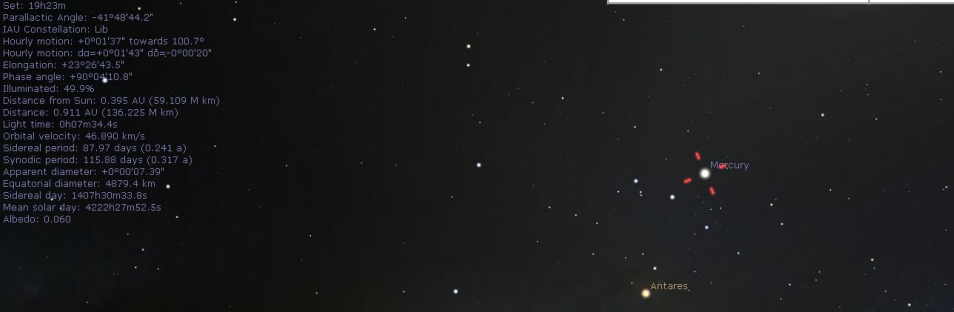
Venus

11h23m06.58s

+4°11'58.4"

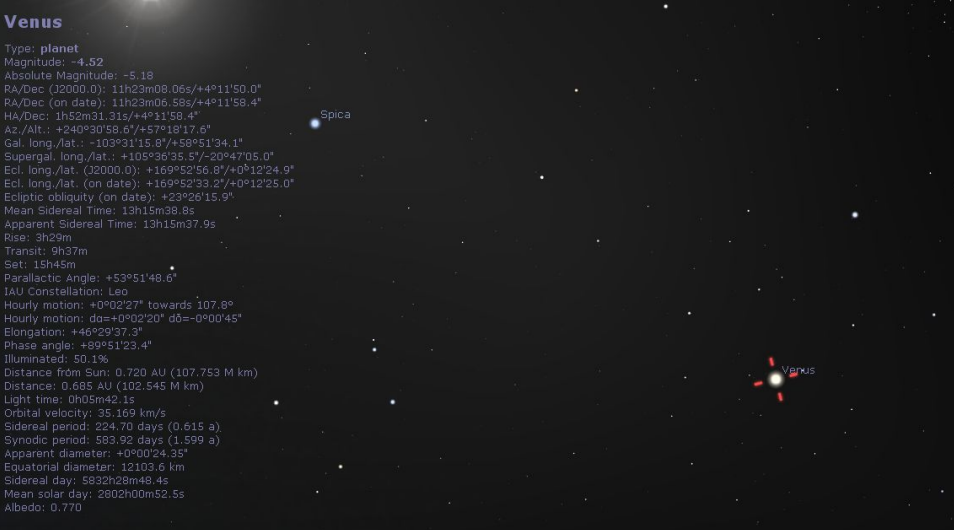
+57°18'17.6"

+240°30'58.6"



Venus

Type: planet  
Magnitude: -4.52  
Absolute Magnitude: -5.18  
RA/Dec (J2000.0): 11h23m08.06s/+4°11'50.0"  
RA/Dec (on date): 11h23m06.58s/+4°11'58.4"  
HA/Dec: 1h52m31.31s/+4°11'58.4"  
Az./Alt.: +240°30'58.6"/+57°18'17.6"  
Gal. long./lat.: -103°02'115.6"/+59°51'34.1"  
Supergal. long./lat.: +105°36'35.5"/-20°47'05.0"  
Ecl. long./lat. (J2000.0): +169°52'56.8"/+0°12'24.9"  
Ecl. long./lat. (on date): +169°52'33.2"/+0°12'25.0"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 9h23m  
Transit: 9h37m  
Set: 15h45m  
Parallactic Angle: +53°51'48.6"  
IAU Constellation: Leo  
Hourly motion: +0°02'27" towards 107.6°  
Hourly motion: dα=+0°02'20" dδ=-0°00'45"  
Elongation: +46°29'37.3"  
Phase angle: +89°51'23.4"  
Illuminated: 50.1%  
Distance from Sun: 0.720 AU (107.753 M km)  
Distance: 0.685 AU (102.545 M km)  
Light time: 0h05m42.1s  
Orbital velocity: 35.169 km/s  
Sidereal period: 224.70 days (0.615 a)  
Synodic period: 583.92 days (1.599 a)  
Apparent diameter: +0°00'24.35"  
Equatorial diameter: 12103.6 km  
Sidereal day: 5832h28m48.4s  
Mean solar day: 2602h00m52.5s  
Albedo: 0.770



Mars

Type: planet  
Magnitude: 0.72  
Absolute Magnitude: -1.52  
Mean Opposition Magnitude: -2.01  
RA/Dec (J2000.0): 18h42m29.88s/-24°46'52.4"  
RA/Dec (on date): 18h42m28.12s/-24°46'48.6"  
HA/Dec: 18h33m09.77s/-24°46'48.6"  
Az /Alt : +115°57'46.0"/-2°10'09.7"  
Gal. long./lat.: +9°42'47.6"/-9°11'04.5"  
Supergal. long./lat.: -157°55'03.0"/+49°23'41.9"  
Ecl. long./lat. (J2000.0): +279°38'26.0"/-1°41'48.4"  
Ecl. long./lat. (on date): +279°38'02.4"/-1°41'48.4"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 11h41m  
Transit: 16h58m  
Set: 22h15m  
Parallactic Angle: -66°04'55.4"  
IAU Constellation: Sgr  
Hourly motion: +0°01'51" towards 86.0°  
Hourly motion: dα=+0°02'02" dδ=+0°00'08"  
Elongation: +63°16'38.7"  
Phase angle: +39°46'27.8"  
Illuminated: 88.4%  
Distance from Sun: 1.386 AU (207.413 M km)  
Distance: 1.512 AU (226.215 M km)  
Light time: 0h12m4.6s  
Orbital velocity: 26.409 km/s  
Sidereal period: 686.97 days (1.881 a)  
Synodic period: 779.95 days (2.135 a)  
Apparent diameter: +0°00'06.19"  
Equatorial diameter: 6792.4 km  
Sidereal day: 24h37m22.7s  
Mean solar day: 24h39m35.2s  
Equatorial rotation velocity: 0.241 km/s  
Albedo: 0.150

