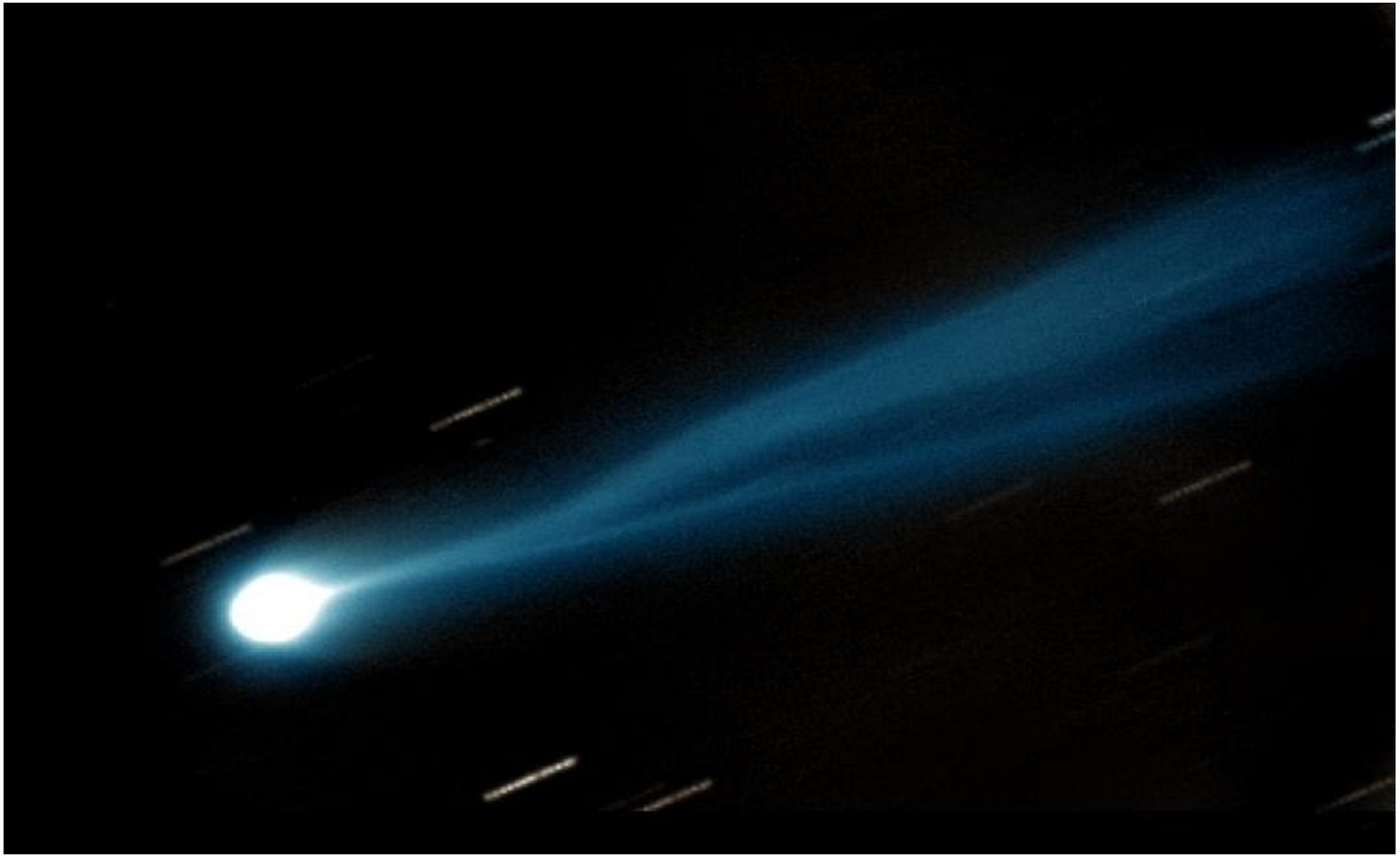
ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν
Πανεπιστήμιον Αθηνών

Εισαγωγή στην Αστροφυσική

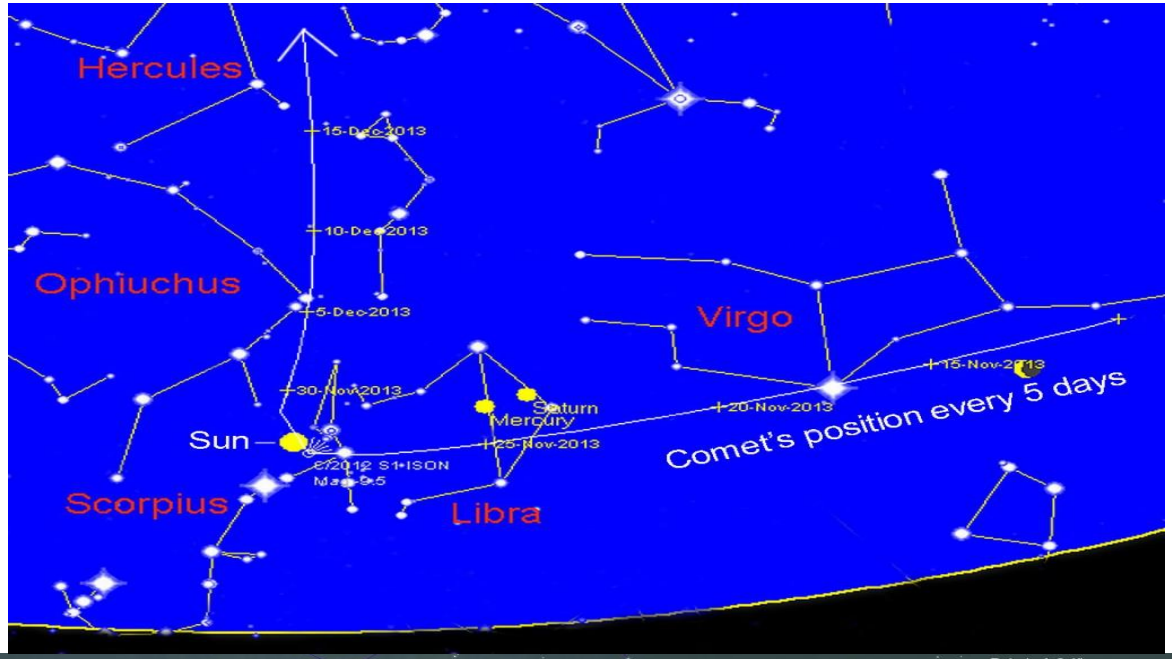
Ενότητα 4: Πλανητικό σύστημα

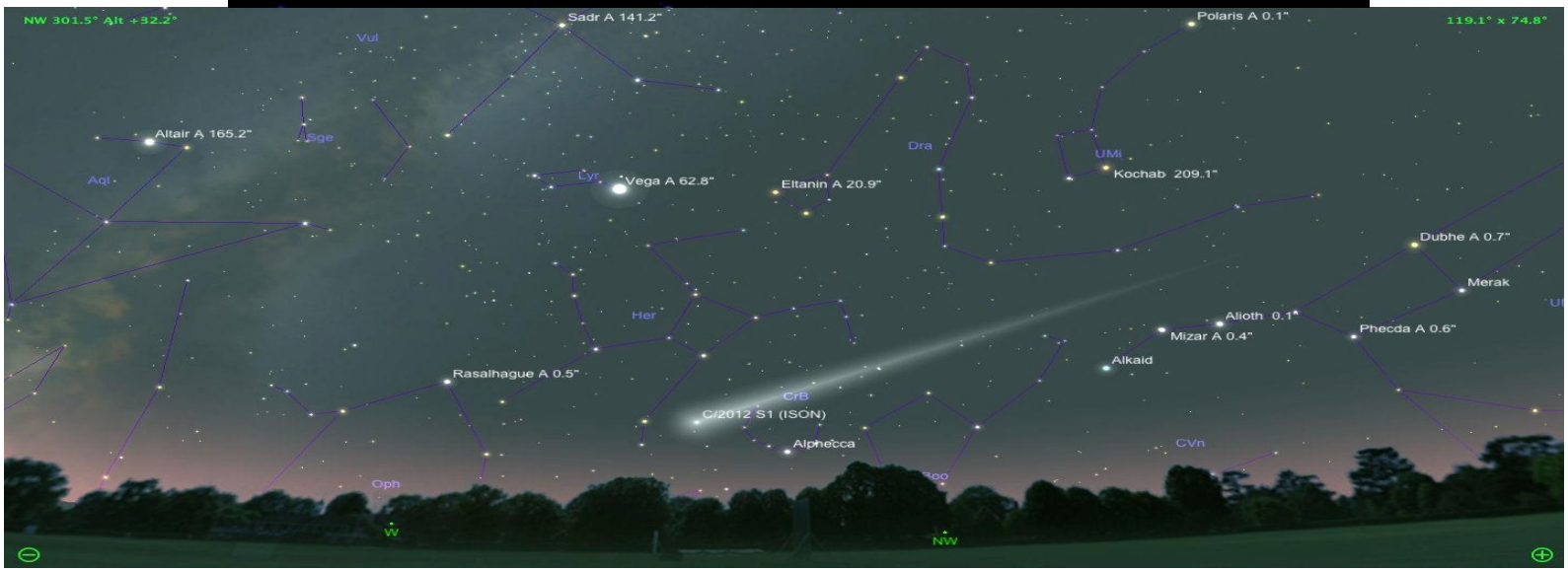
Παναγιώτα Πρέκα
Σχολή Θετικών Επιστημών
Τμήμα Φυσικής

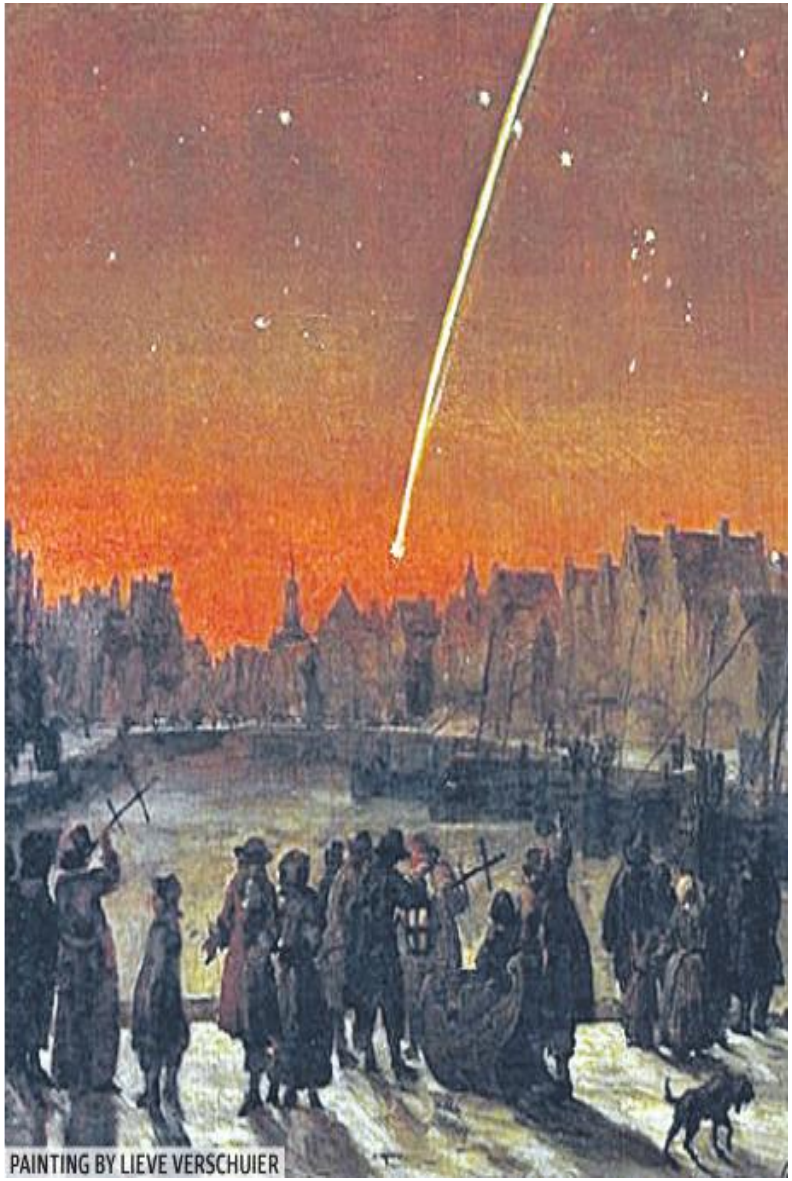
Comet ISON
University of Athens
by K. Gazeas
18-11-2013

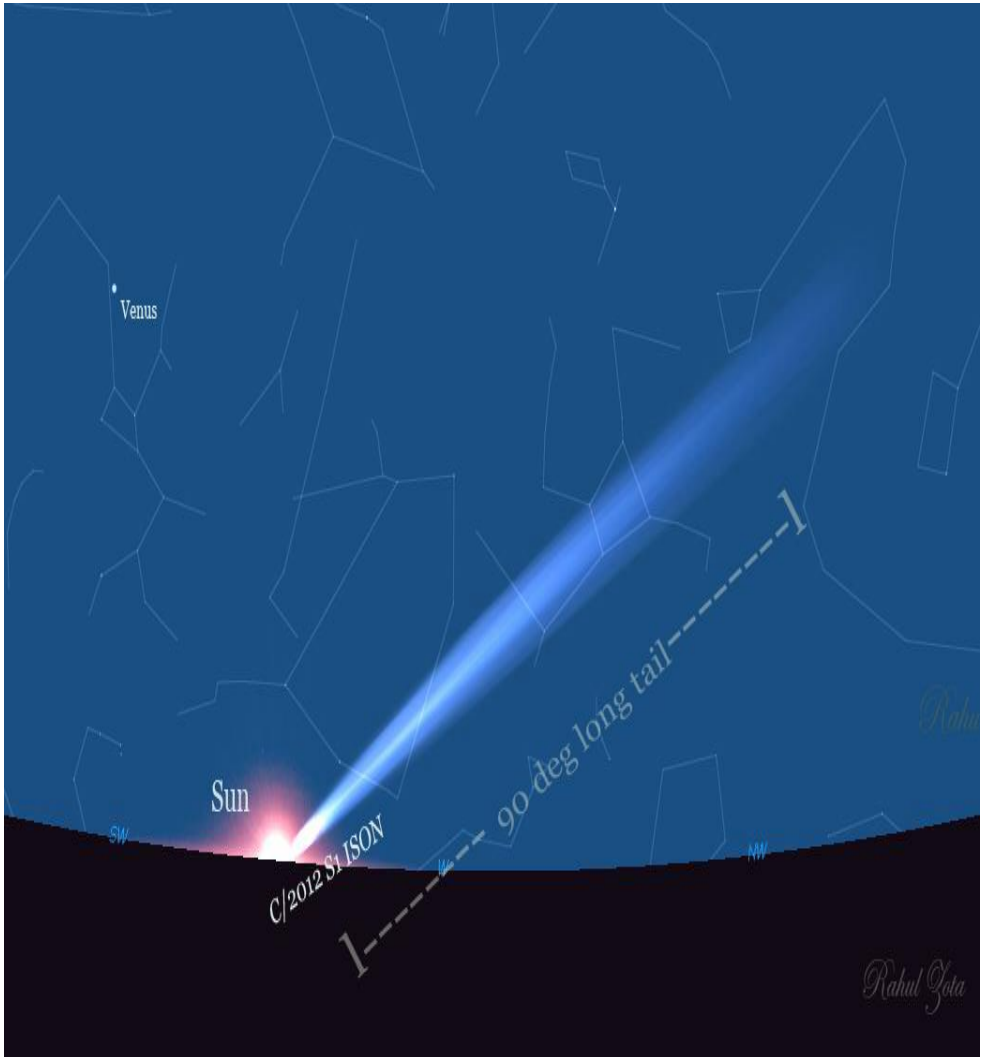


ISON COMET

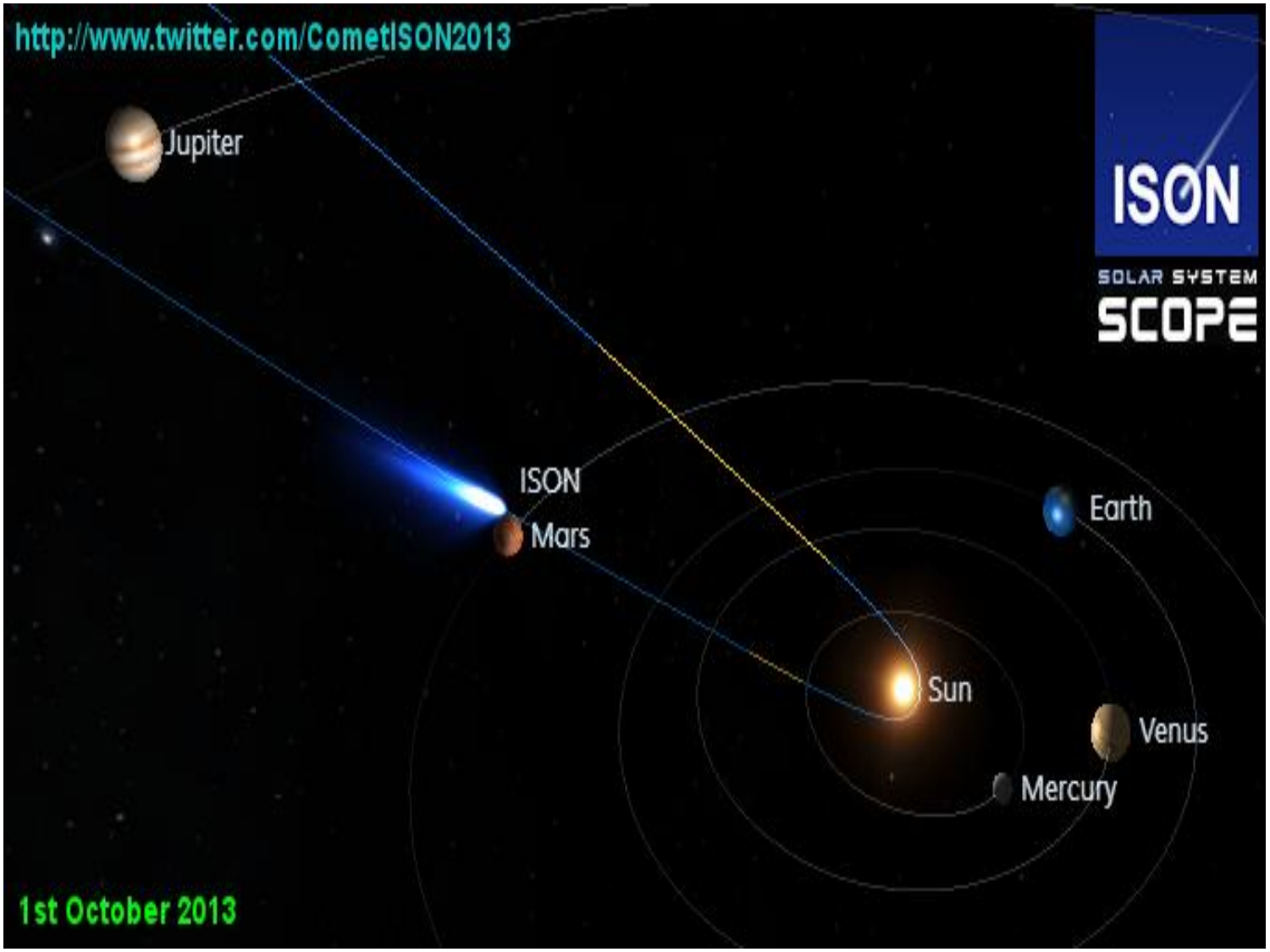

Hercules
15-Dec-2013
10-Dec-2013
Ophiuchus
5-Dec-2013
Virgo
30-Nov-2013
15-Nov-2013
Saturn
Mercury
20-Nov-2013
Sun
25-Nov-2013
C/2012 S1•ISON
Mag 0.5
Comet's position every 5 days
Scorpius
Libra


NW 301.5° Alt +32.2°
119.1° x 74.8°
Sadr A 141.2"
Polaris A 0.1"
Vul
Altair A 165.2"
Sge
Aql
Lyr
Vega A 62.8"
Eltanin A 20.9"
Dra
UMi
Kochab 209.1"
Dubhe A 0.7"
Merak
Her
Alioth 0.1"
Mizar A 0.4"
Phecda A 0.6"
Alkaid
Rasalhague A 0.5"
CrB
C/2012 S1 (ISON)
Alphecca
CVn
Oph
W
NW