Solar Objects

Mars

Jupiter

RA

18h42m28.12s

01h50m13.03s

Declination

-24°46'48.6"

+09°42'15.2"

Altitude

-02°10'09.7"

-56°54'01.0"

Azimuth

+115°57'46.0"

+344°15'18.6"

Jupiter

Type: planet  
Magnitude: -2.92  
Absolute Magnitude: -9.40  
Mean Opposition Magnitude: -2.70  
RA/Dec (J2000.0): 1h50m14.47s/+9°42'26.1"  
RA/Dec (on date): 1h50m13.03s/+9°42'15.2"  
HA/Dec: 11h25m24.86s/+9°42'15.2"  
Az /Alt : +344°15'18.6"/-56°54'01.0"  
Gal. long./lat.: +146°05'22.7"/-50°30'05.0"  
Supergal. long./lat.: -50°15'54.1"/-10°24'55.4"  
Ecl. long./lat. (J2000.0): +28°03'22.8"/+1°31'49.6"  
Ecl. long./lat. (on date): +28°02'56.8"/+1°31'49.7"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 17h46m  
Transit: 0h03m  
Set: 6h20m  
Parallactic Angle: +14°45'25.0"  
IAU Constellation: Psc  
Hourly motion: +0°00'20" towards 249.8°  
Hourly motion: dα=0°00'19" dδ=0°00'07"  
Elongation: +42°31'22.1"  
Phase angle: +1°20'36.7"  
Illuminated: 100.0%  
Distance from Sun: 4.958 AU (741.743 M km)  
Distance: 3.972 AU (594.192 M km)  
Light time: 0h33m02.8s  
Orbital velocity: 13.695 km/s  
Sidereal period: 4331.87 days (11.860 a)  
Synodic period: 398.89 days (1.092 a)  
Apparent diameter: +0°00'49.63"  
Equatorial diameter: 142964.0 km  
Sidereal day: 9h55m29.7s  
Mean solar day: 9h55m33.1s  
Equatorial rotation velocity: 12.572 km/s  
Albedo: 0.510

Saturn

Type: planet  
Magnitude: -0.20  
Absolute Magnitude: -8.88  
Mean Opposition Magnitude: 0.  
RA/Dec (J2000.0): 2h50m30.69s/+13°37'26.9"  
RA/Dec (on date): 2h50m29.21s/+13°37'16.2"  
HA/Dec: 10h25m08.68s/+13°37'16.2"  
Az./Alt.: +324°51'56.3"/-47°13'17.1"  
Gal. long./lat.: +162°00'18.6"/-40°02'44.7"  
Supergal. long./lat.: -40°58'29.97/-22°49'46.1"  
Ecl. long./lat. (J2000.0): +44°17'24.6"/+2937°08.6"  
Ecl. long./lat. (on date): +44°17'01.0"/+2937°08.5"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 18h39m  
Transit: 1h03m  
Set: 7h27m  
Parallactic Angle: +33°13'22.2"  
IAU Constellation: Ari  
Hourly motion: +0°00'12" towards 252.9°  
Hourly motion: dα=-0°00'12" dδ=-0°00'04"  
Elongation: +171°29'56.9"  
Phase angle: +0°53'48.2"  
Illuminated: 100.0%  
Distance from Sun: 9.198 AU (1375.657 M km)  
Distance: 8.214 AU (1228.764 M km)  
Light time: 1h08m18.8s  
Orbital velocity: 10.018 km/s  
Sidereal period: 10760.00 days (29.459 a)  
Synodic period: 378.09 days (1.035 a)  
Apparent diameter: +0°00'20.23", with rings: +0°00'47.13"  
Equatorial diameter: 120536.0 km  
Sidereal day: 10h39m22.4s  
Mean solar day: 10h39m24.0s  
Equatorial rotation velocity: 9.871 km/s  
Albedo: 0.500

Solar Objects	RA	Declination	Altitude	Azimuth
Saturn	2h50m29.21s	+13°37'16.2"	-47°02'44.7"	+324°51'56.3"
Neptune	20h15m23.37s	-19°32'31.1"	-20°35'23.1"	+103°25'30.3"

Neptune

Type: planet  
Magnitude: 7.92  
Absolute Magnitude: -6.87  
Mean Opposition Magnitude: 7.84  
RA/Dec (J2000.0): 20h15m25.07s/-19°32'30.5"  
RA/Dec (on date): 20h15m23.37s/-19°32'31.1"  
HA/Dec: 17h00m14.52s/-19°32'31.1"  
Az./Alt.: +103°25'30.3"/-20°35'23.1"  
Gal. long./lat.: +23°39'13.4"/-26°56'16.6"  
Supergal. long./lat.: -123°34'44.3"/+49°35'09.2"  
Ecl. long./lat. (J2000.0): +301°40'05.8"/+0°15'10.7"  
Ecl. long./lat. (on date): +301°39'42.2"/+0°15'10.7"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m36.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 13h03m  
Transit: 18h31m  
Set: 23h58m  
Parallactic Angle: -72°44'40.9"  
IAU Constellation: Cap  
Hourly motion: +0°00'01" towards 80.9°  
Hourly motion: dα=+0°00'01" dδ=+0°00'00"  
Elongation: +85°17'33.2"  
Phase angle: +1°52'58.4"  
Illuminated: 100.0%  
Distance from Sun: 30.123 AU (4506.301 M km)  
Distance: 30.188 AU (4516.060 M km)  
Light time: 4h11m04.0s  
Orbital velocity: 5.427 km/s  
Sidereal period: 60189.00 days (164.789 a)  
Synodic period: 367.49 days (1.006 a)  
Apparent diameter: +0°00'02.26", with rings: +0°00'05.75"  
Equatorial diameter: 49528.0 km  
Sidereal day: 16h06m36.0s  
Mean solar day: 16h06m36.7s  
Equatorial rotation velocity: 2.683 km/s  
Albedo: 0.620

Uranus

Type: planet

Magnitude: 5.79

Absolute Magnitude: -7.19

Mean Opposition Magnitude: 5.52

RA/Dec (J2000.0): 21h02m13.99s/-17°36'04.4"

RA/Dec (on date): 21h02m12.33s/-17°36'07.2"