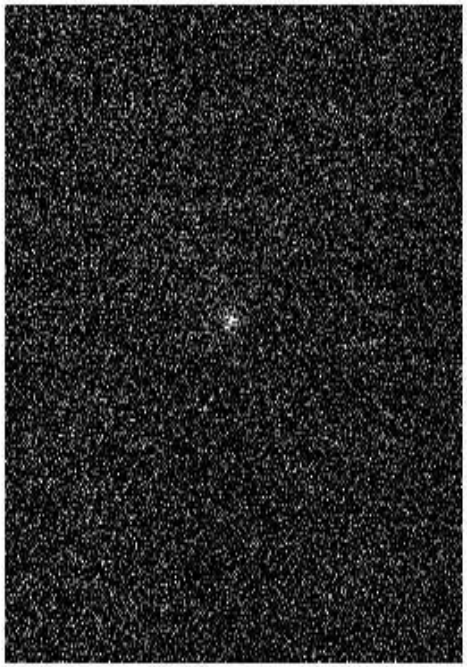

PAINTING BY LIEVE VERSCHUIER

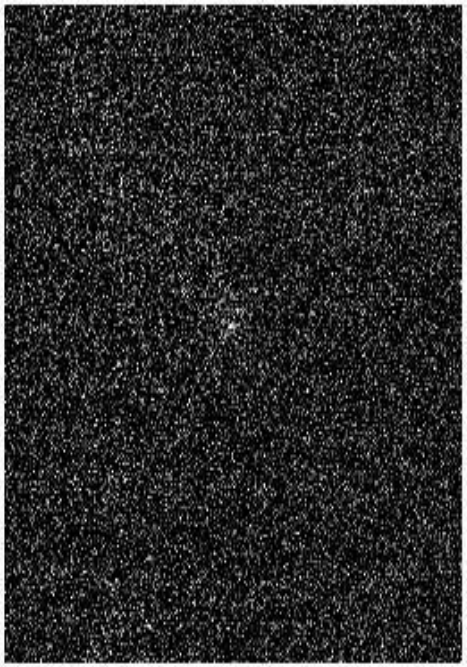

Venus
Sun
C/2012 S1 ISON
90 deg long tail
SW
NW
Rahul Zota

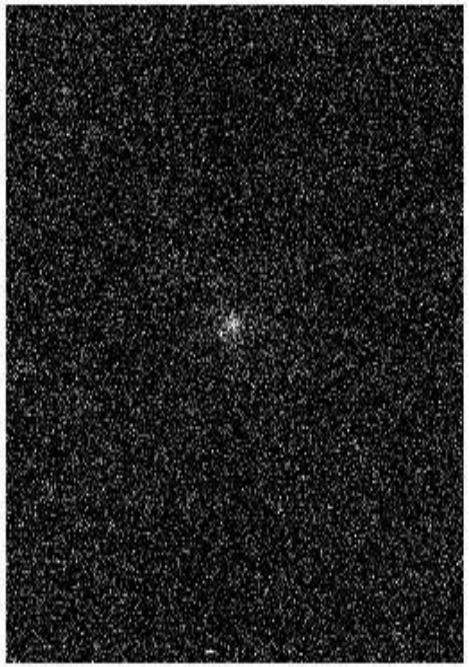

Comet C/2012 S1 ISON April 10, 2013 ▪ *HST* WFC3/UVIS F606W *V*

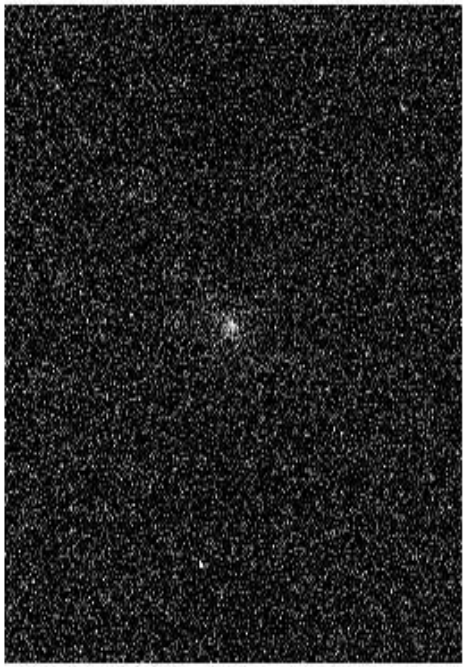

http://www.twitter.com/CometISON2013
Jupiter
ISON
SOLAR SYSTEM
SCOPE
ISON
Mars
Earth
Sun
Venus
Mercury
1st October 2013

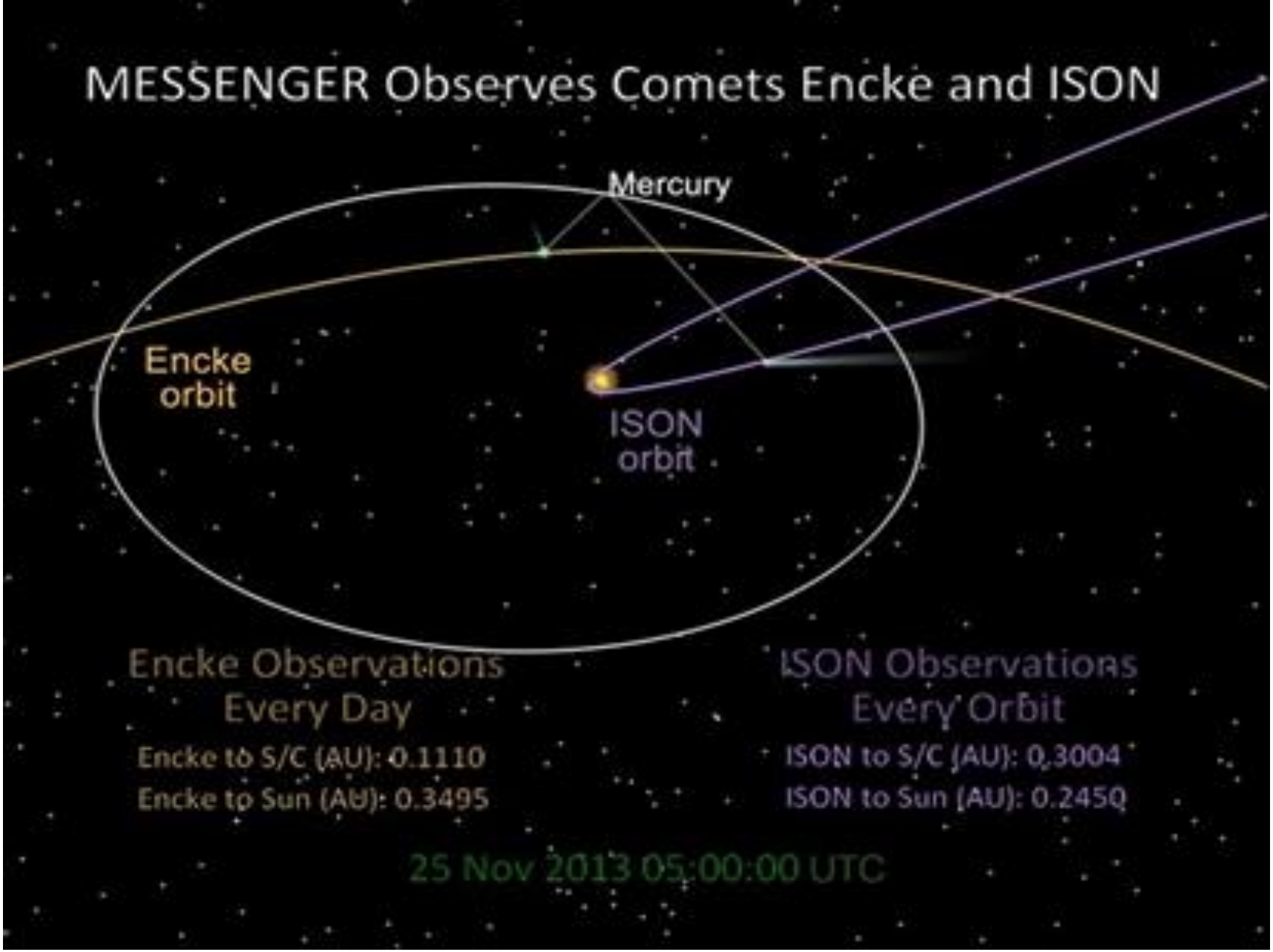
MRO
29-9-2013


033633_9050

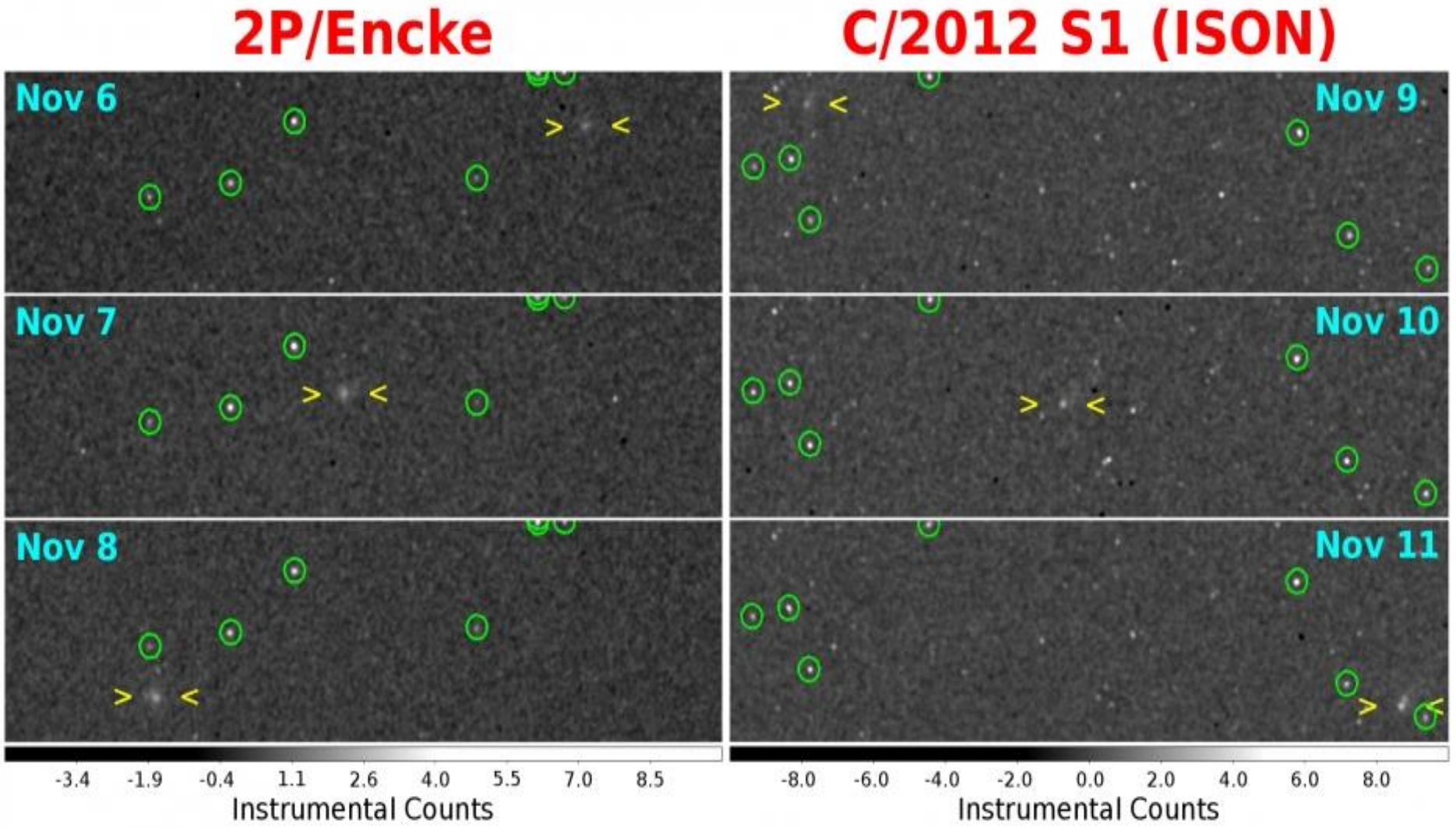

033633_9051

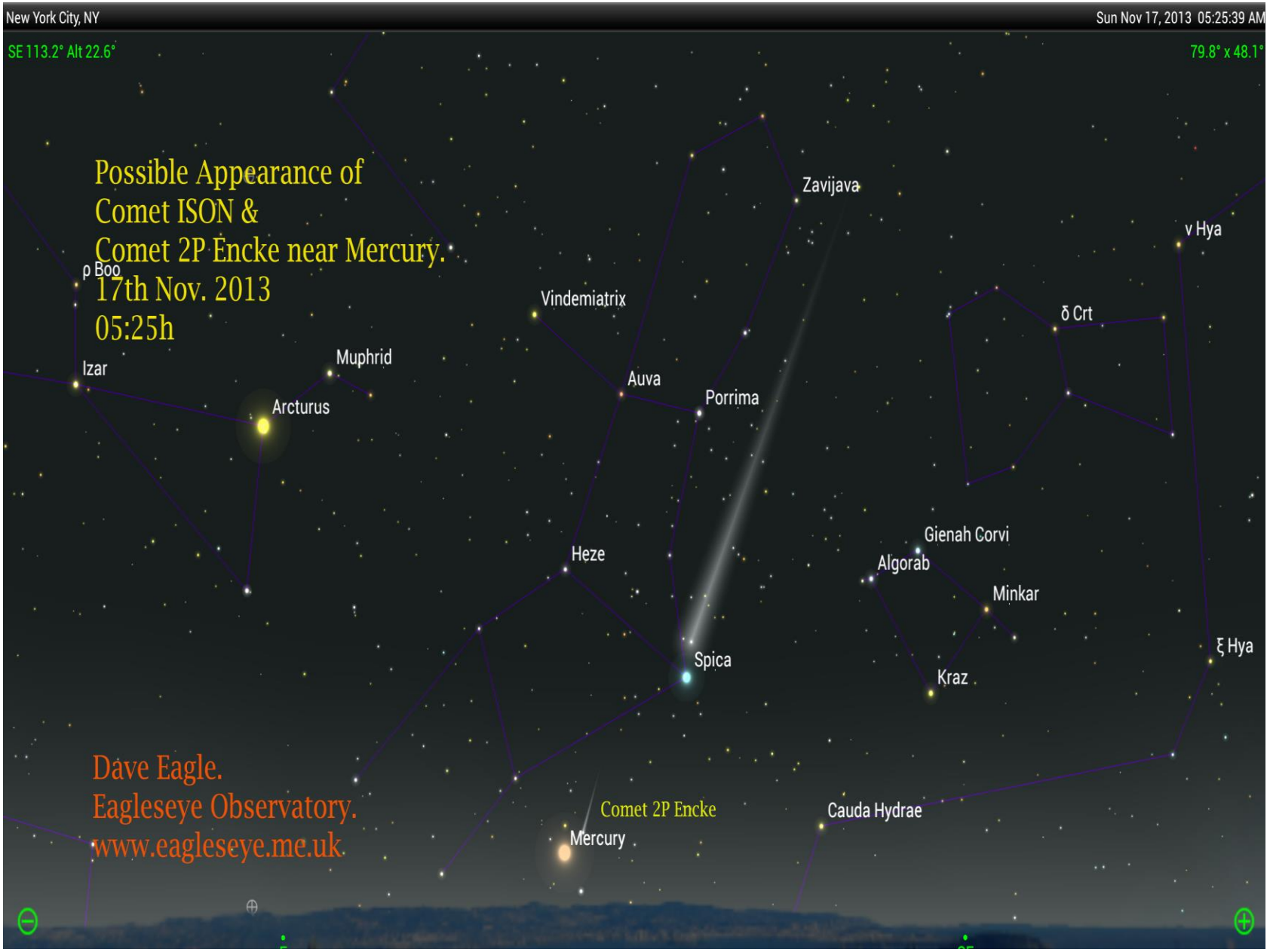

033639_9050


033639_9051

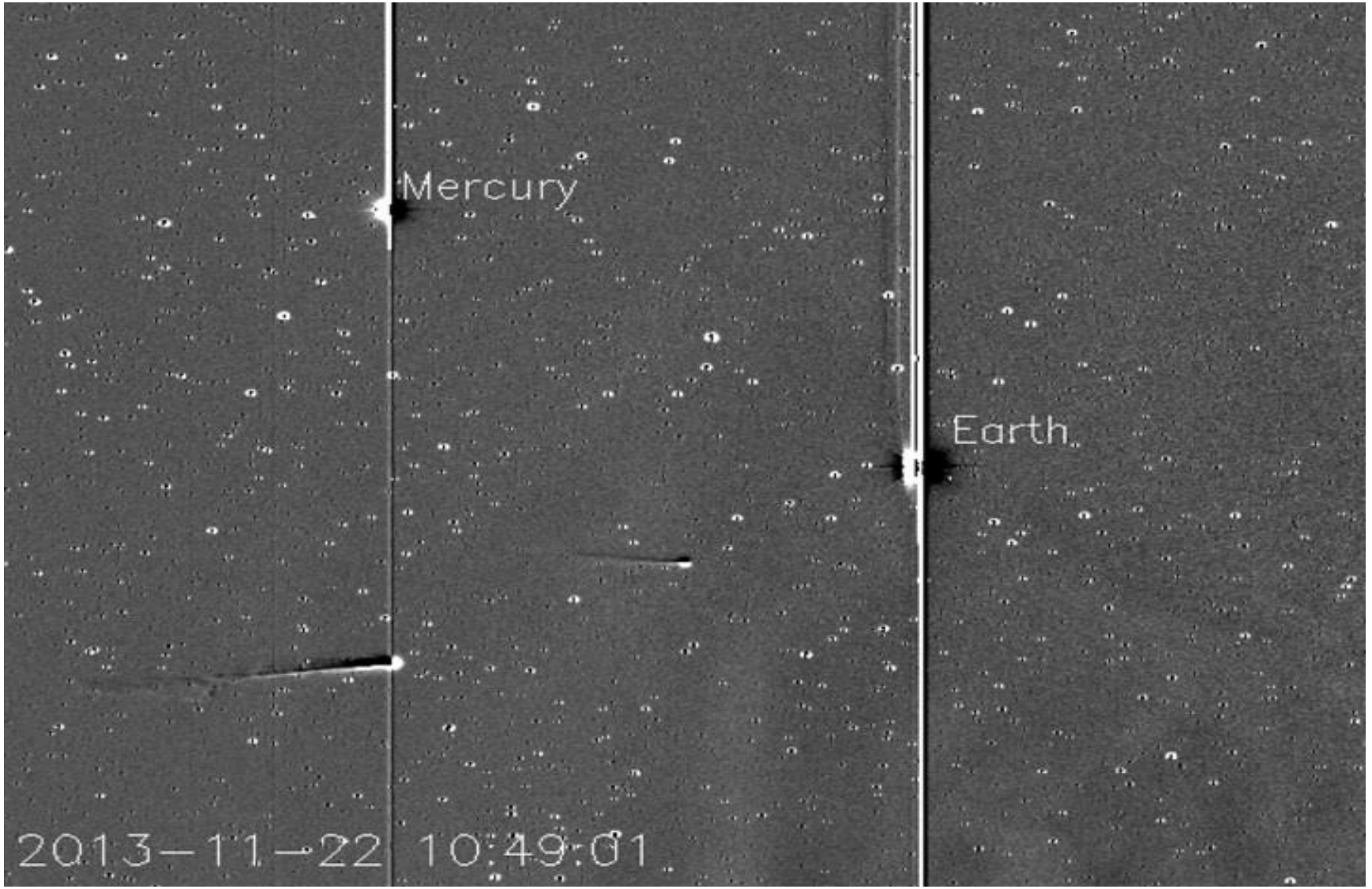

MESSENGER Observes Comets Encke and ISON
Mercury
Encke orbit
ISON orbit
Encke Observations Every Day
Encke to S/C (AU): 0.1110
Encke to Sun (AU): 0.3495
ISON Observations Every Orbit
ISON to S/C (AU): 0.3004
ISON to Sun (AU): 0.2450
25 Nov 2013 05:00:00 UTC