HA/Dec: 16h13m28.56s/-17°36'07.2"

Az./Alt.: +97°51'48.2"/-30°40'39.0"

Gal. long./lat.: +30°28'54.2"/-36°38'45.4"

Supergal. long./lat.: +109°00'23.7"/+44°15'42.7"

Ecl. long./lat. (J2000.0): +312°53'22.3"/-0°41'06.9"

Ecl. long./lat. (on date): +312°52'58.7"/-0°41'06.9"

Ecliptic obliquity (on date): +23°26'15.9"

Mean Sidereal Time: 13h15m38.8s

Apparent Sidereal Time: 13h15m37.9s

Rise: 13h47m

Transit: 19h18m

Set: 0h49m

Parallactic Angle: -74°04'03.5"

IAU Constellation: Cap

Hourly motion: +0°00'01" towards 72.2°

Hourly motion: dα=+0°00'01" dδ=+0°00'00"

Elongation: +96°30'47.9"

Phase angle: +2°50'21.9"

Illuminated: 99.9%

Distance from Sun: 19.918 AU (2979.660 M km)

Distance: 19.781 AU (2959.149 M km)

Light time: 2h44m30.7s

Orbital velocity: 6.855 km/s

Sidereal period: 30685.00 days (84.011 a)

Synodic period: 369.66 days (1.012 a)

Apparent diameter: +0°00'03.5d", with rings: +0°00'13.62"

Equatorial diameter: 51119.0 km

Sidereal day: 17h14m24.0s

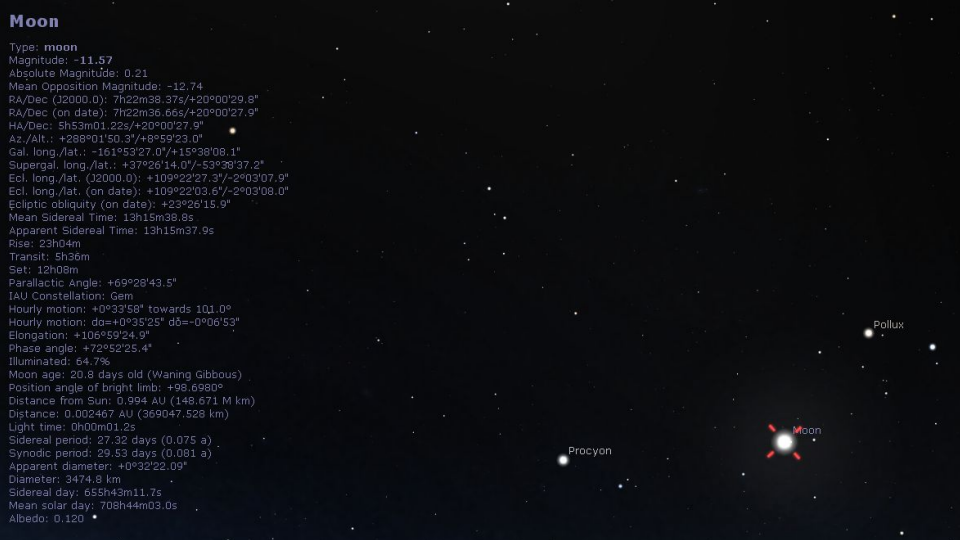
Mean solar day: 17h14m22.5s

Albedo: 0.660

Solar Objects	RA	Declination	Altitude	Azimuth
Moon	07h22m36.66s	+20°00'27.9"	+8°59'23.0	+288°01'50.3"
Uranus	21h02m12.33s	-17°36'07.2"	-30°40'39.0"	+97°51'48.2"