MESSENGER
MERCURY

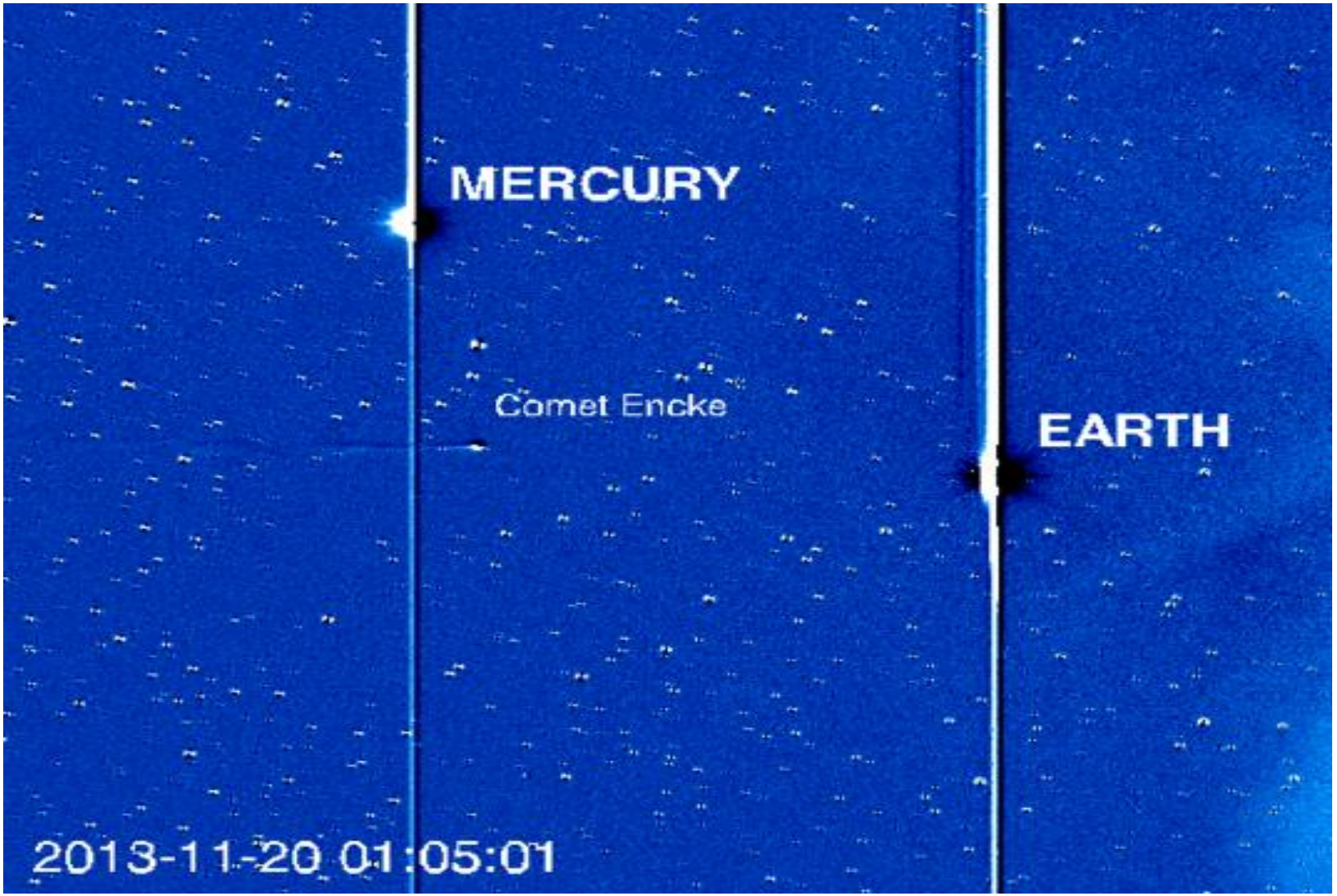



New York City, NY
Sun Nov 17, 2013 05:25:39 AM
SE 113.2° Alt 22.6°
79.8° x 48.1°
Possible Appearance of
Comet ISON &
Comet 2P Encke near Mercury.
17th Nov. 2013
05:25h
ρ Boo
Izar
Muphrid
Arcturus
Vindemiatrix
Zavijava
Auva
Porrima
v Hya
δ Crt
Heze
Gienah Corvi
Algorab
Minkar
Spica
Kraz
ξ Hya
Dave Eagle.
Eagleseye Observatory.
www.eagleseye.me.uk
Comet 2P Encke
Mercury
Cauda Hydrae

STEREO

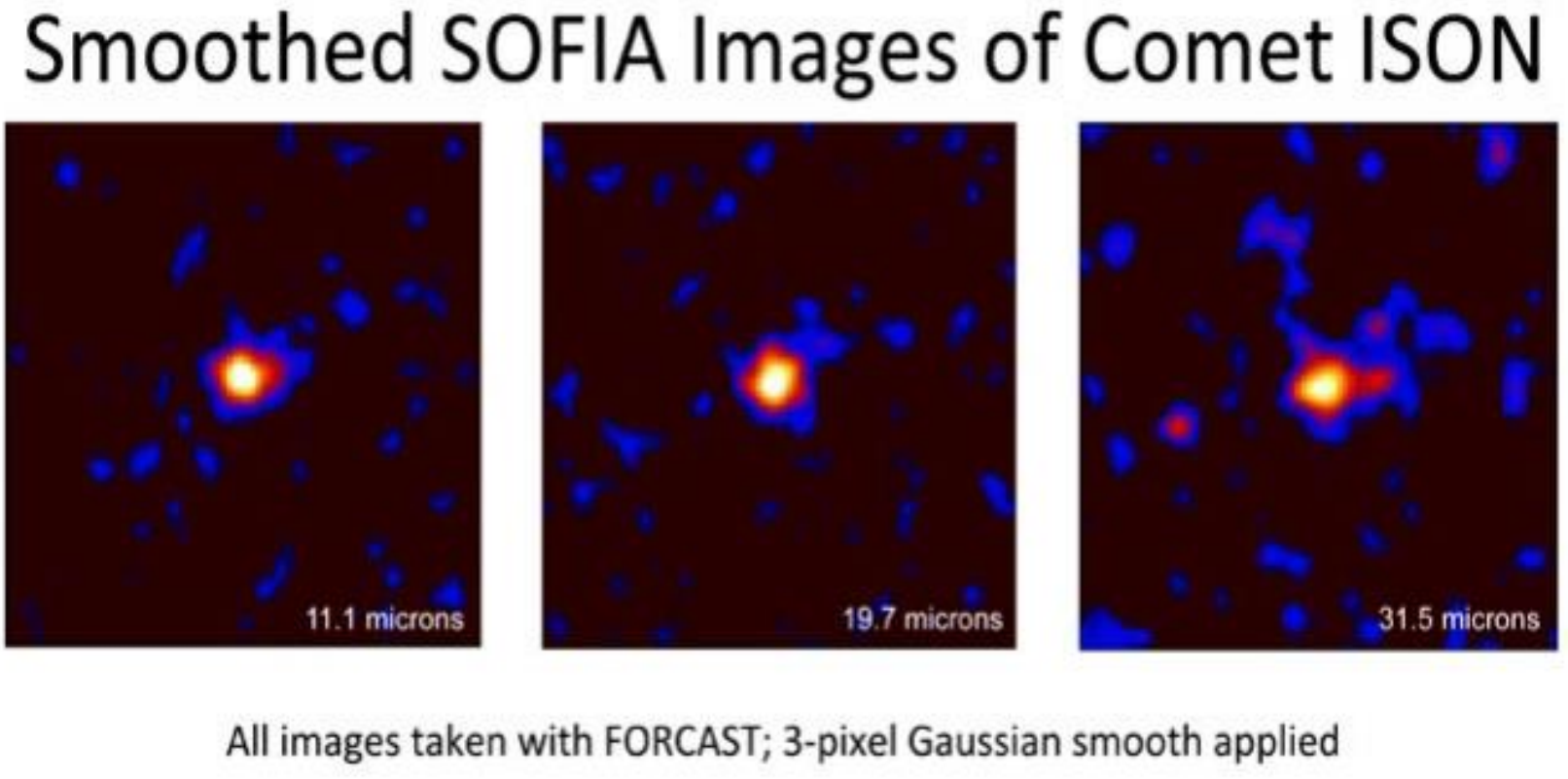


STEREO

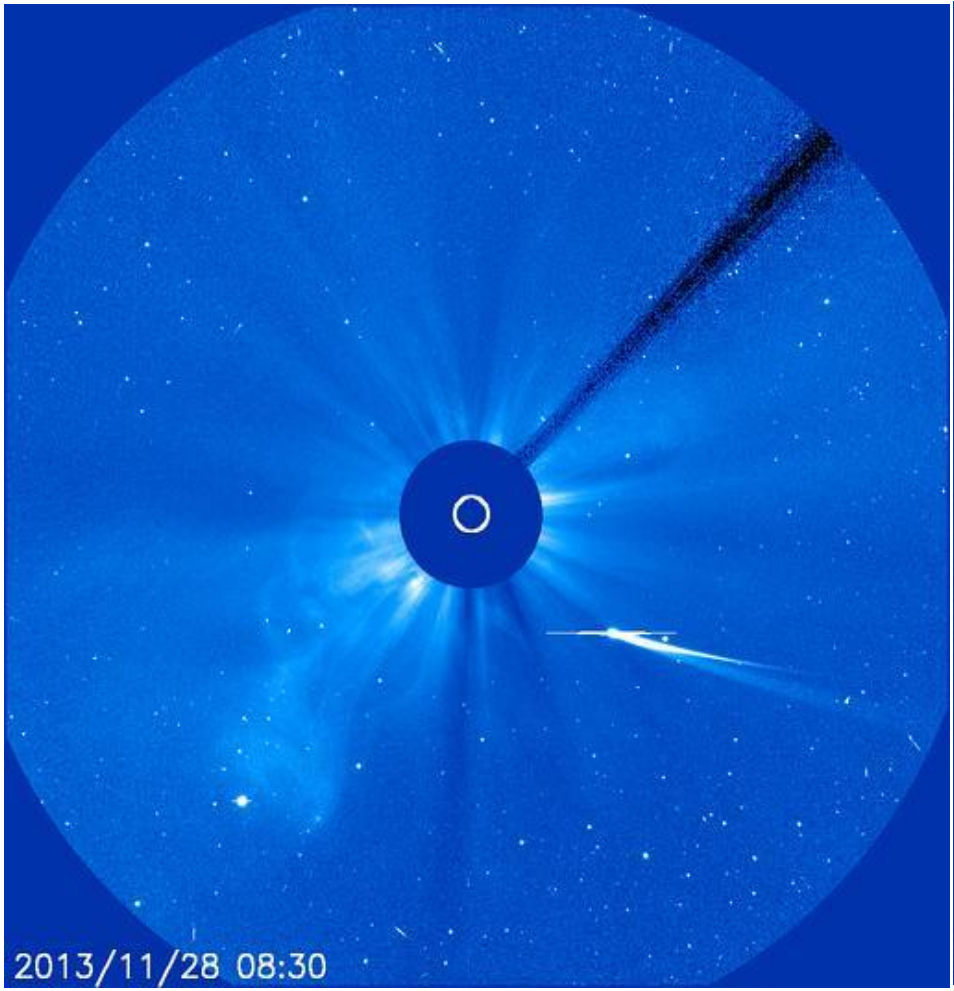


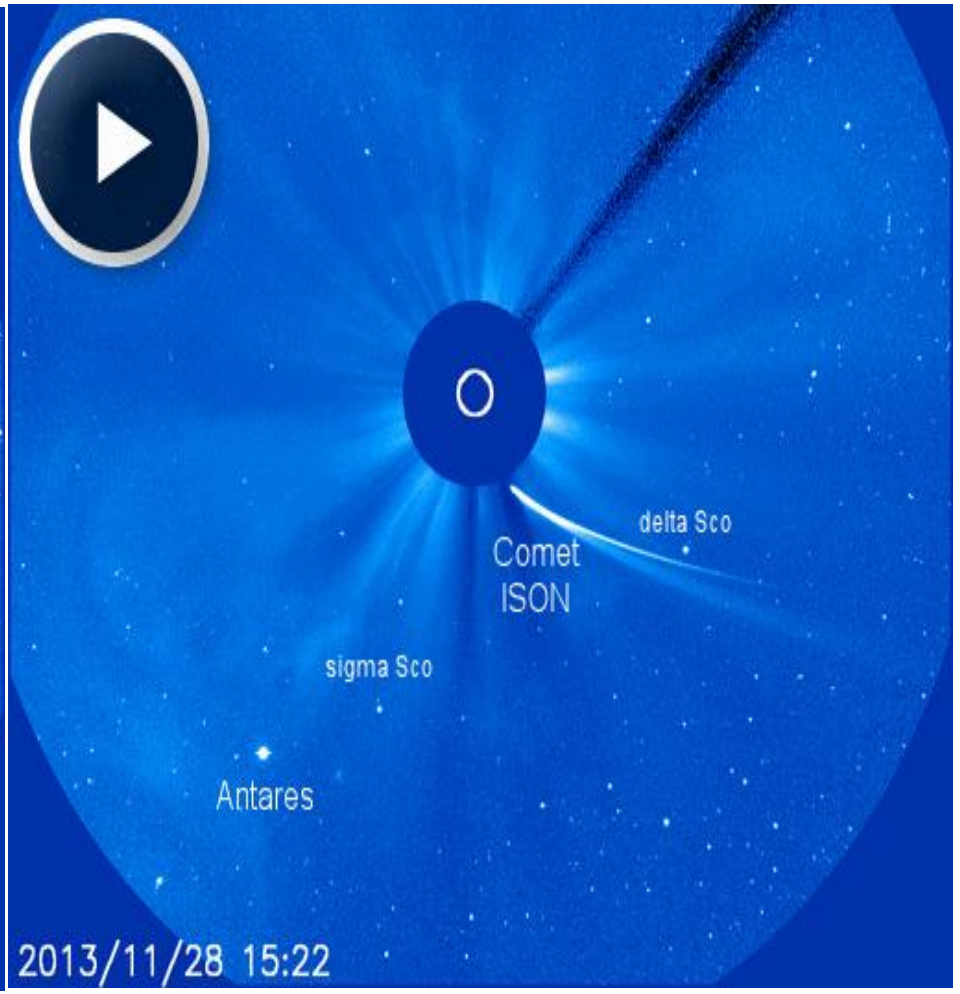
ISON: ΟΥΡΑ 8 ΕΚΑΤ. ΧΛΜ, 21 ΦΟΡΕΣ ΤΗΝ ΑΠΟΣΤΑΣΗ ΓΗ-ΣΕΛΗΝΗ

NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA)