Moon

Type: moon  
Magnitude: -11.57  
Absolute Magnitude: 0.21  
Mean Opposition Magnitude: -12.74  
RA/Dec (J2000.0): 7h22m38.37s/+20°00'29.8"  
RA/Dec (on date): 7h22m36.66s/+20°00'27.9"  
HA/Dec: 9h53m01.22s/+20°00'27.9"  
Az./Alt.: +288°01'50.3"/+8°59'23.0"  
Gal. long./lat.: +161°53'27.0"/+15°38'08.1"  
Supergal. long./lat.: +37°26'14.0"/-53°28'37.2"  
Ecl. long./lat. (J2000.0): +109°22'27.3"/-2°03'07.9"  
Ecl. long./lat. (on date): +109°22'03.6"/-2°03'08.0"  
Ecliptic obliquity (on date): +23°26'15.9"  
Mean Sidereal Time: 13h15m38.8s  
Apparent Sidereal Time: 13h15m37.9s  
Rise: 23h04m  
Transit: 9h38m  
Set: 12h03m  
Parallactic Angle: +69°28'43.5"  
IAU Constellation: Gem  
Hourly motion: +0°33'58" towards 101.0°  
Hourly motion: dα=+0°35'25" dδ=-0°06'53"  
Elongation: +106°59'24.9"  
Phase angle: +72°52'25.4"  
Illuminated: 64.7%  
Moon age: 20.8 days old (Waning Gibbous)  
Position angle of bright limb: +98.698°  
Distance from Sun: 0.994 AU (148.671 M km)  
Distance: 0.002467 AU (369047.528 km)  
Light time: 0h00m01.2s  
Sidereal period: 27.32 days (0.075 a)  
Synodic period: 29.53 days (0.081 a)  
Apparent diameter: +0°32'22.09"  
Diameter: 3474.8 km  
Sidereal day: 65h43m11.7s  
Mean solar day: 708h44m03.0s  
Albedo: 0.120





```

[RA,delta] = SolarAzElq('1999-10-30 11:30:00',22.2913,70.7930,140);
fprintf('RA = %f rad \n',RA)
fprintf('dec = %f rad \n',delta)

function [RA,delta] = SolarAzElq(UTC,Lat,Lon,Alt)
if nargin<4 || isempty(Alt), Alt = 0;end
d2r = pi/180; %radian to degrees conversion factor
r2d = 180/pi; %radian to degrees conversion factor
if ischar(UTC)
UTC = cellstr(UTC);
end
if iscell(UTC)
UTC = reshape(datenum(UTC(:),'yyyy-mm-dd HH:MM:SS'),size(UTC));
end
[year,month,day,hour,min,sec] = datevec(UTC);
if ndims(UTC)>2 %#ok<ISMAT>
year = reshape(year ,size(UTC));
month = reshape(month,size(UTC));
day = reshape(day ,size(UTC));
hour = reshape(hour ,size(UTC));
min = reshape(min ,size(UTC));
sec = reshape(sec ,size(UTC));
end
[jd,UTH] = juliandate(year,month,day,hour,min,sec);
day = jd - 2451543.5;
w = 282.9404 + 4.70935e-5 * day;

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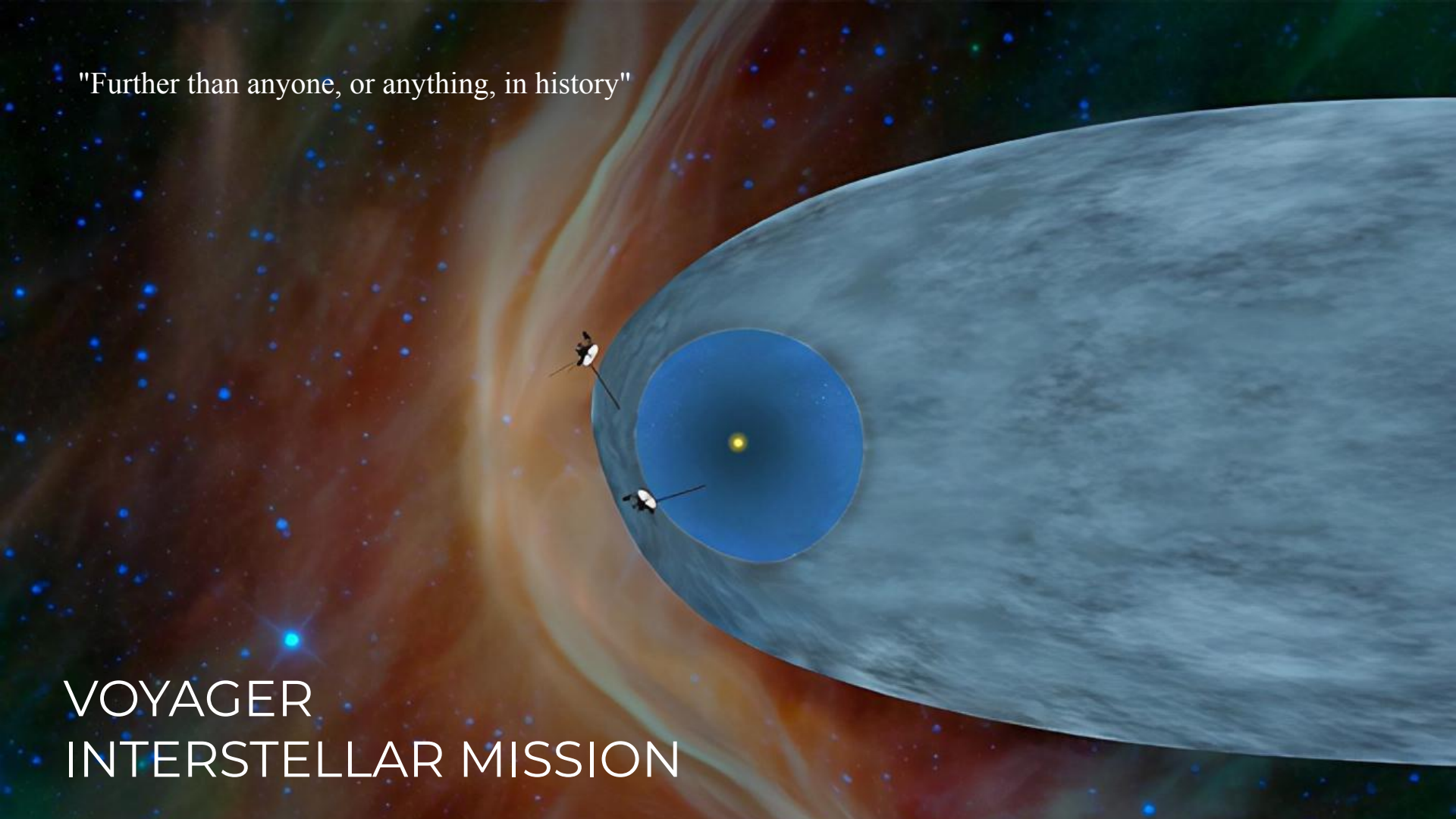
e = 0.016709 - 1.151e-9 * day;
M = mod(356.0470 + 0.9856002585 * day, 360);
L = w + M;
oblecl = (23.4393 - 3.563e-7 * day)*d2r;
E = M + r2d*e.*sin(M*d2r).*(1+e.*cos(M*d2r));
x = cos(E*d2r)-e;
year = sin(E*d2r).*sqrt(1-e.^2);
r = sqrt(x.^2 + year.^2);
v = atan2(year,x)*r2d;
lon = v + w;
xeclip = r.*cos(lon*d2r);
yeclip = r.*sin(lon*d2r);
zeclip = 0;
xequat = xeclip;
yequat = yeclip.*cos(oblecl) +
zeclip*sin(oblecl);
zequat = yeclip.*sin(0.409115648642983) +
zeclip*cos(oblecl);
r = sqrt(xequat.^2 + yequat.^2 + zequat.^2) -
(Alt/149598000);
RA = atan2(yequat,xequat); % in radians
delta = asin(zequat./r); % in radians
end

function [jd,UTH] =
juliandate(year,month,day,hour,min,sec)

```

"Further than anyone, or anything, in history"