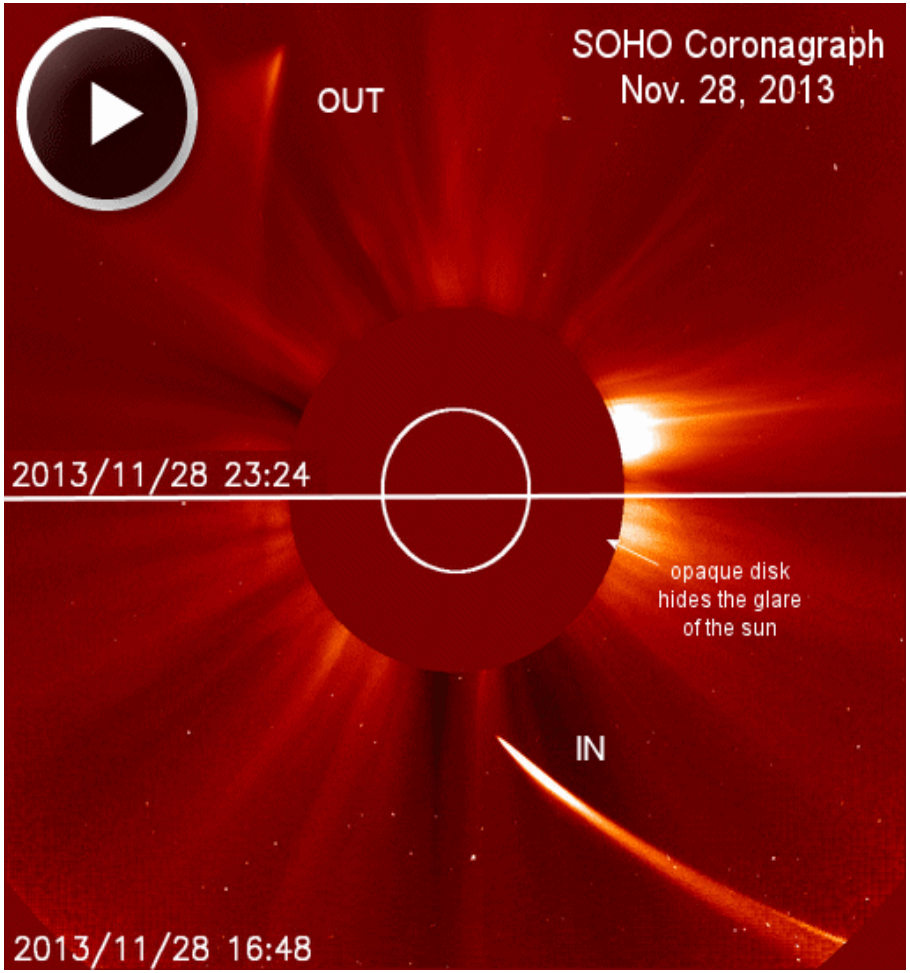


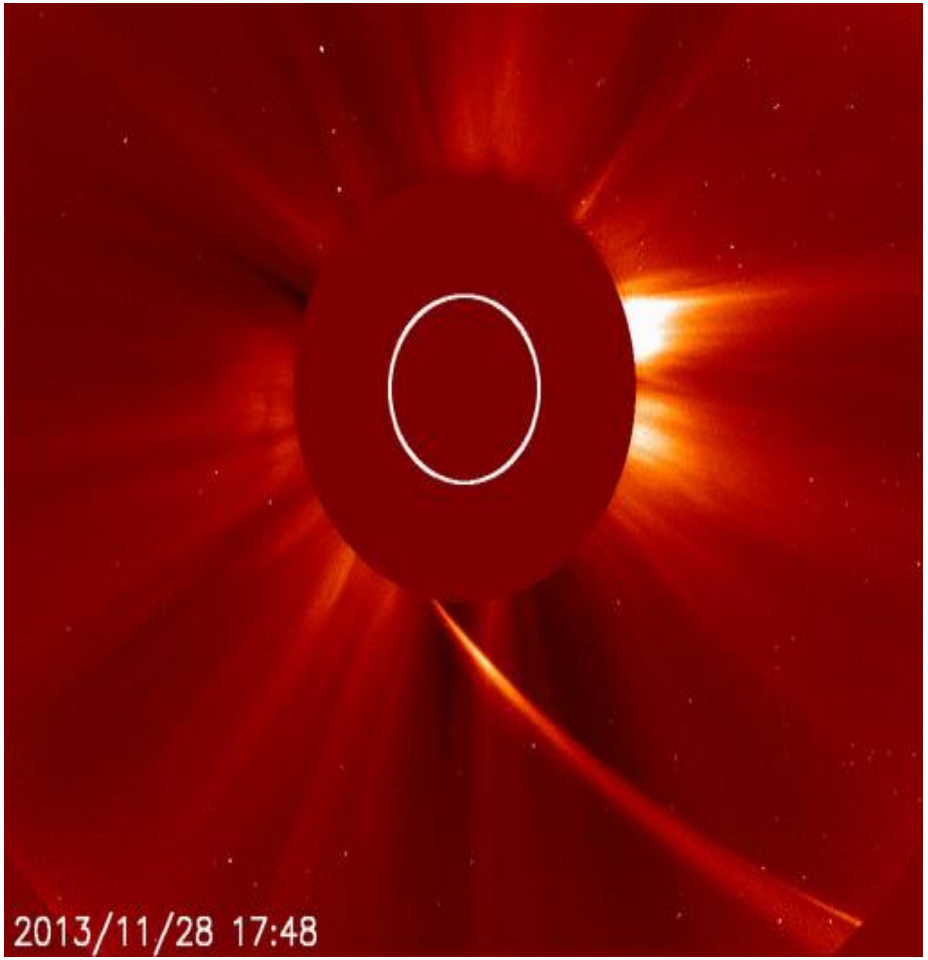
SOHO

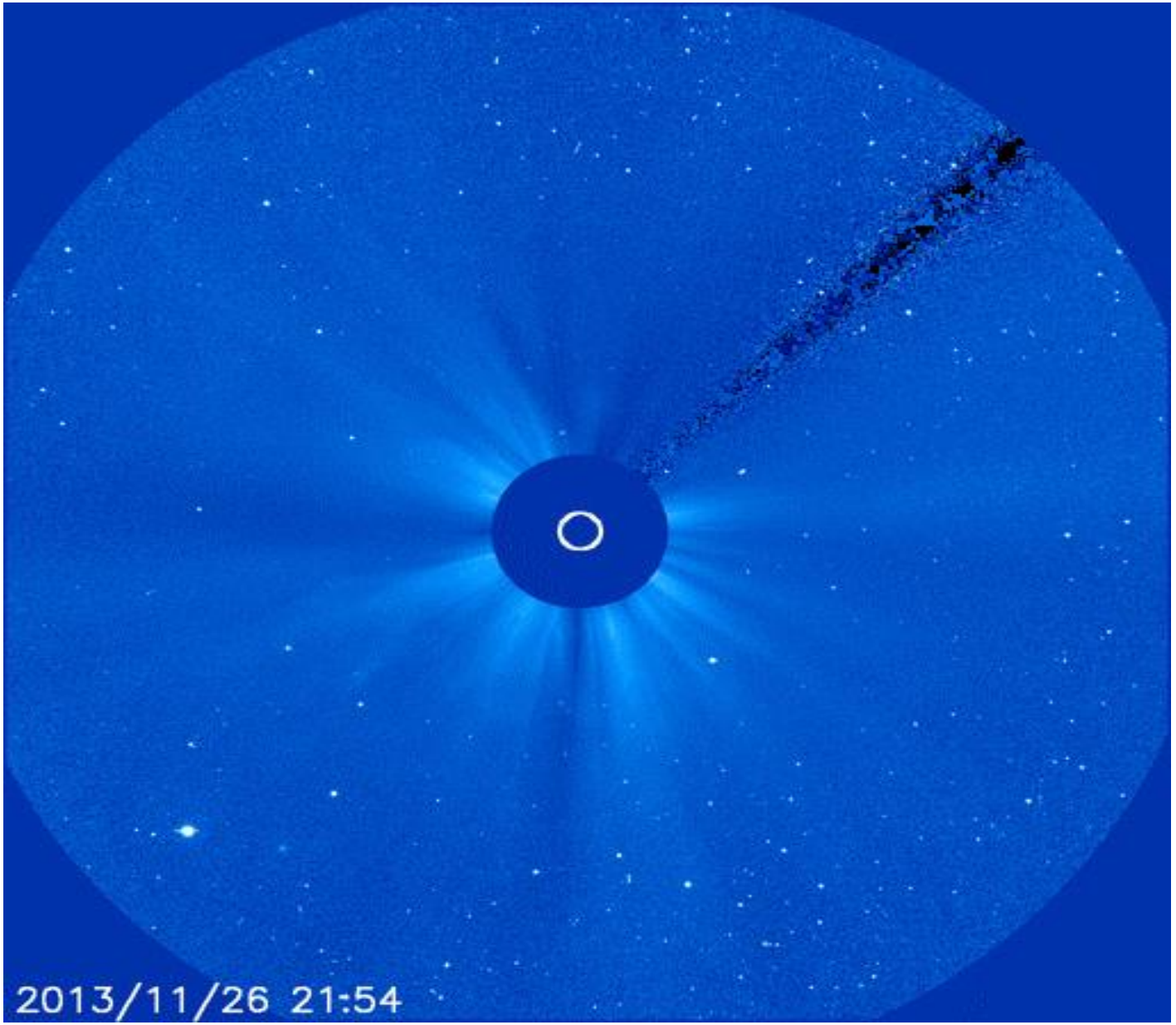

2013/11/28 08:30

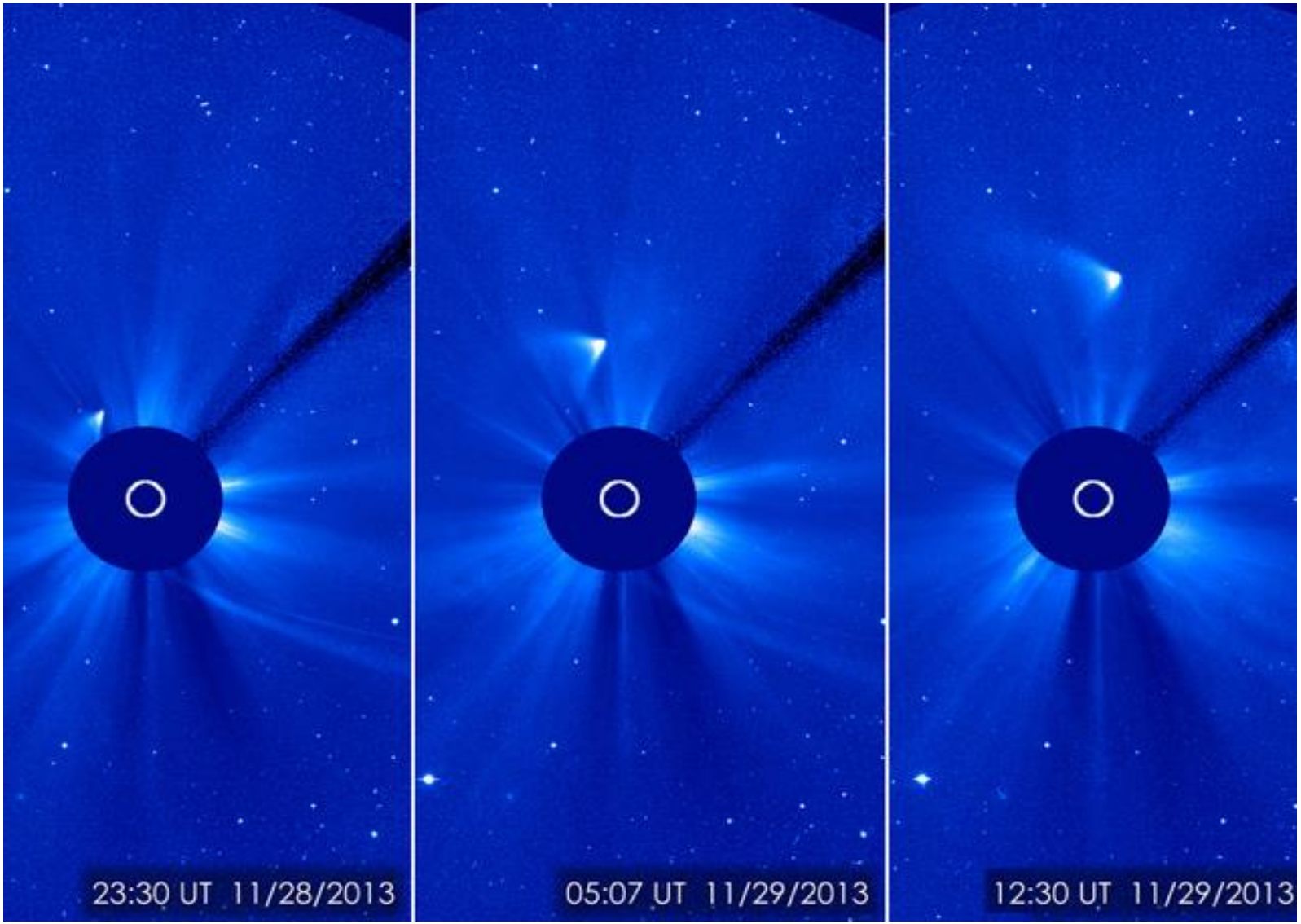

delta Sco
Comet
ISON
sigma Sco
Antares
2013/11/28 15:22

SOHO

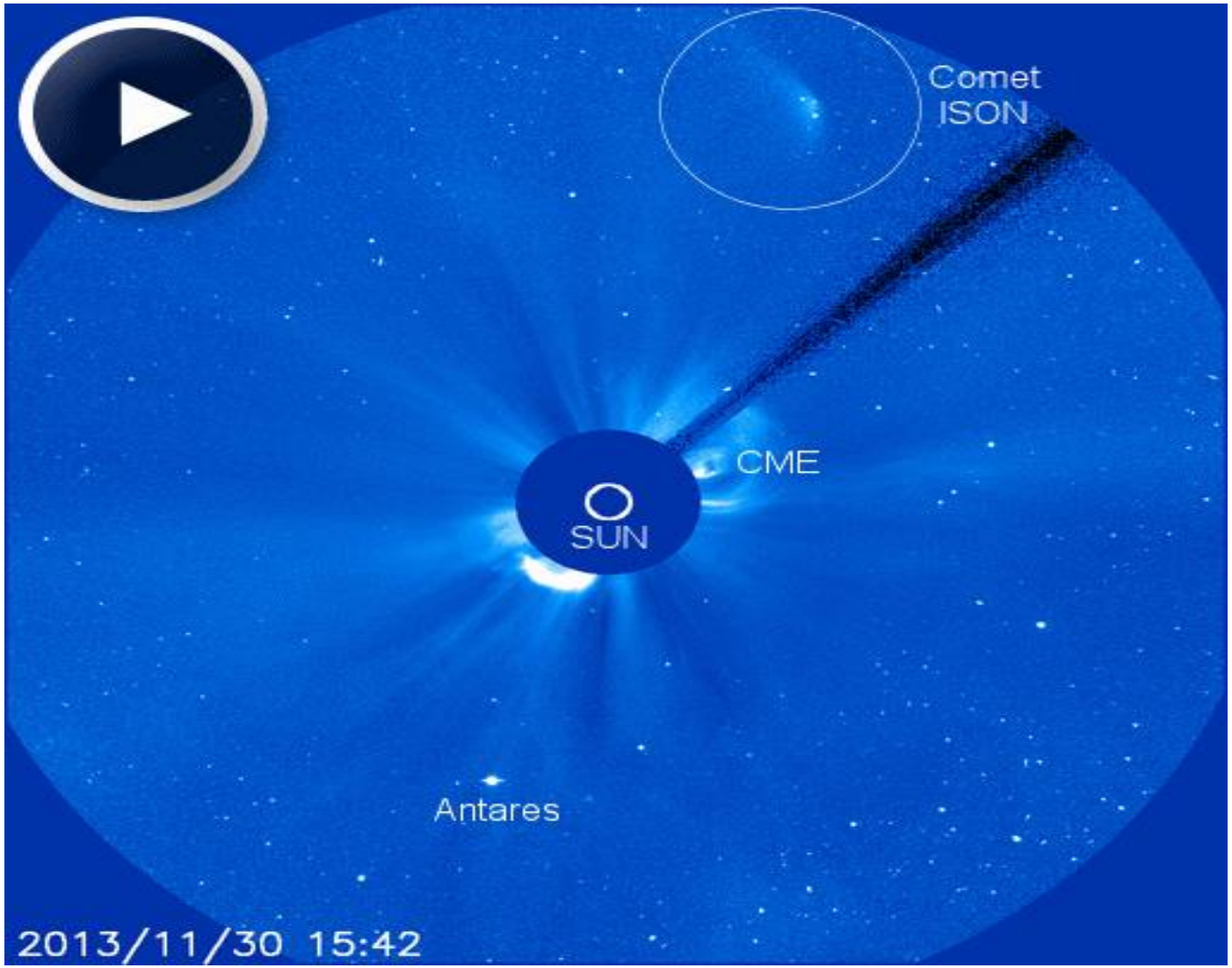

SOHO Coronagraph
Nov. 28, 2013
OUT
2013/11/28 23:24
opaque disk
hides the glare
of the sun
IN
2013/11/28 16:48

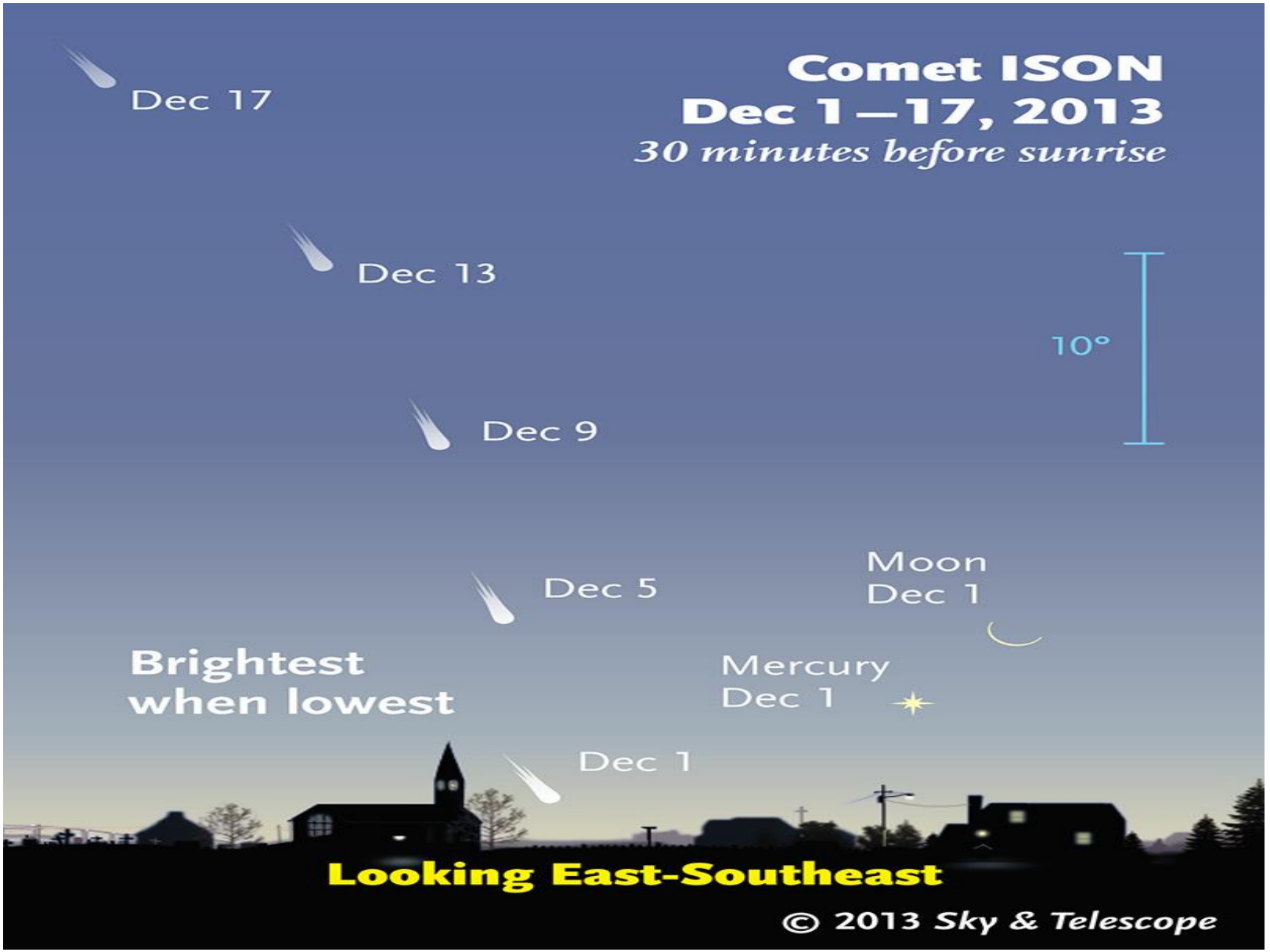

2013/11/28 17:48


2013/11/26 21:54

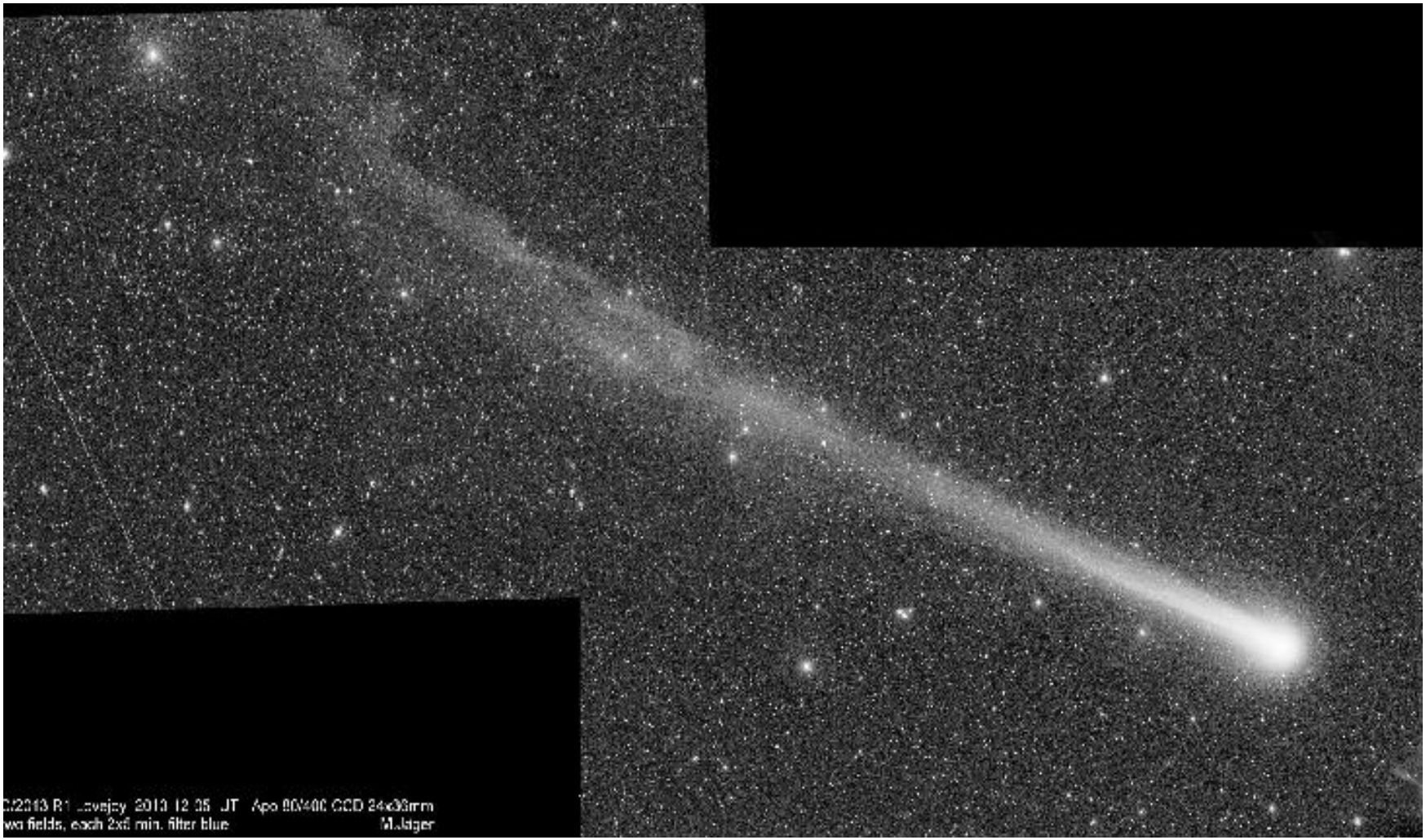

23:30 UT 11/28/2013
05:07 UT 11/29/2013
12:30 UT 11/29/2013

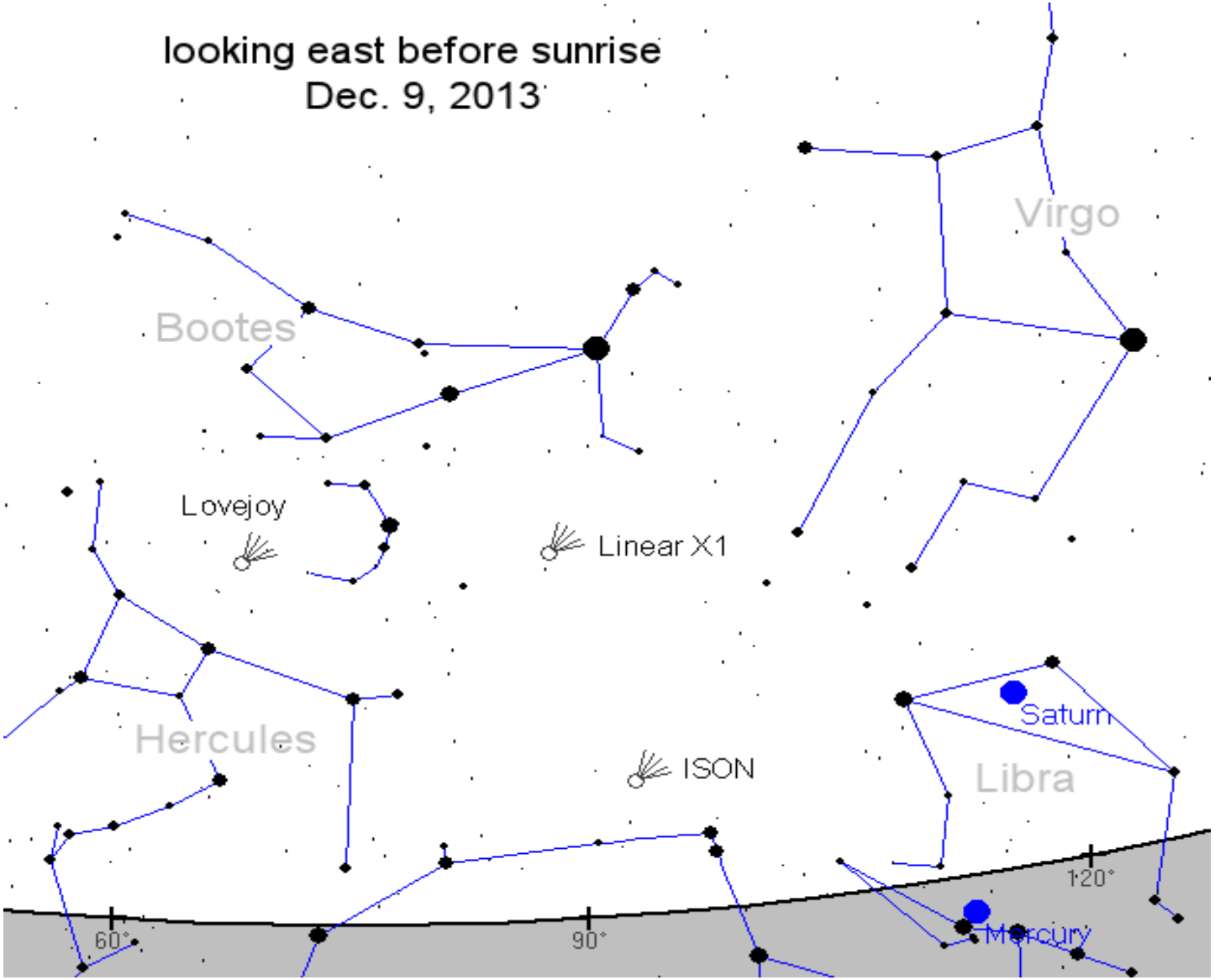
ΝΕΦΟΣ ΣΚΟΝΗΣ….




Comet ISON
Dec 1—17, 2013
30 minutes before sunrise
Dec 17
Dec 13
Dec 9
Dec 5
Dec 1
10°
Moon
Dec 1
Mercury
Dec 1
Brightest
when lowest
Looking East-Southeast
© 2013 Sky & Telescope

Comet Lovejoy
5-12-2013
Austria

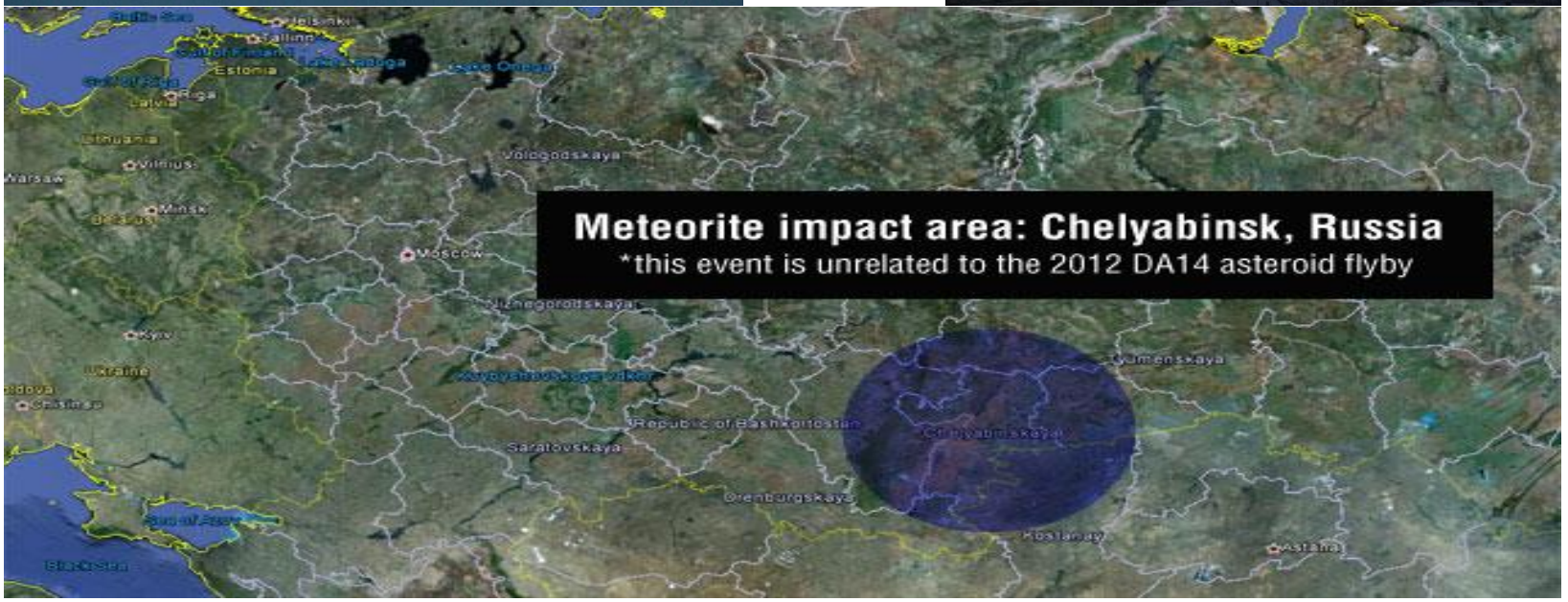



looking east before sunrise
Dec. 9, 2013
Virgo
Bootes
Lovejoy
Linear X1
Hercules
ISON
Saturn
Libra
120°
60°
90°
Mercury