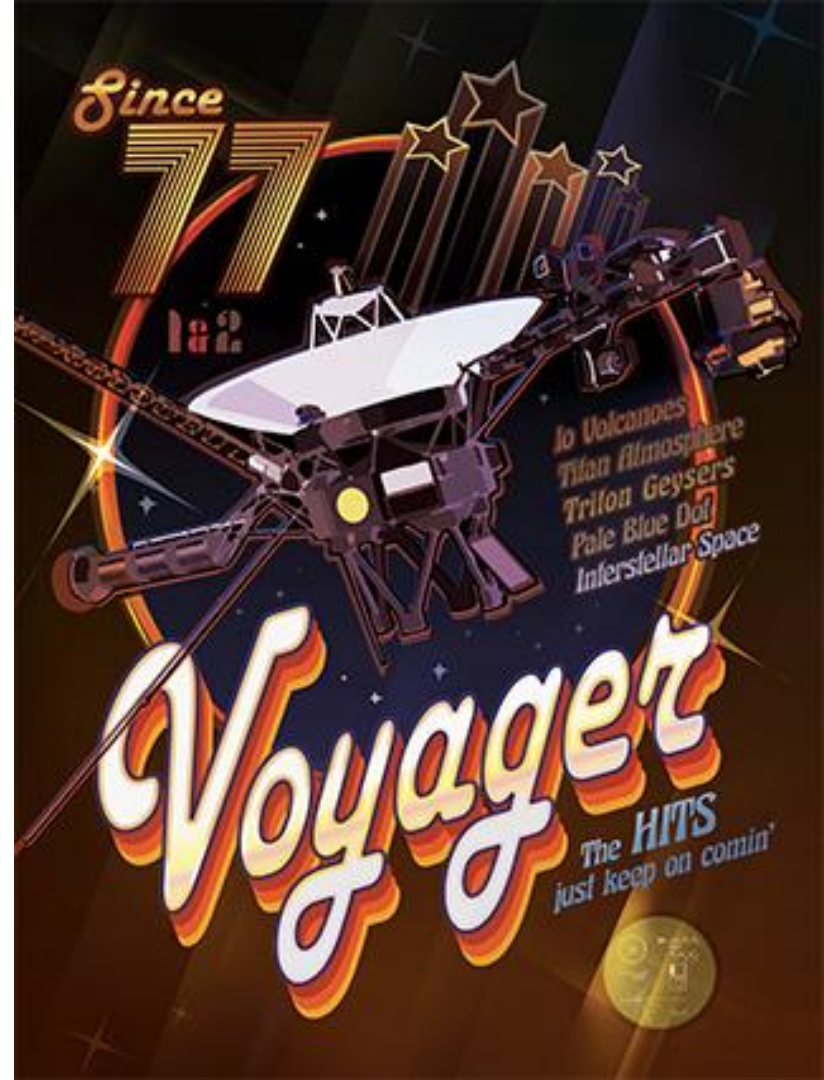
# VOYAGER INTERSTELLAR MISSION





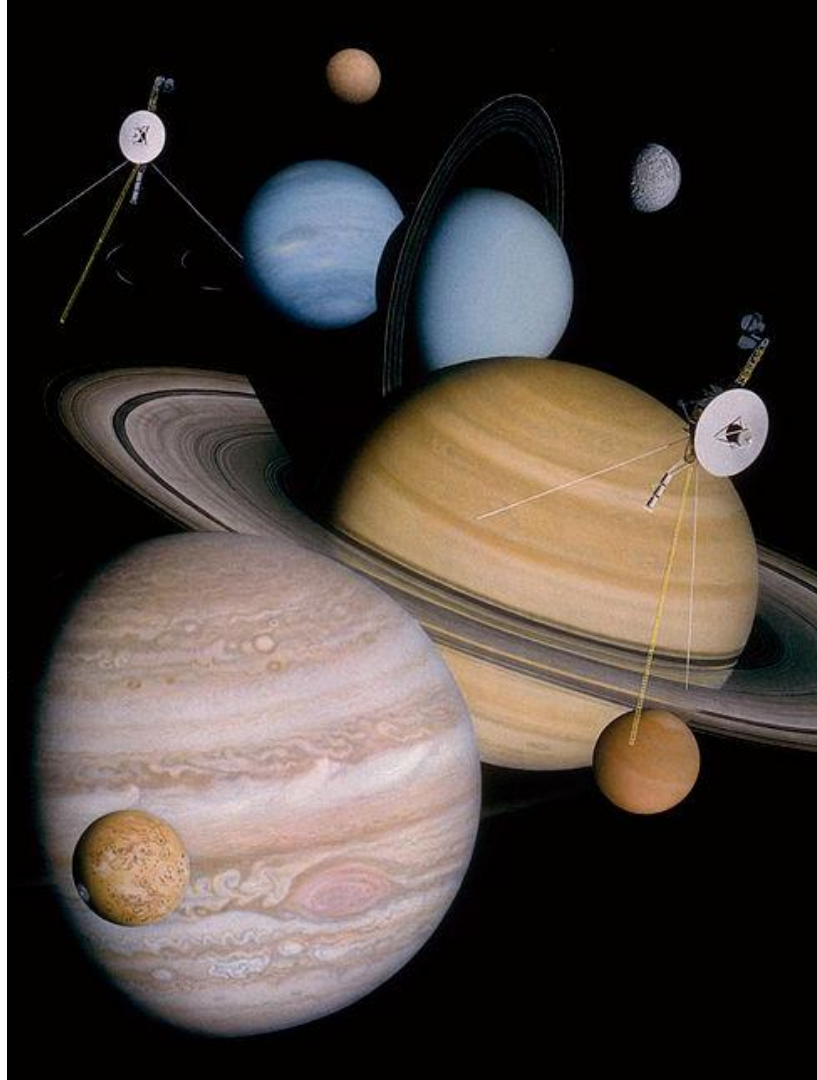
# The Mission

- The initial mission was launched in 1977 to study Jupiter, Uranus, Saturn, Neptune.
- The mission was a part of “The Grand Tour”.
- The original mission got extended to “Voyager Interstellar Mission”.
- They are the only and the farthest interstellar man made probes in the history.
- Expected to cross the realms of Milky way.