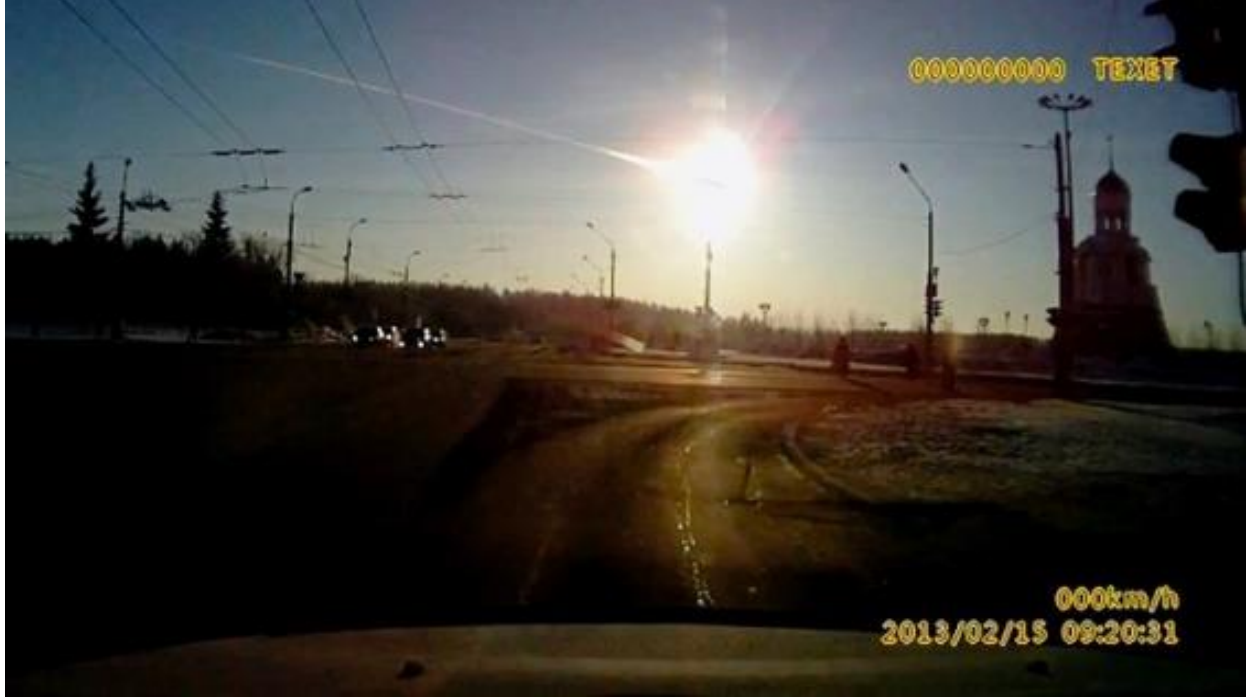
PANSTARRS MARCH 2013

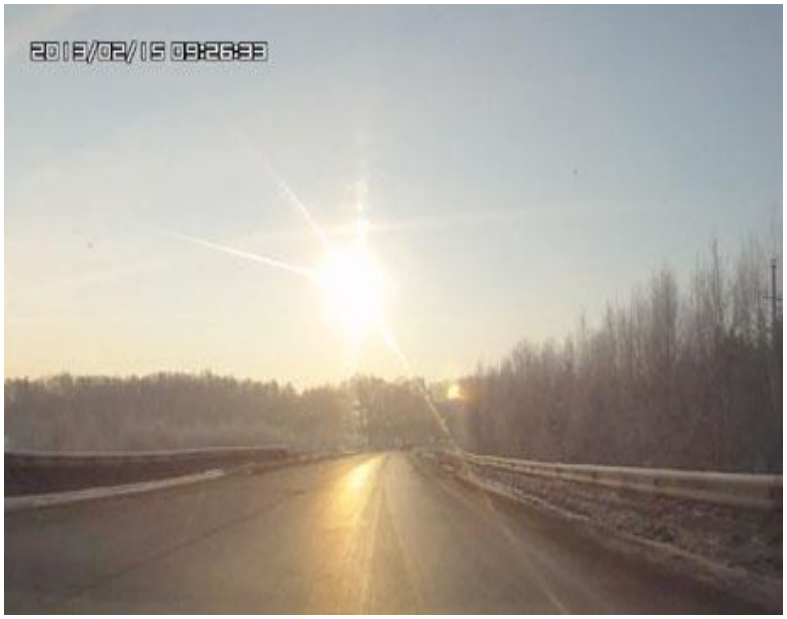
PANSTARRS
30-3-2013

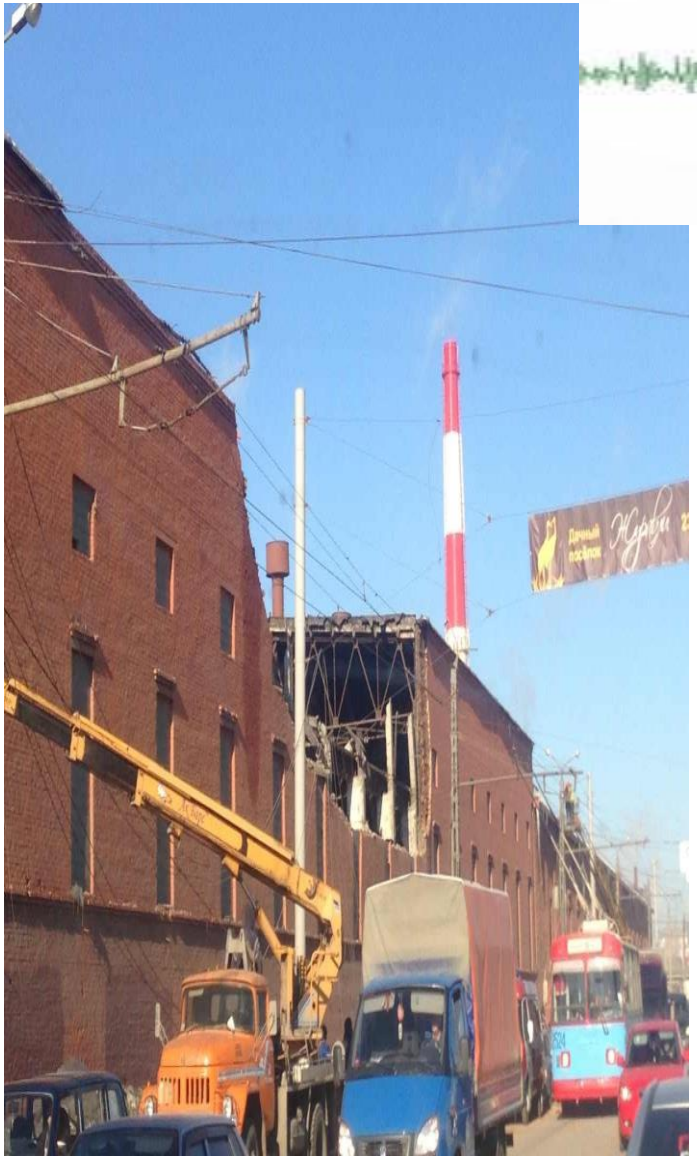
15 February 2013

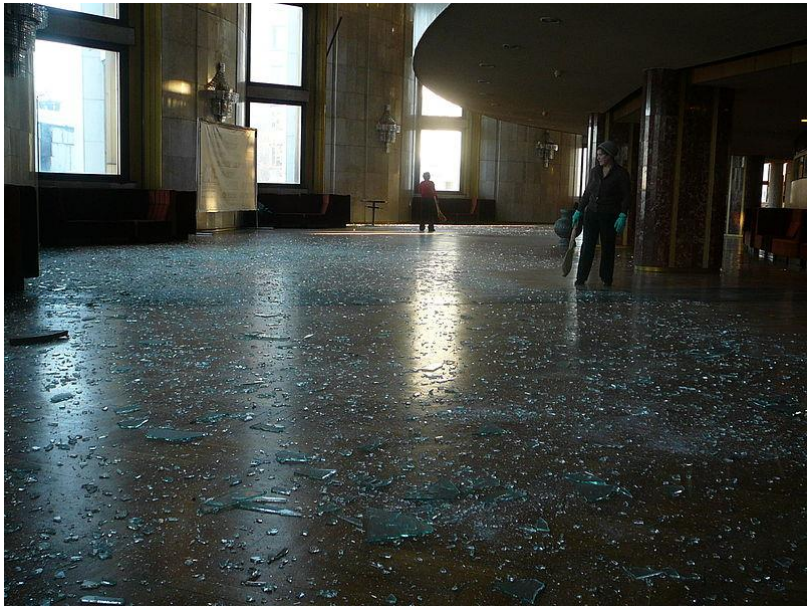


USA and RUSSIA

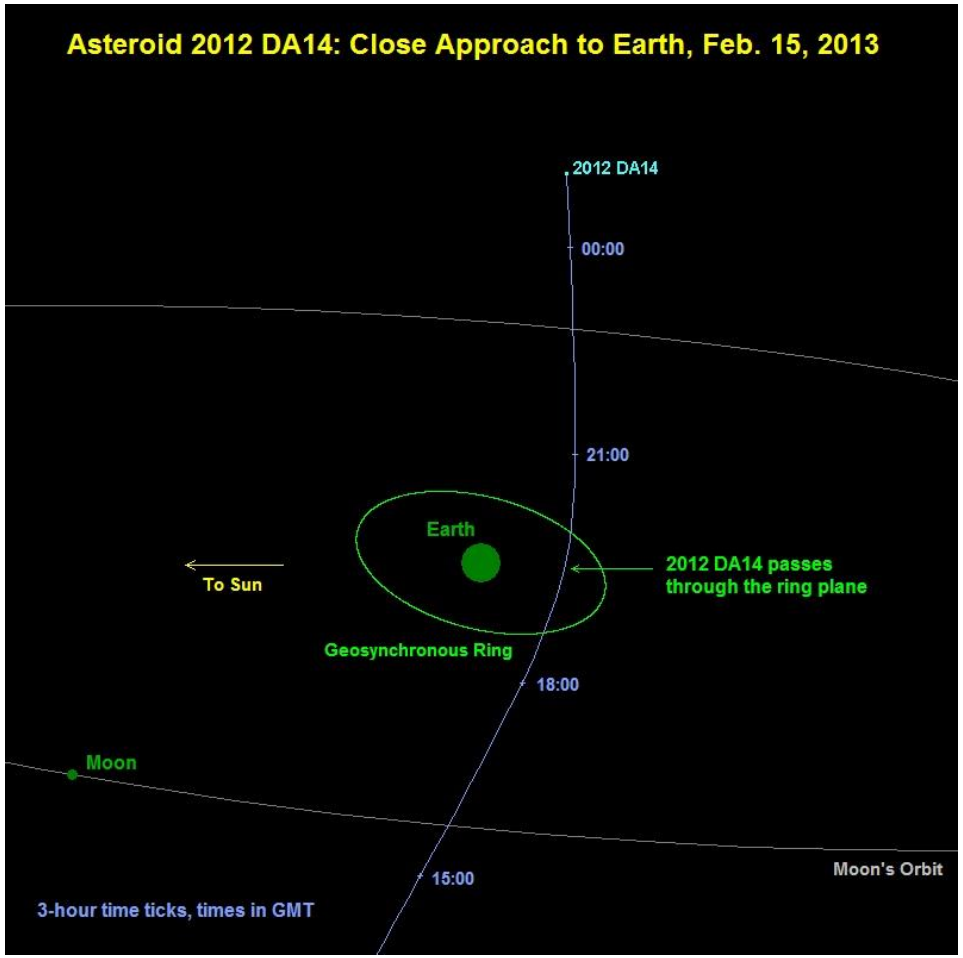

000000000 TEXET
000km/h
2013/02/15 09:20:31


2013/02/15 09:26:33

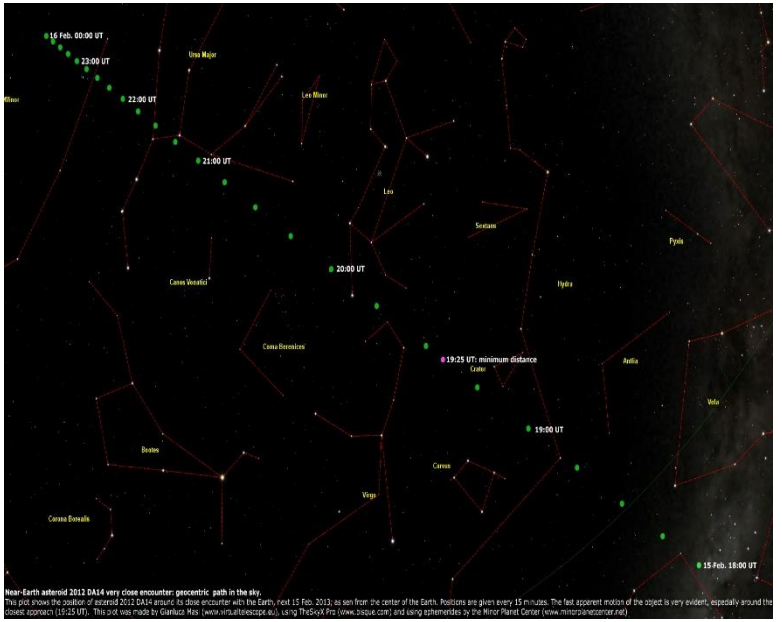


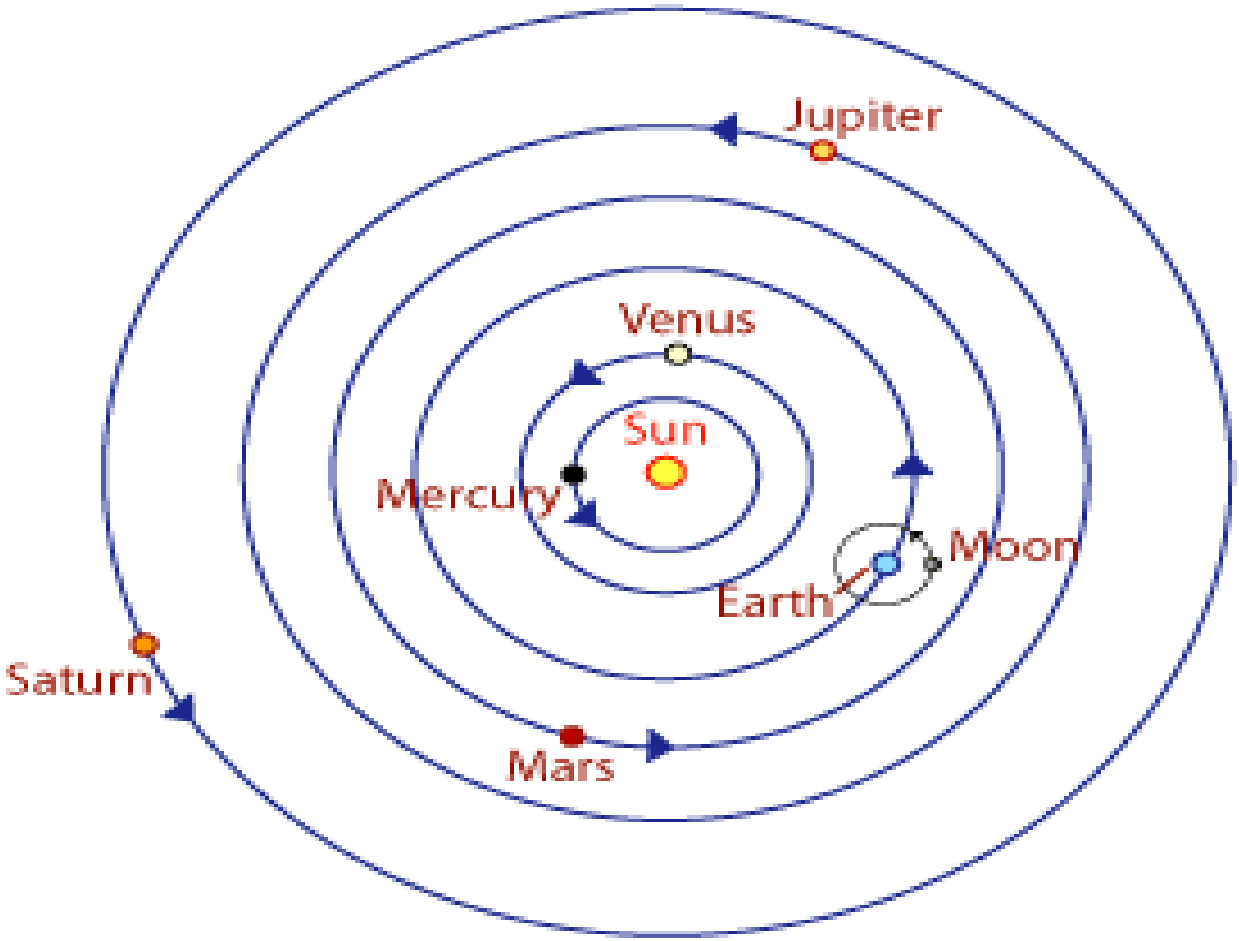


TONGUSKA 30-6-1908

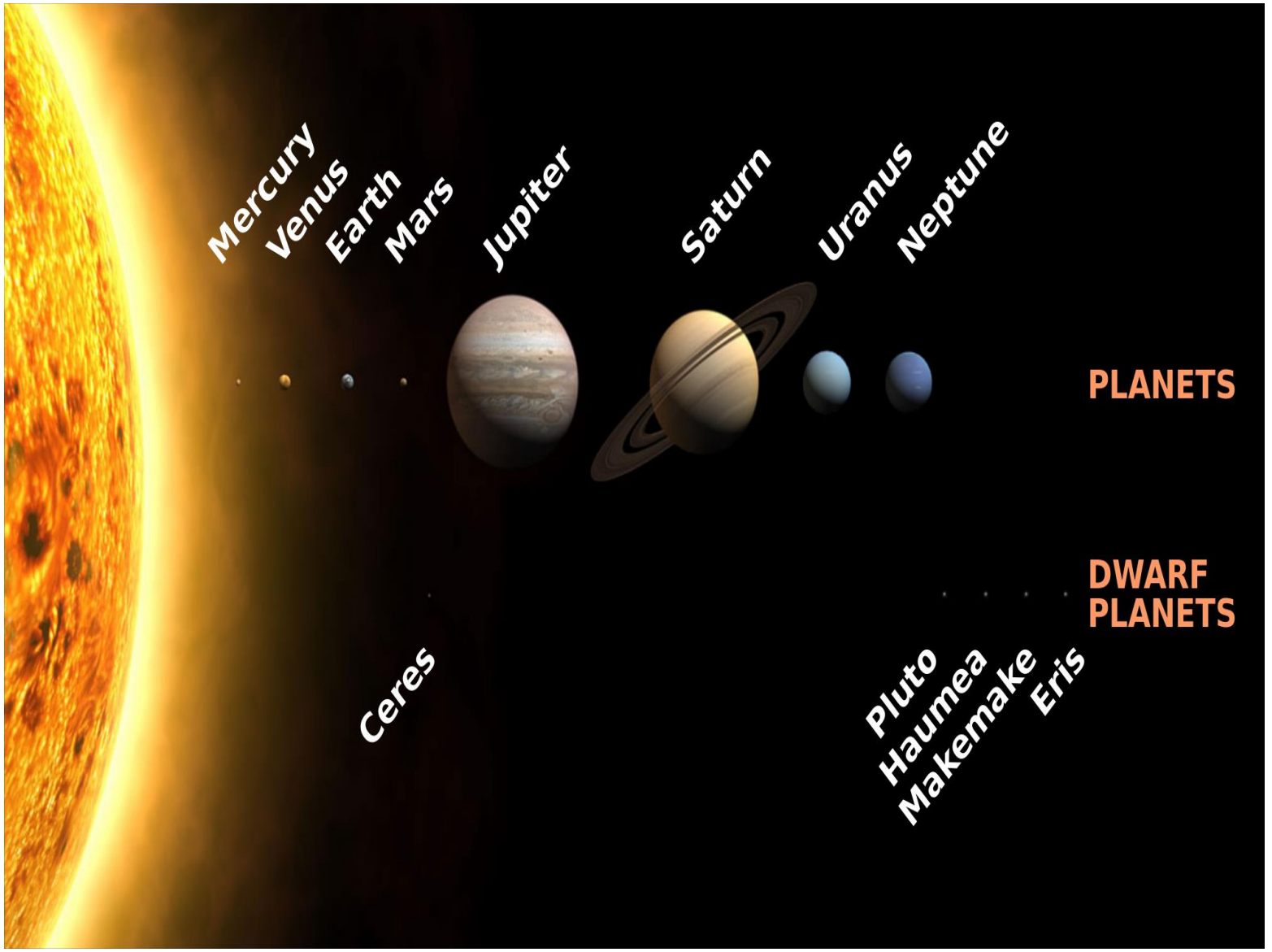

Asteroid 2012 DA14: Close Approach to Earth, Feb. 15, 2013
2012 DA14
00:00
21:00
Earth
To Sun
2012 DA14 passes
through the ring plane
Geosynchronous Ring
18:00
Moon
15:00
Moon's Orbit
3-hour time ticks, times in GMT

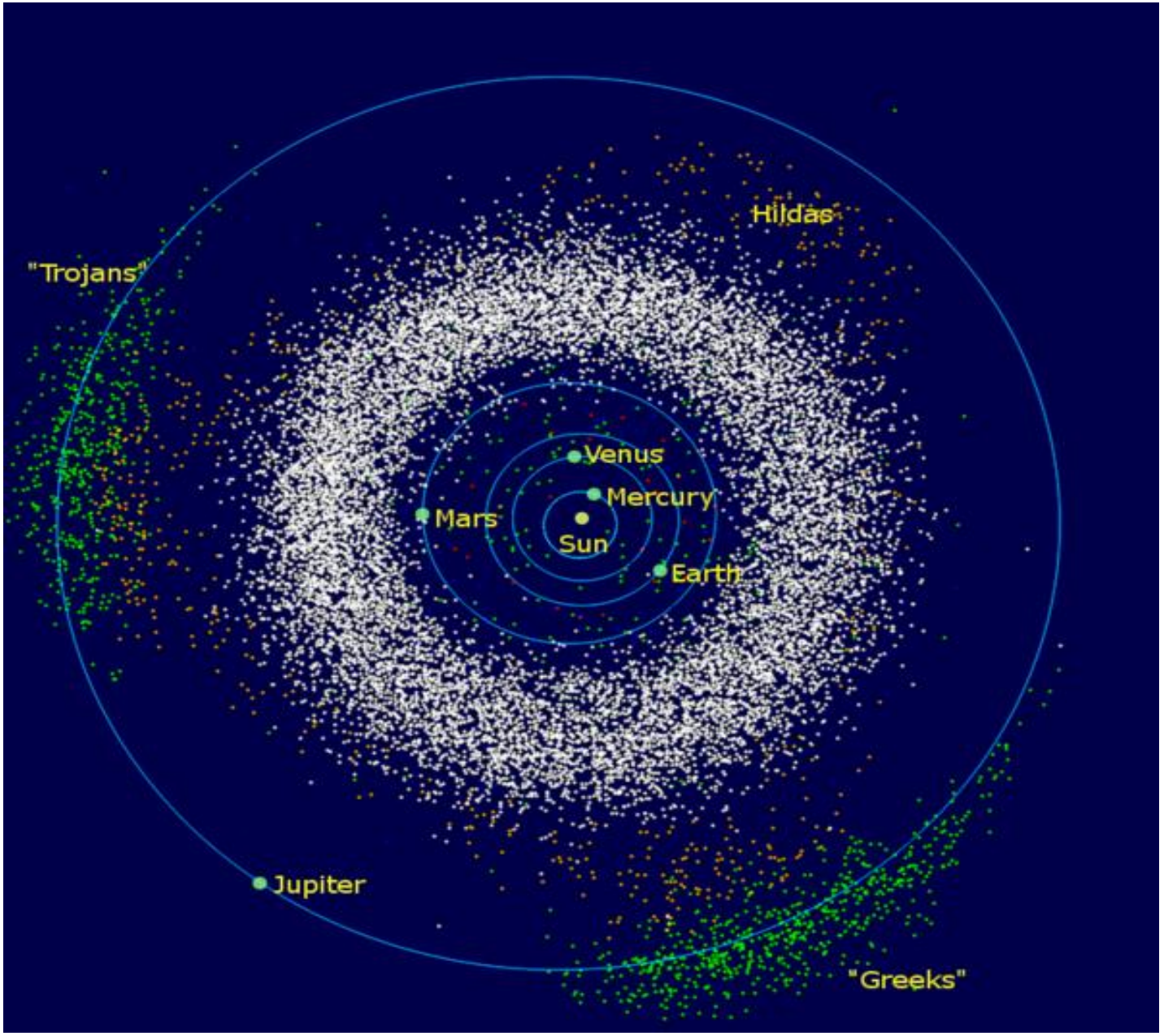

Asteroid 2012 DA14
December 11th, 2012
Credit: Remanzacco Observatory

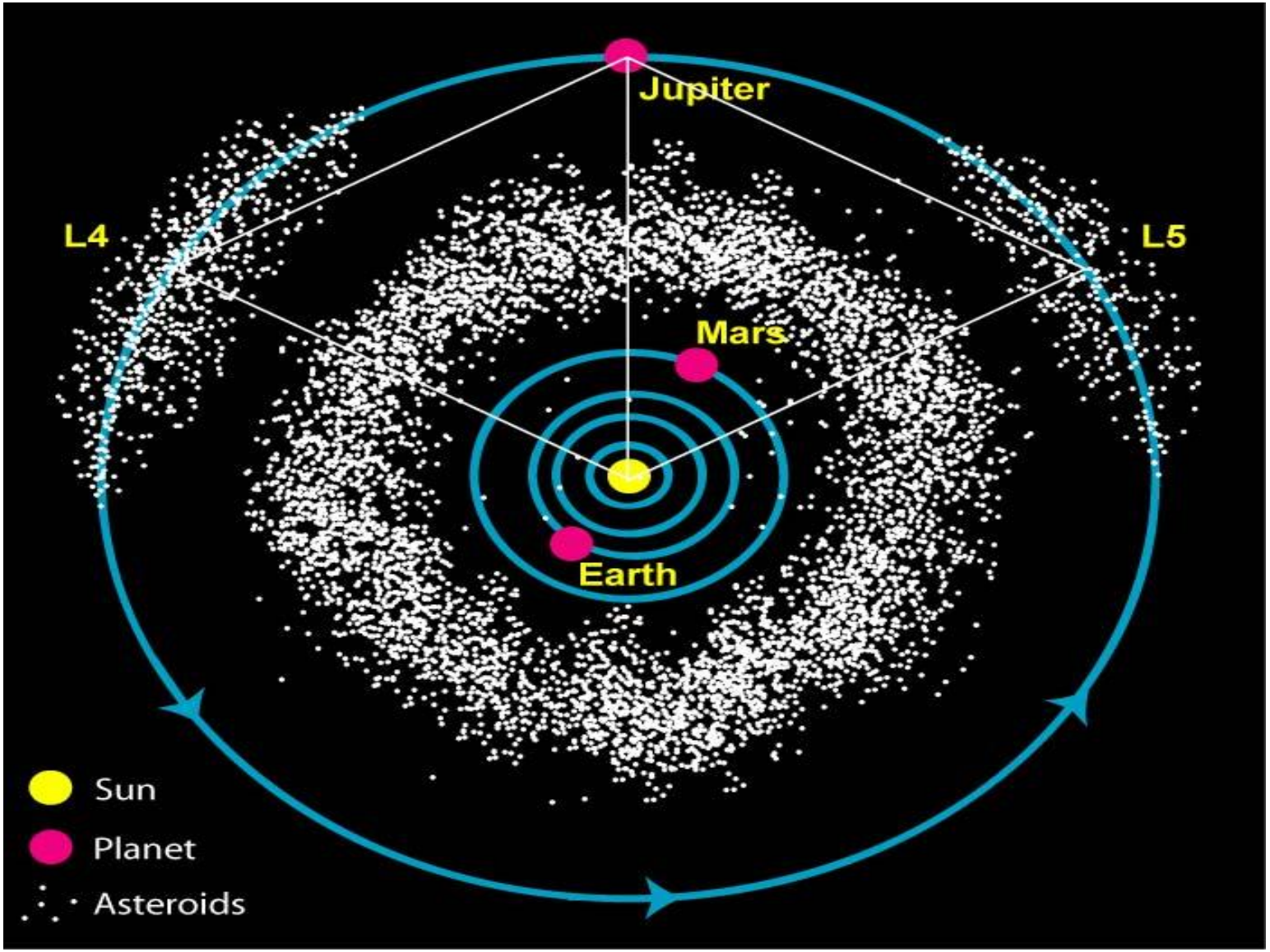

16 Feb. 00:00 UT
23:00 UT
22:00 UT
21:00 UT
20:00 UT
19:25 UT: minimum distance
19:00 UT
15 Feb. 18:00 UT
Ursa Major
Leo Minor
Leo
Sextans
Pyxis
Hydra
Crater
Corvus
Virgo
Vela
Antlia
Boötes
Corona Borealis
Near-Earth asteroid 2012 DA14 very close encounter: geocentric path in the sky.

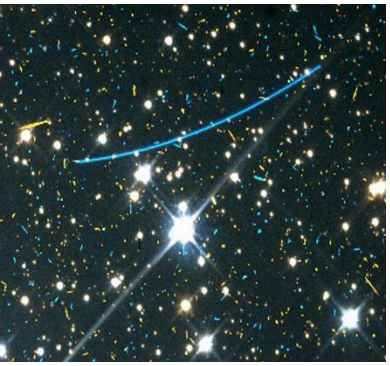


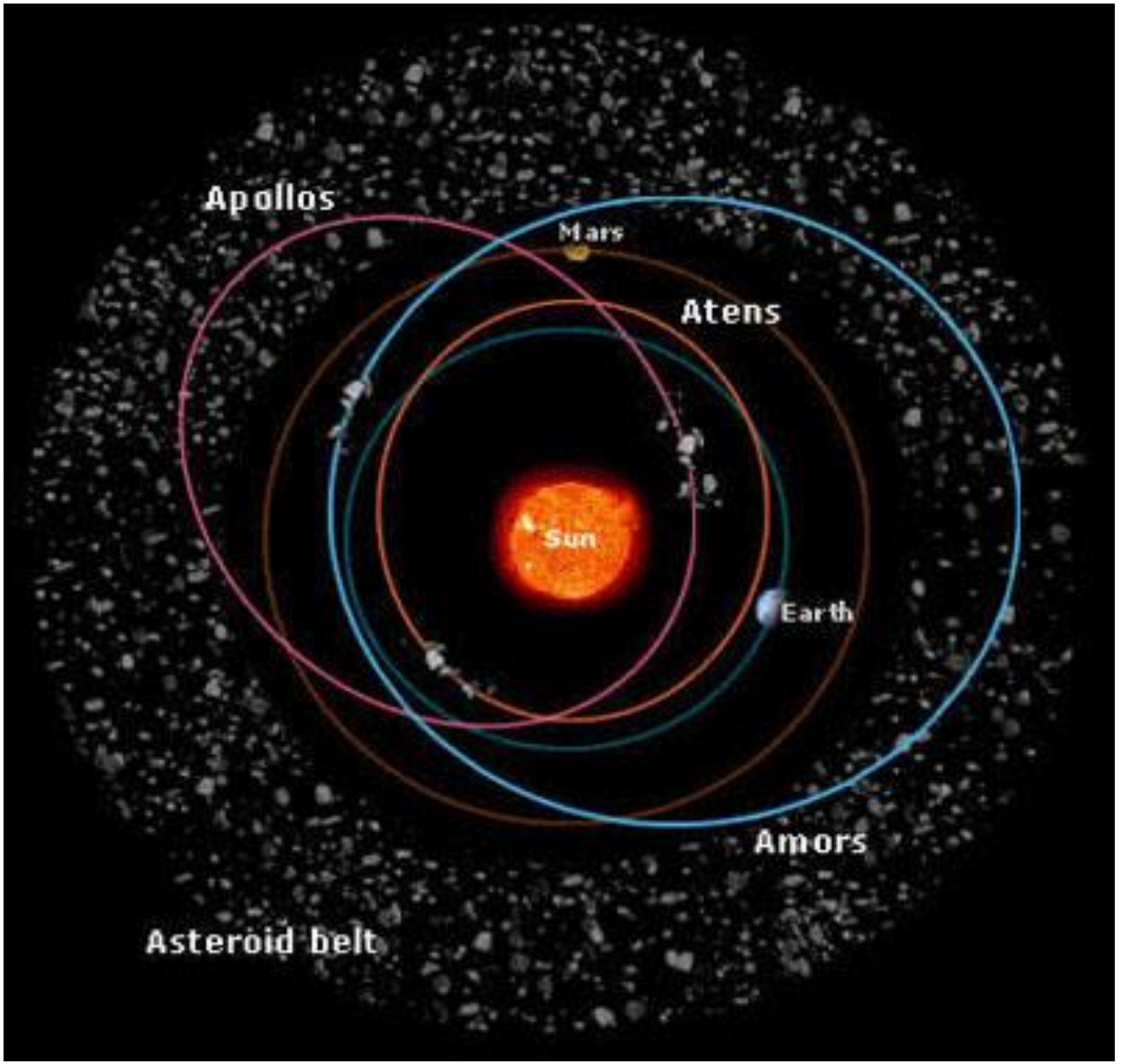
Aristarchus' Heliocentric Model
(Not to scale)


Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
PLANETS
DWARF PLANETS
Ceres
Pluto
Haumea
Makemake
Eris


Hildas
"Trojans"
Venus
Mercury
Mars
Sun
Earth
Jupiter
"Greeks"

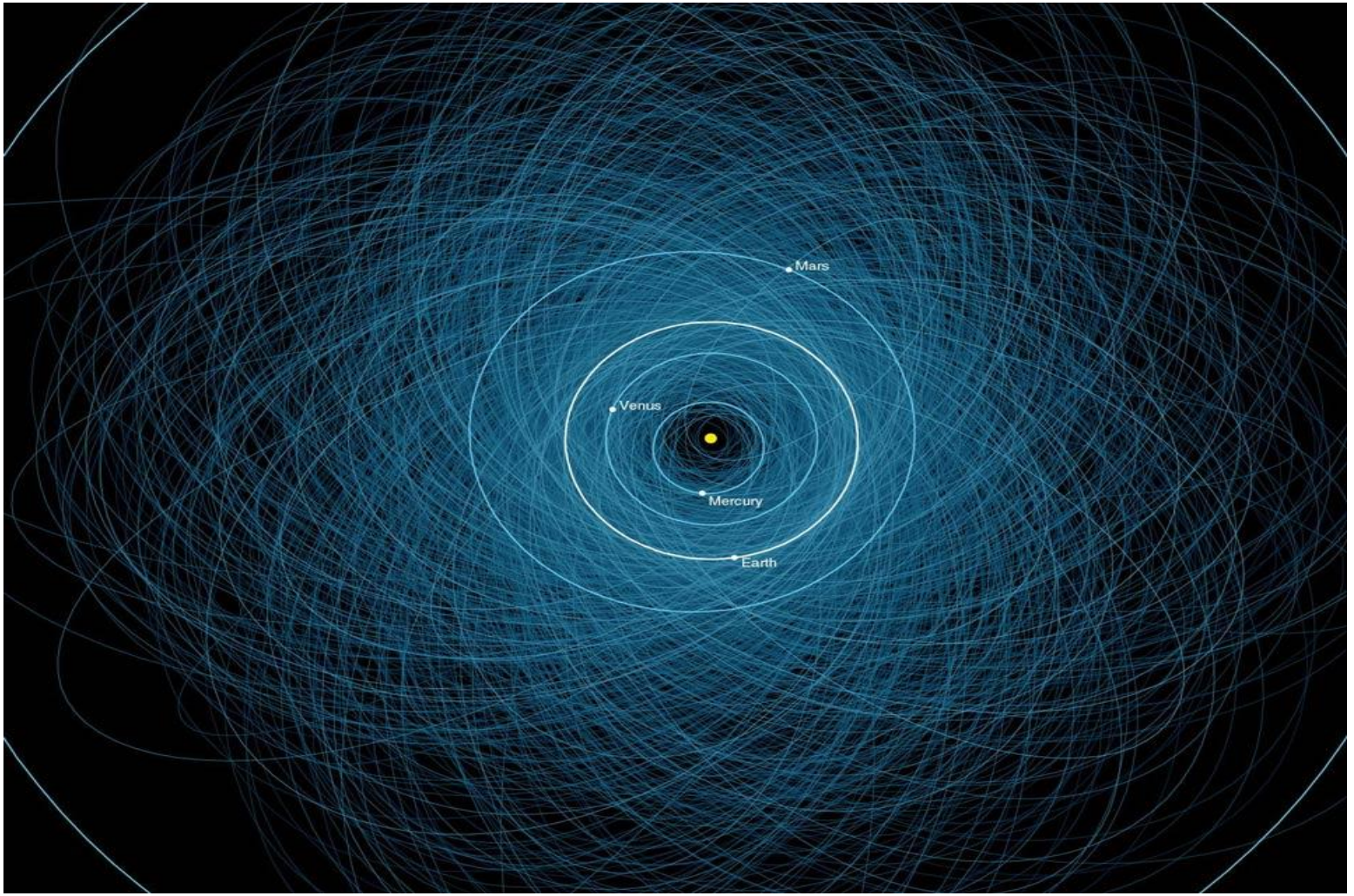

Jupiter
L4
L5
Mars
Earth
Sun
Planet
Asteroids

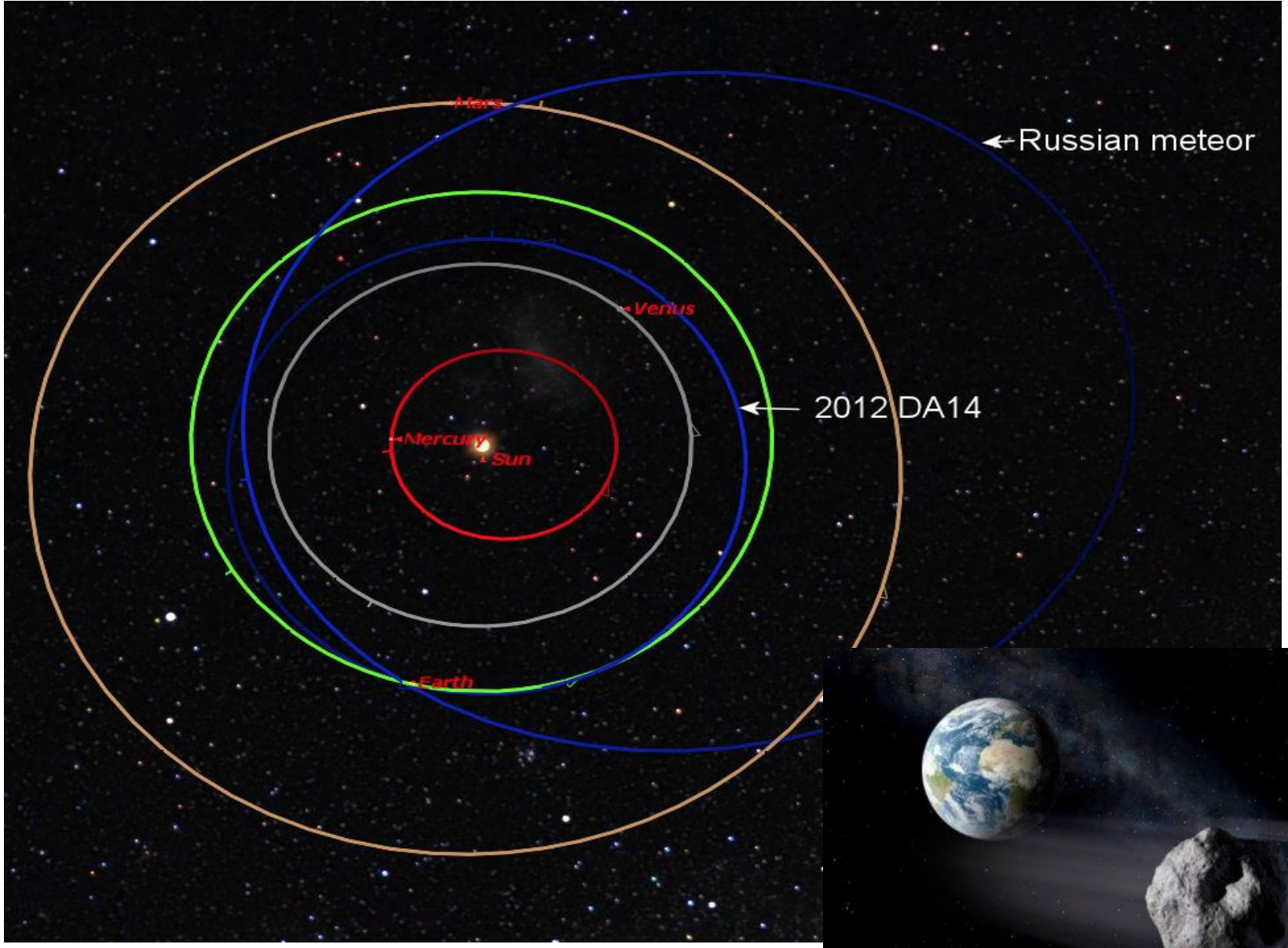


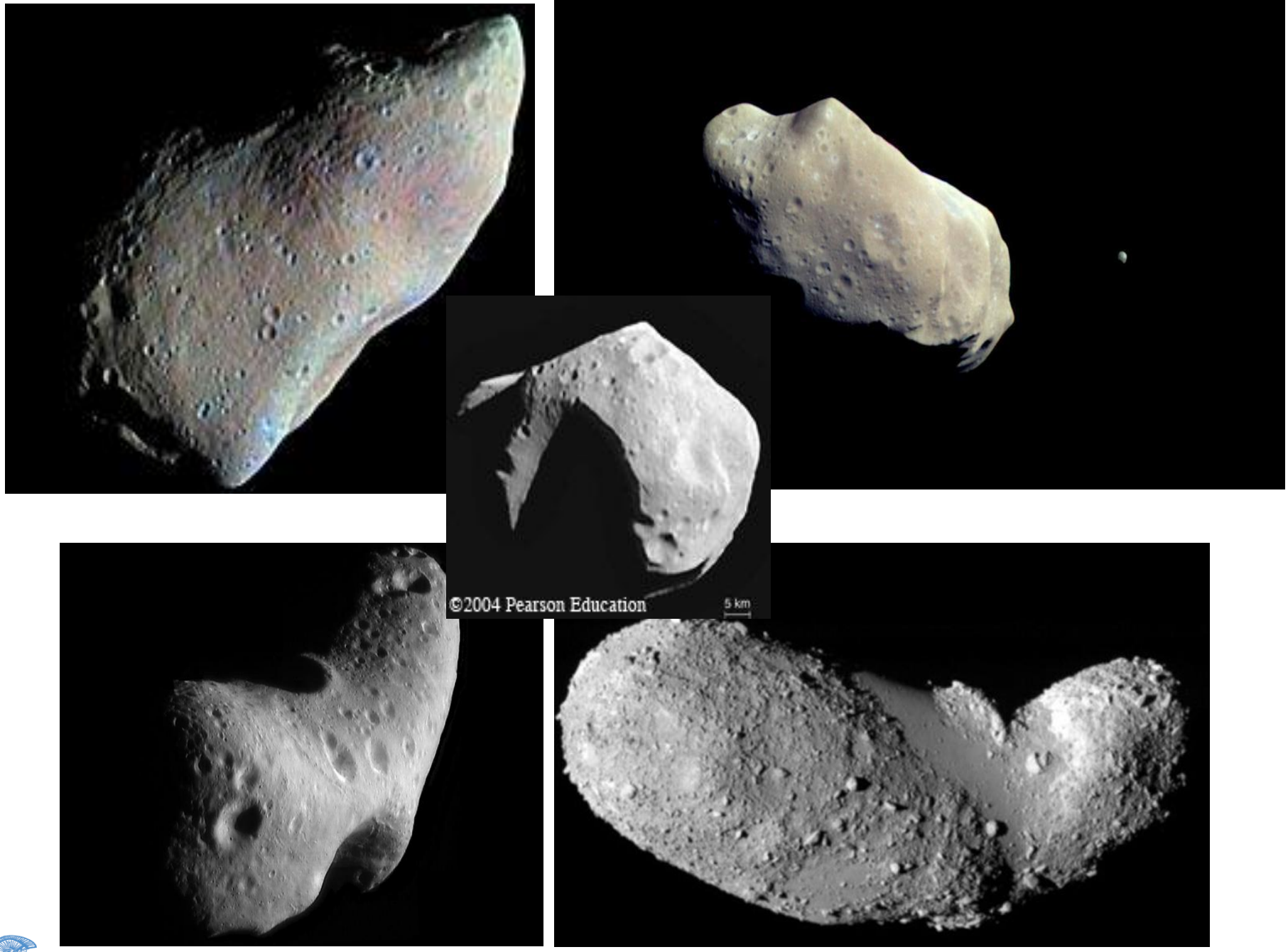

Apollos
Mars
Atens
Sun
Earth
Amors
Asteroid belt

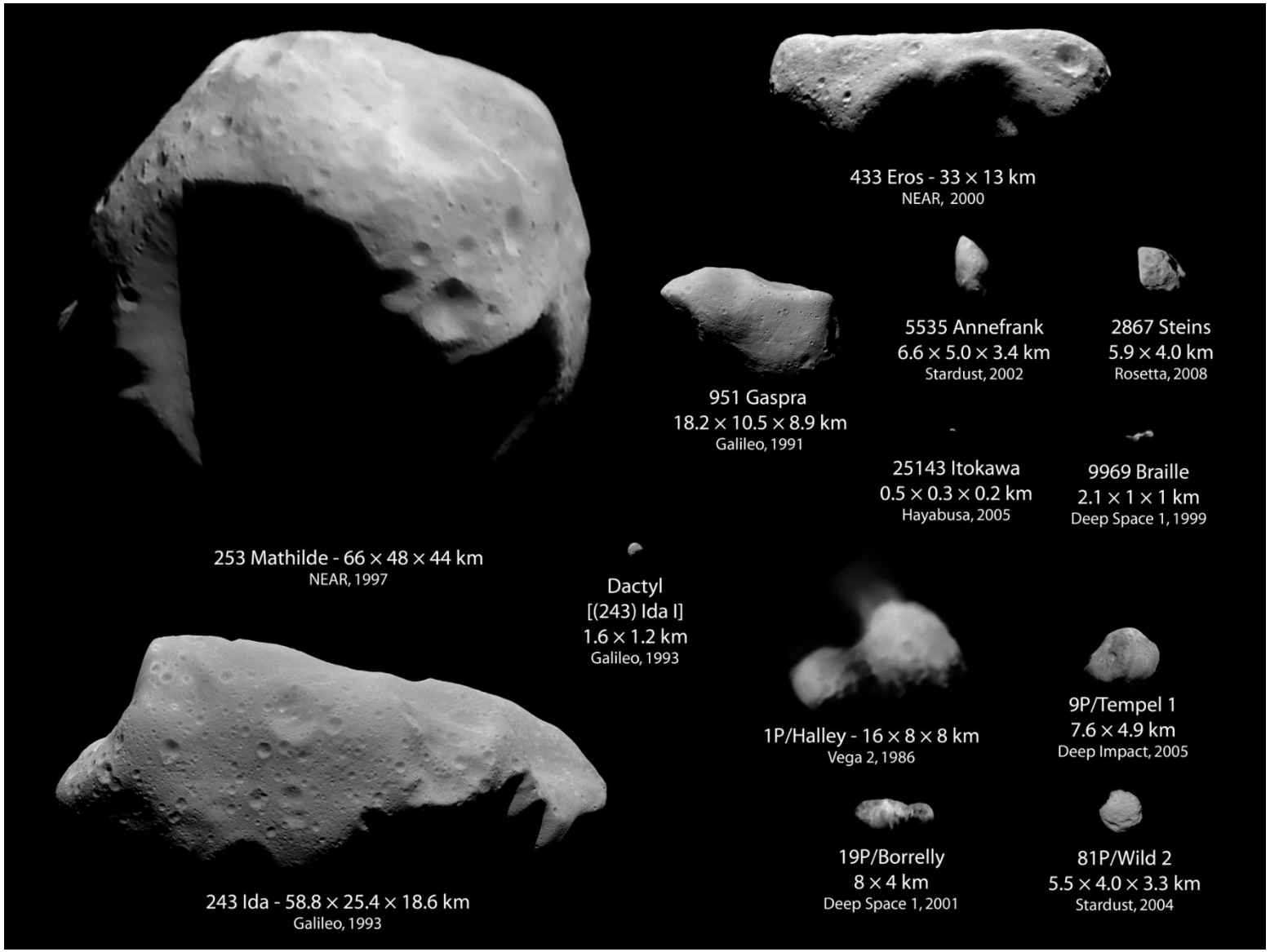
DIAMETER OVER 140 m,

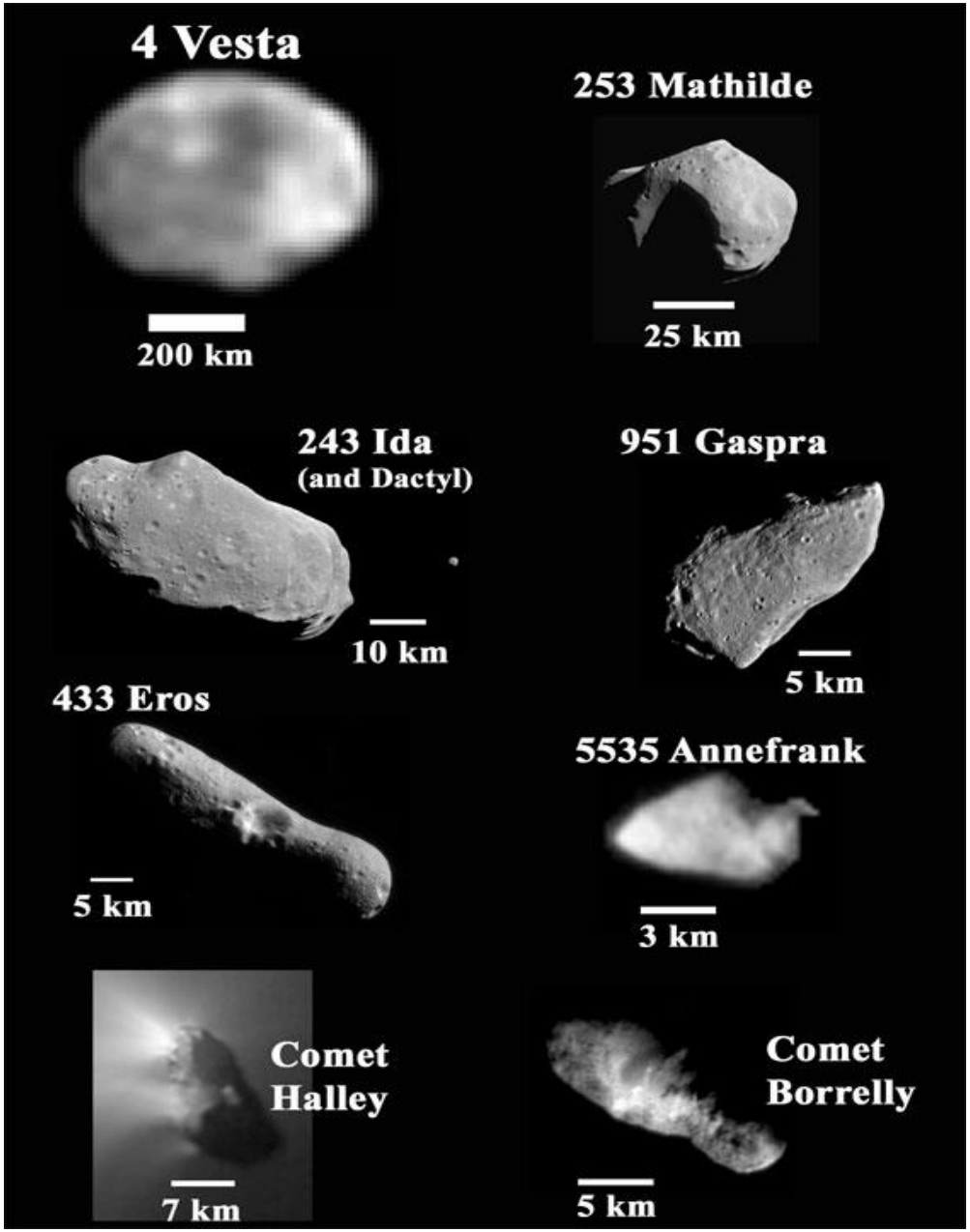
DISTANCE FROM EARTH 7.5 10^6 km (*20 EARTH-MOON distance*)