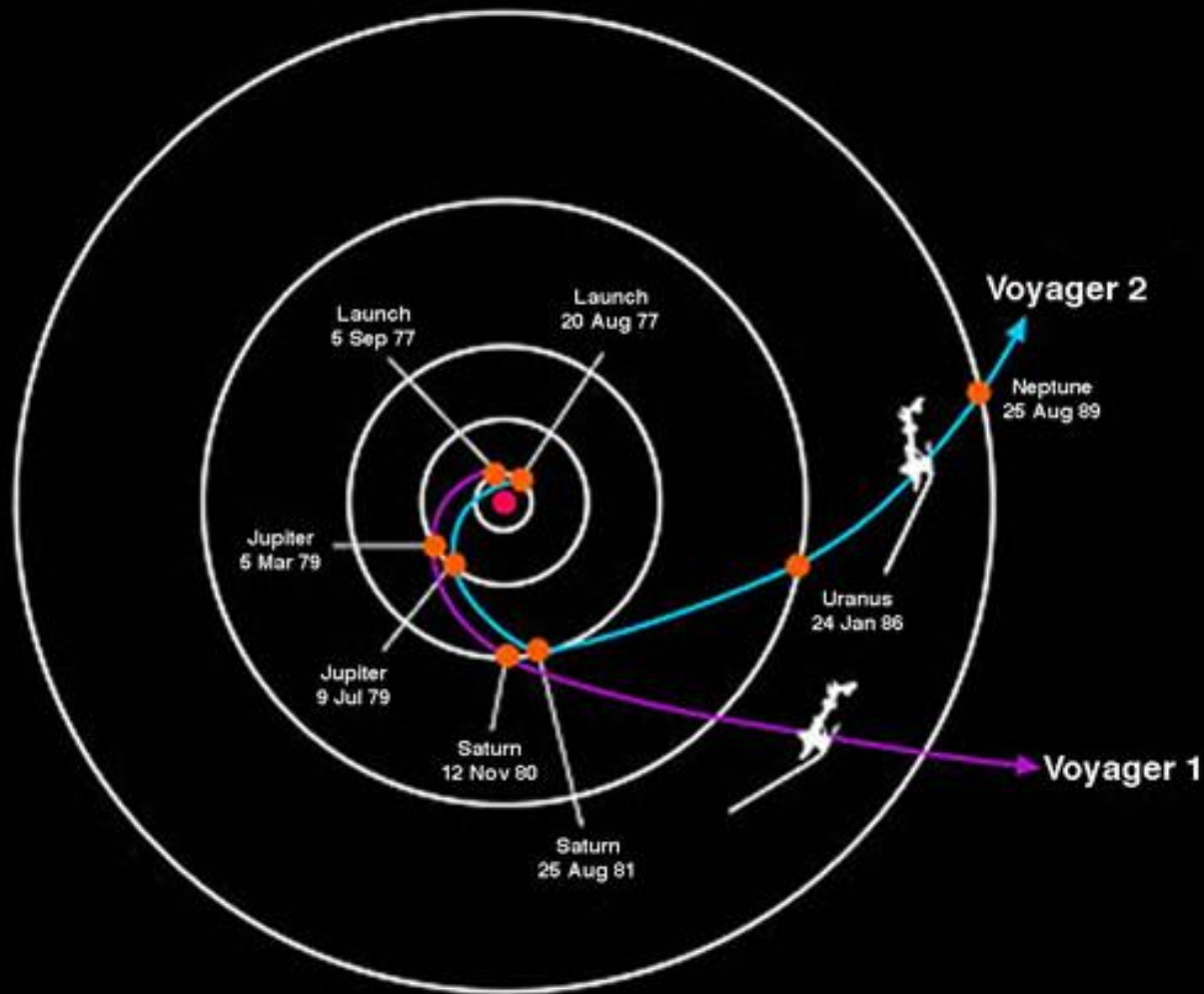


# Astonishing Discoveries

- Active Volcanoes on Jupiter's moon Io.
- V1 Discovered the Rings and moons of Jupiter.
- Various data on Saturn surface and its moons.
- V2 revealed the Great Red Spot on Jupiter to be a complex storm system, and also imaged several smaller storms.
- All our knowledge of Uranus and Neptune comes from V2.
- On Uranus, V 2 found evidence of an ocean of boiling water about 500 miles (800 kilometers) below its cloud tops.
- In October 2020, Voyagers confirmed high density of space outside the solar system.

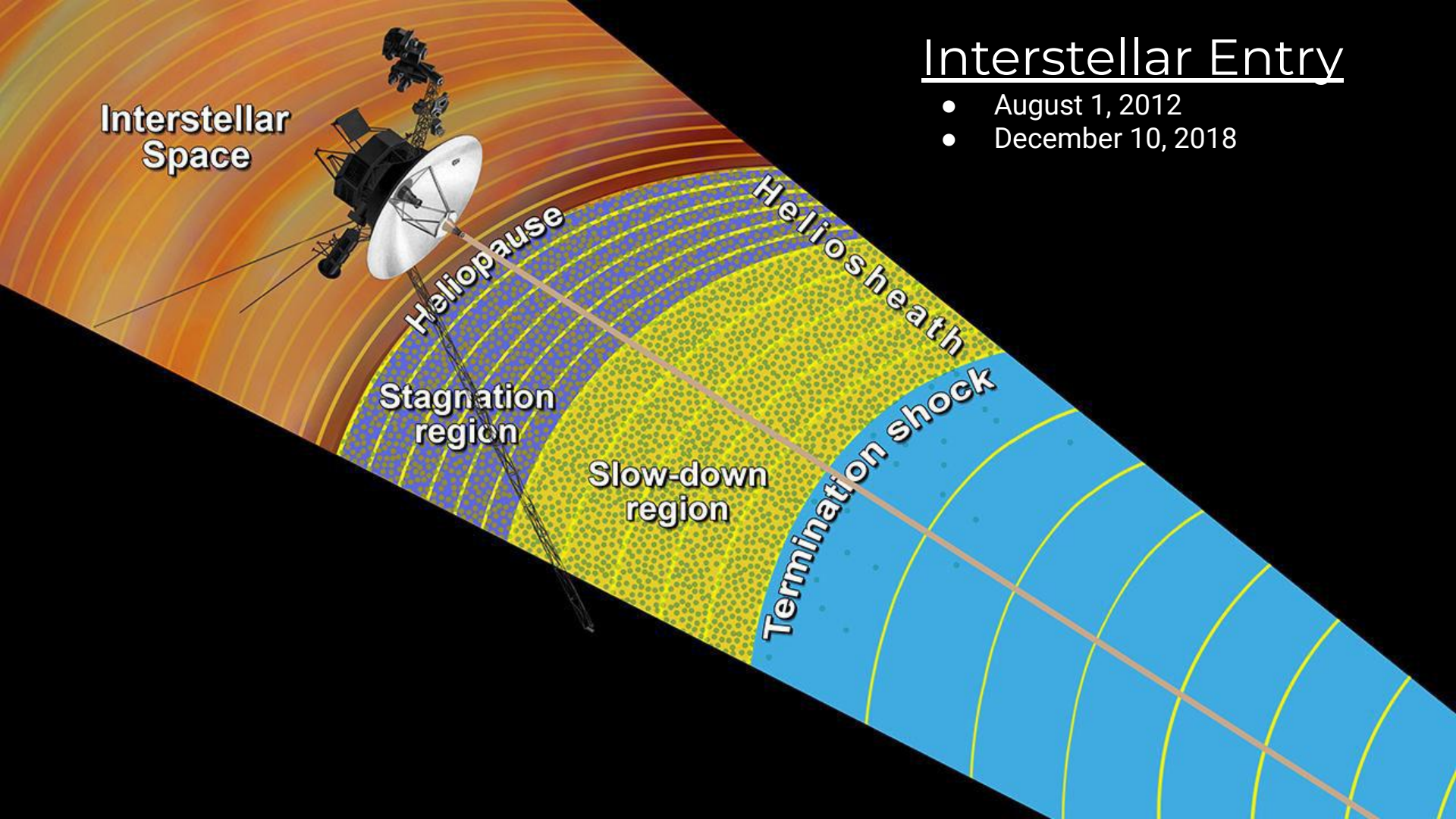


# Timeline



# Interstellar Entry

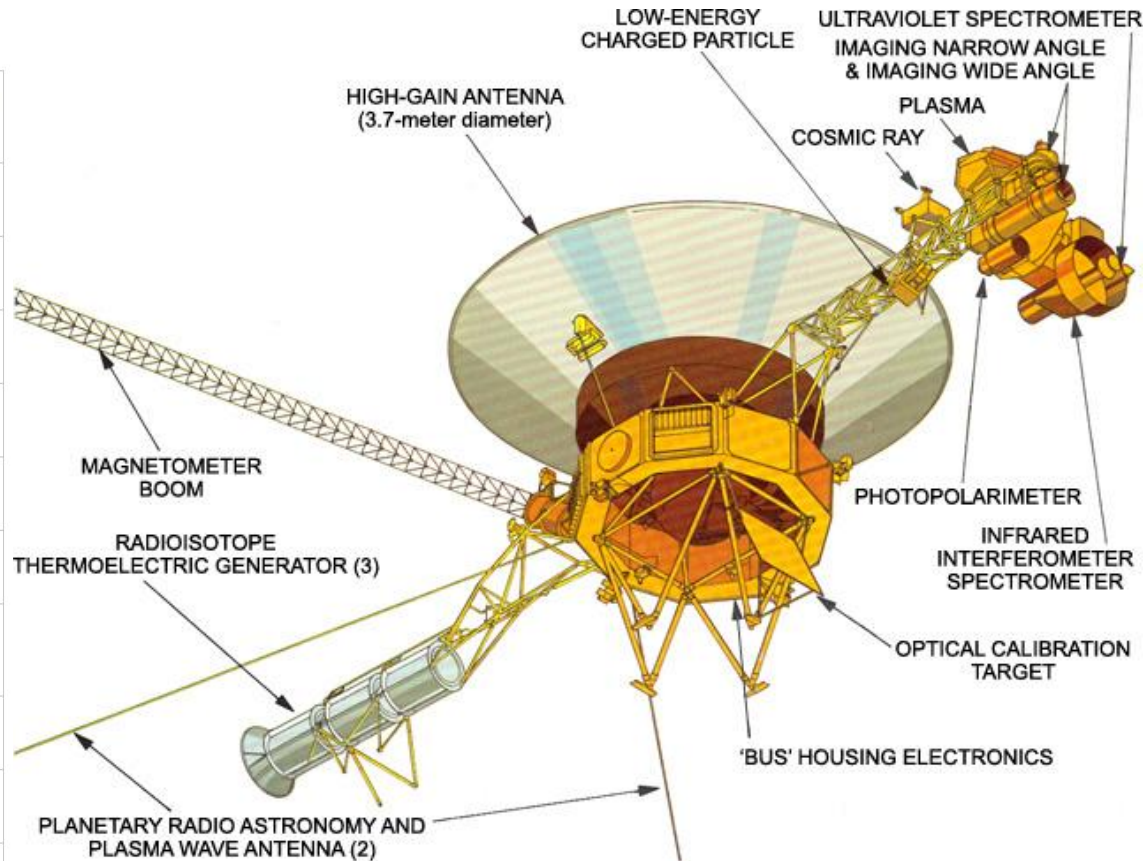
- August 1, 2012
- December 10, 2018





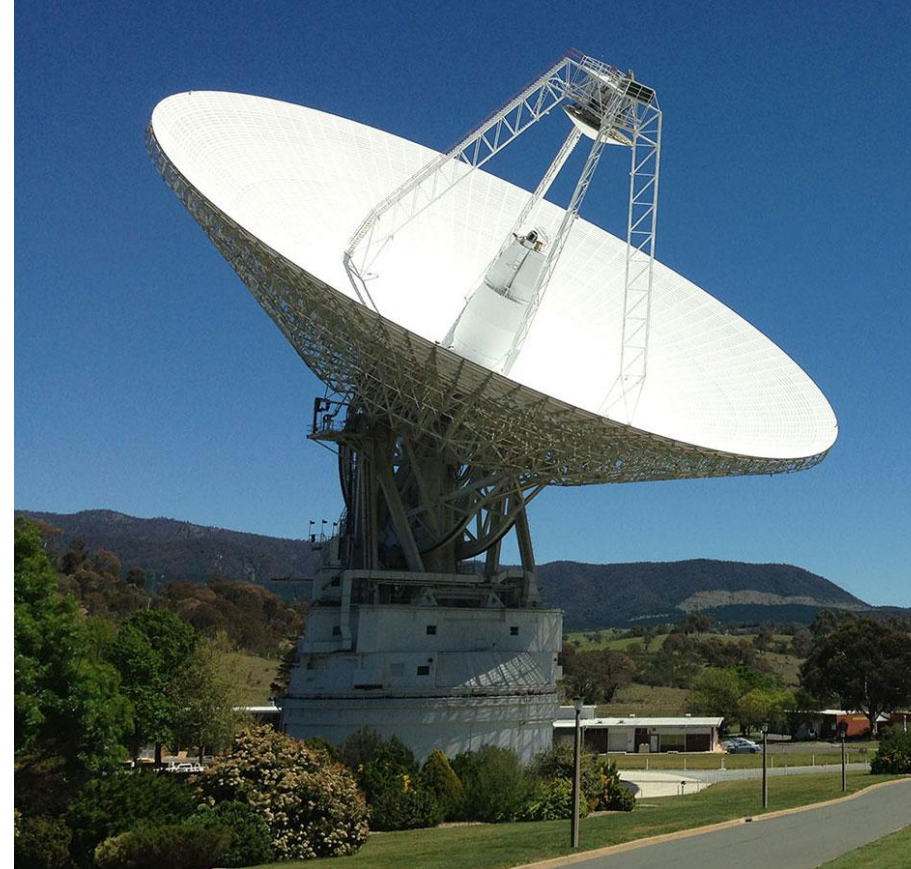
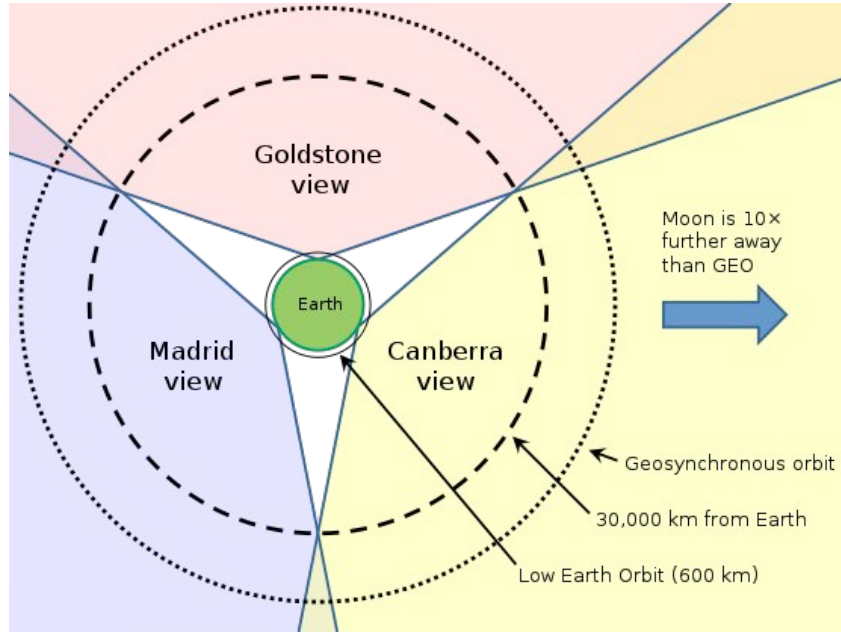
# Instruments

Instrument	Voyager 1	Voyager 2
Cosmic Ray Subsystem (CRS)	ON	ON
Low-Energy Charged Particles (LECP)	ON	ON
Magnetometer (MAG)	ON	ON
Plasma Wave Subsystem (PWS)	ON	ON
Plasma Science (PLS)	OFF	ON
Imaging Science Subsystem (ISS)	OFF	OFF
Infrared Interferometer Spectrometer and Radiometer (IRIS)	OFF	OFF
Photopolarimeter Subsystem (PPS)	OFF	OFF
Planetary Radio Astronomy (PRA)	OFF	OFF
Ultraviolet Spectrometer (UVS)	OFF	OFF



# Communication

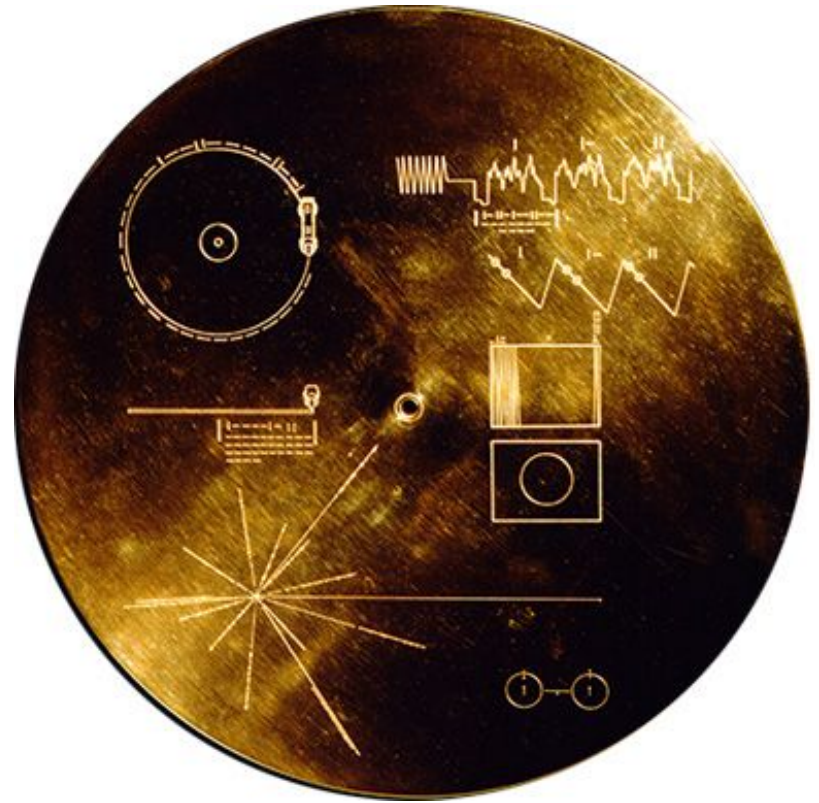
20KW Uplink  
20W Downlink





# The Golden Record

- Variety of natural sounds, such as those made by surf, wind and thunder, birds, whales, and other animals
- 115 images (encoded in analog form)
- Music (total duration of 90min)
- Spoken greetings from Earth-people (in fifty-five languages)



THANK YOU!