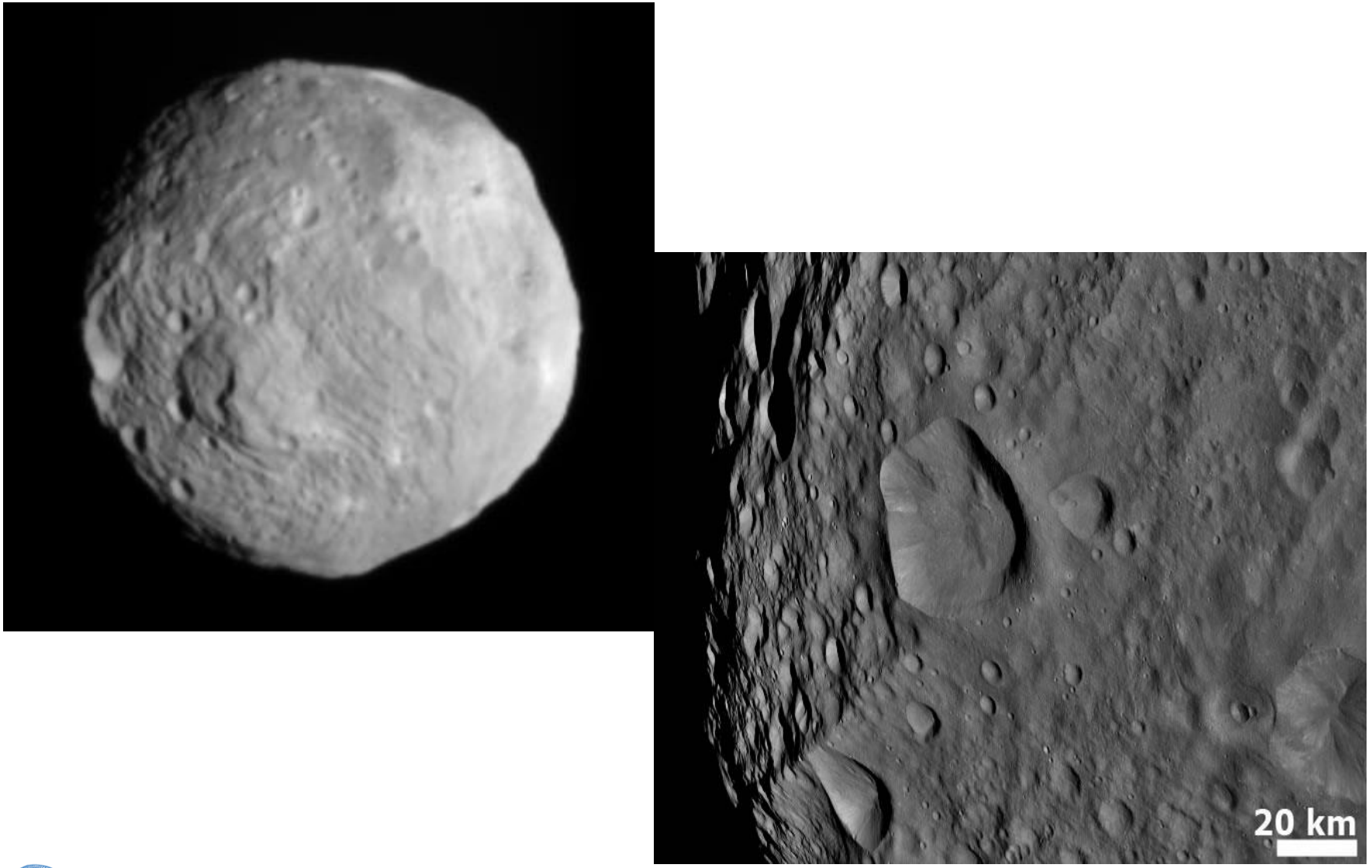

Mars
Russian meteor
Venus
2012 DA14
Mercury
Sun
Earth

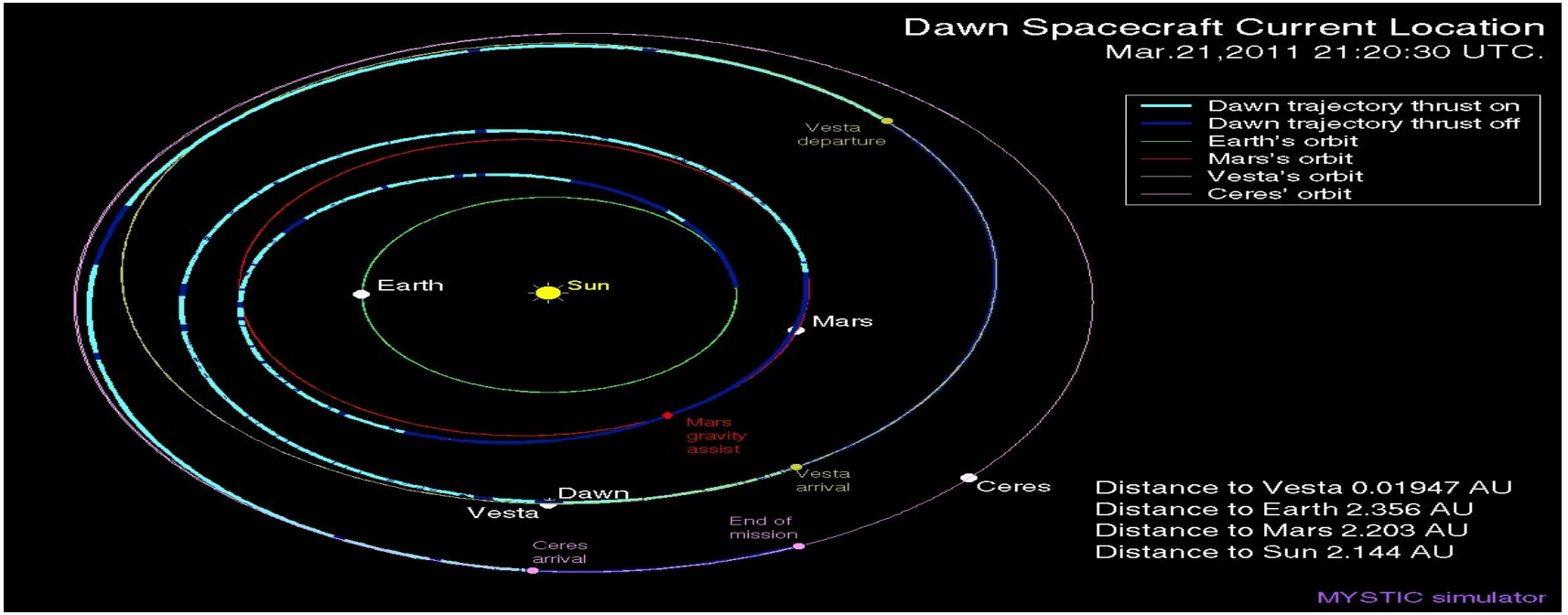

©2004 Pearson Education
5 km

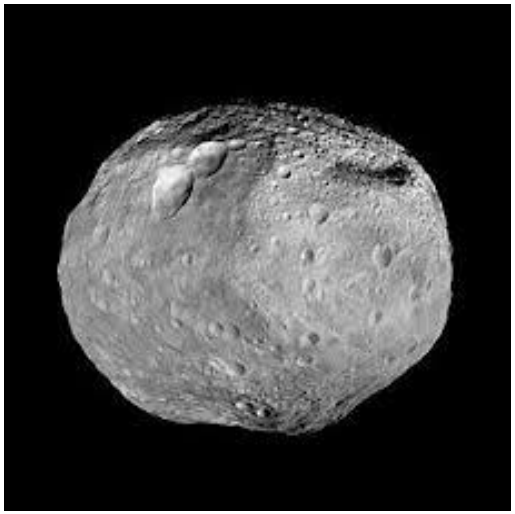

433 Eros - 33 × 13 km
NEAR, 2000
5535 Annefrank
6.6 × 5.0 × 3.4 km
Stardust, 2002
2867 Steins
5.9 × 4.0 km
Rosetta, 2008
951 Gaspra
18.2 × 10.5 × 8.9 km
Galileo, 1991
25143 Itokawa
0.5 × 0.3 × 0.2 km
Hayabusa, 2005
9969 Braille
2.1 × 1 × 1 km
Deep Space 1, 1999
253 Mathilde - 66 × 48 × 44 km
NEAR, 1997
Dactyl
[(243) Ida I]
1.6 × 1.2 km
Galileo, 1993
1P/Halley - 16 × 8 × 8 km
Vega 2, 1986
9P/Tempel 1
7.6 × 4.9 km
Deep Impact, 2005
19P/Borrelly
8 × 4 km
Deep Space 1, 2001
81P/Wild 2
5.5 × 4.0 × 3.3 km
Stardust, 2004
243 Ida - 58.8 × 25.4 × 18.6 km
Galileo, 1993

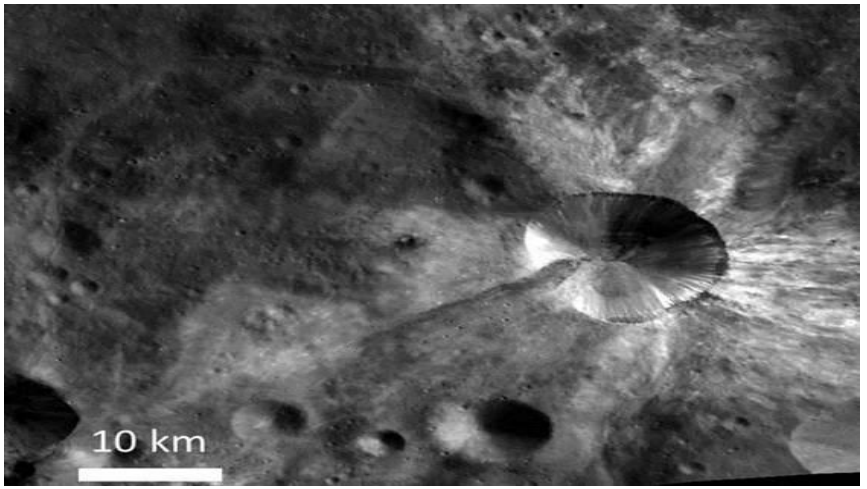

4 Vesta
200 km
253 Mathilde
25 km
243 Ida
(and Dactyl)
10 km
951 Gaspra
5 km
433 Eros
5 km
5535 Annefrank
3 km
Comet
Halley
7 km
Comet
Borrelly
5 km

Vesta/dawn mission

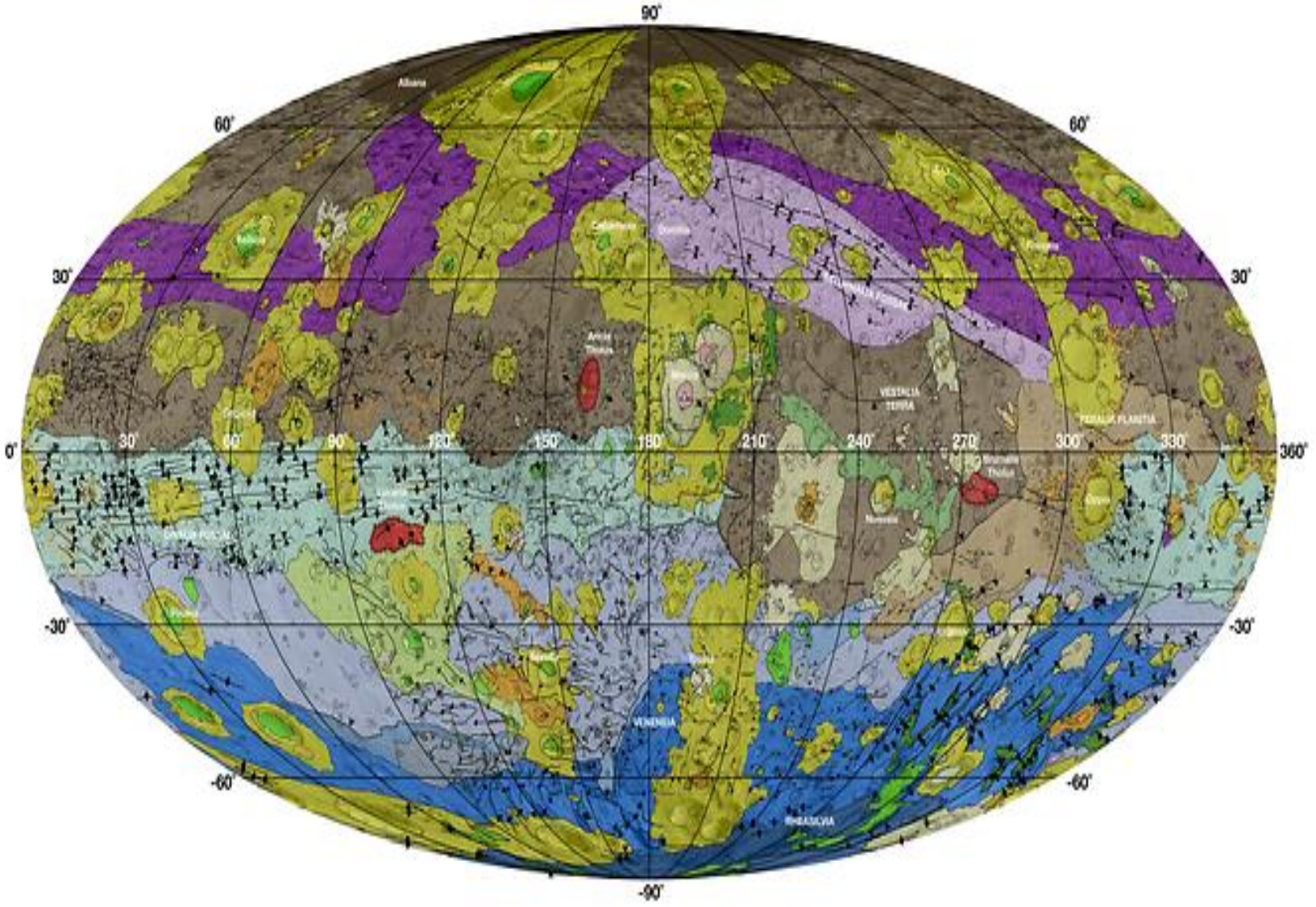


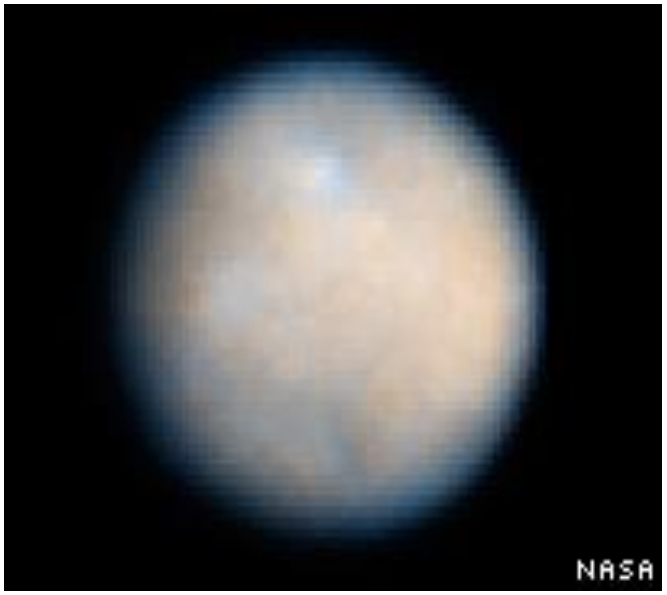

Dawn Spacecraft Current Location
Mar.21,2011 21:20:30 UTC.
Dawn trajectory thrust on
Dawn trajectory thrust off
Earth's orbit
Mars's orbit
Vesta's orbit
Ceres' orbit
Vesta departure
Earth
Sun
Mars
Mars gravity assist
Vesta arrival
Dawn
Vesta
Ceres
End of mission
Ceres arrival
Distance to Vesta 0.01947 AU
Distance to Earth 2.356 AU
Distance to Mars 2.203 AU
Distance to Sun 2.144 AU
MYSTIC simulator

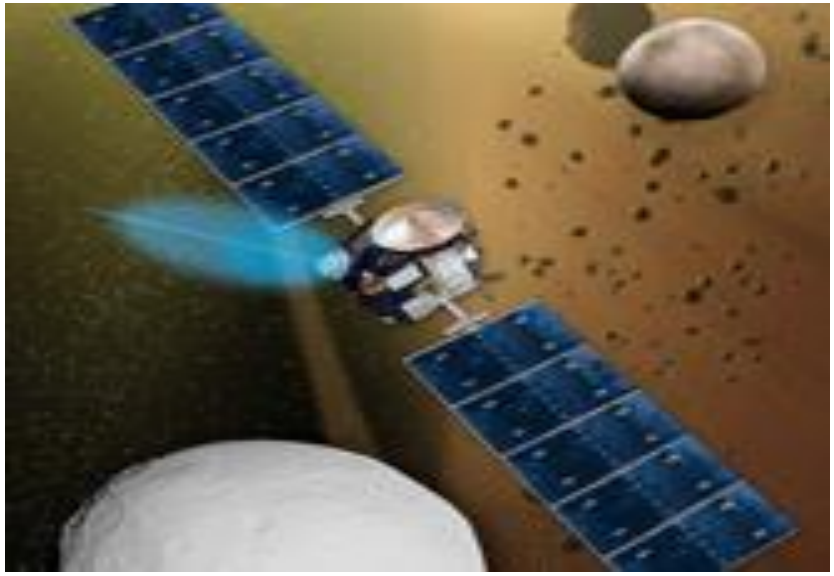


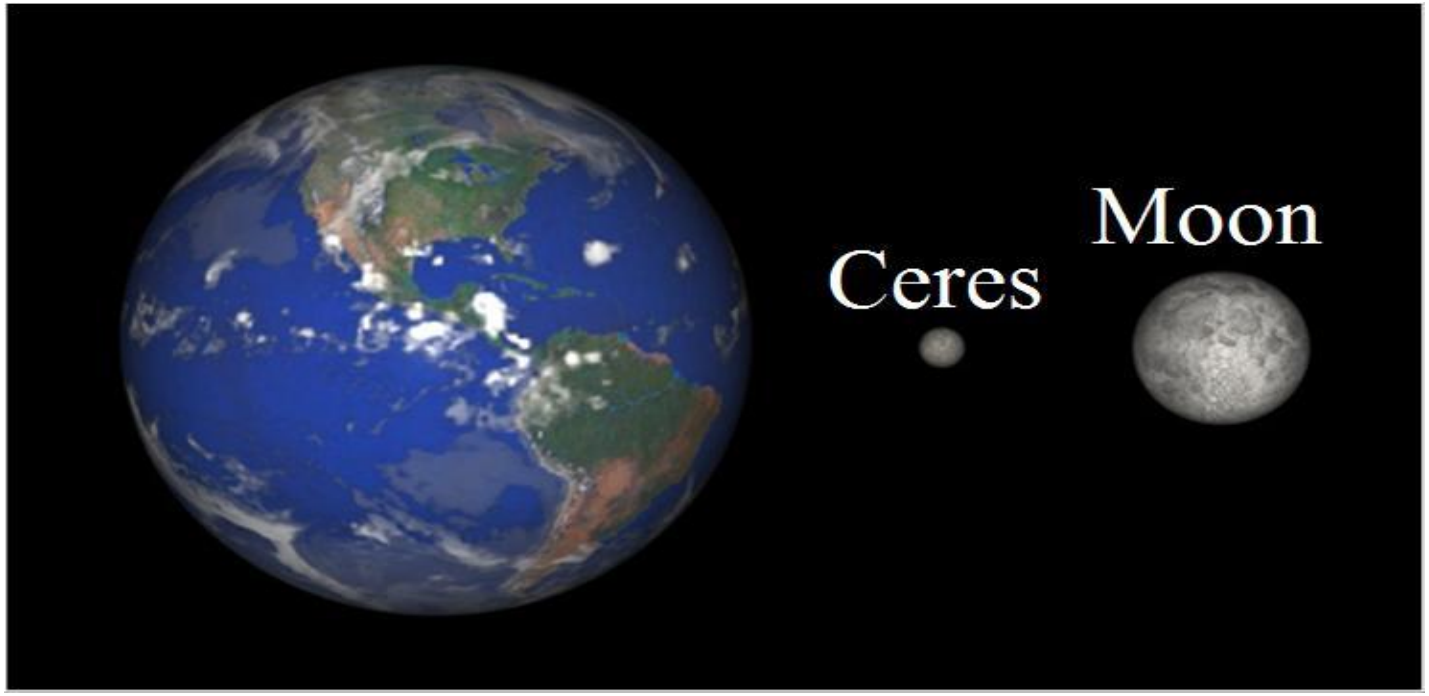

10 km

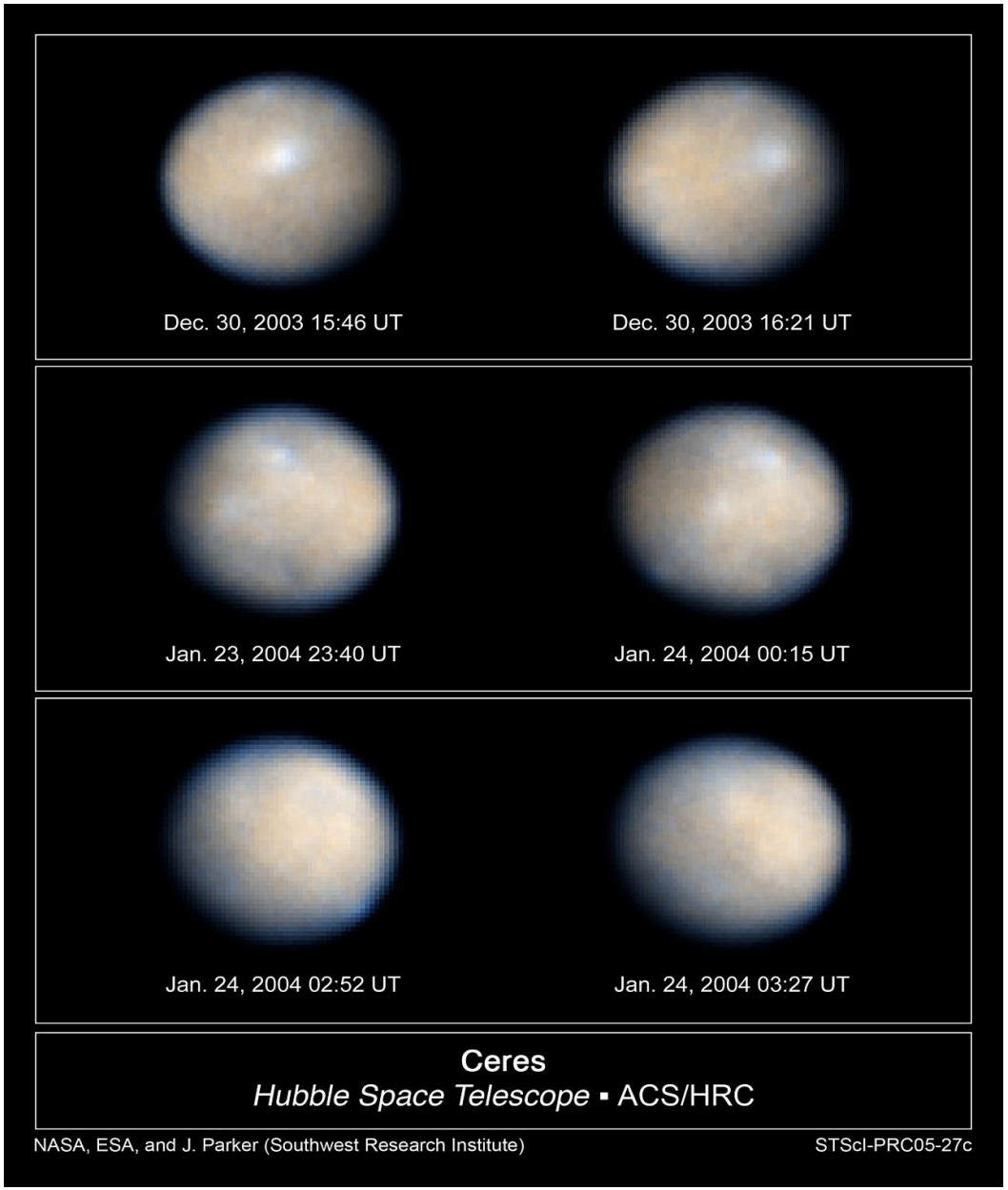
Vesta-ΕΣΤΙΑ


90°
60°
30°
0°
-30°
-60°
-90°
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
360°
VESTALIA TERRA
VENENIA
RHEASILVIA

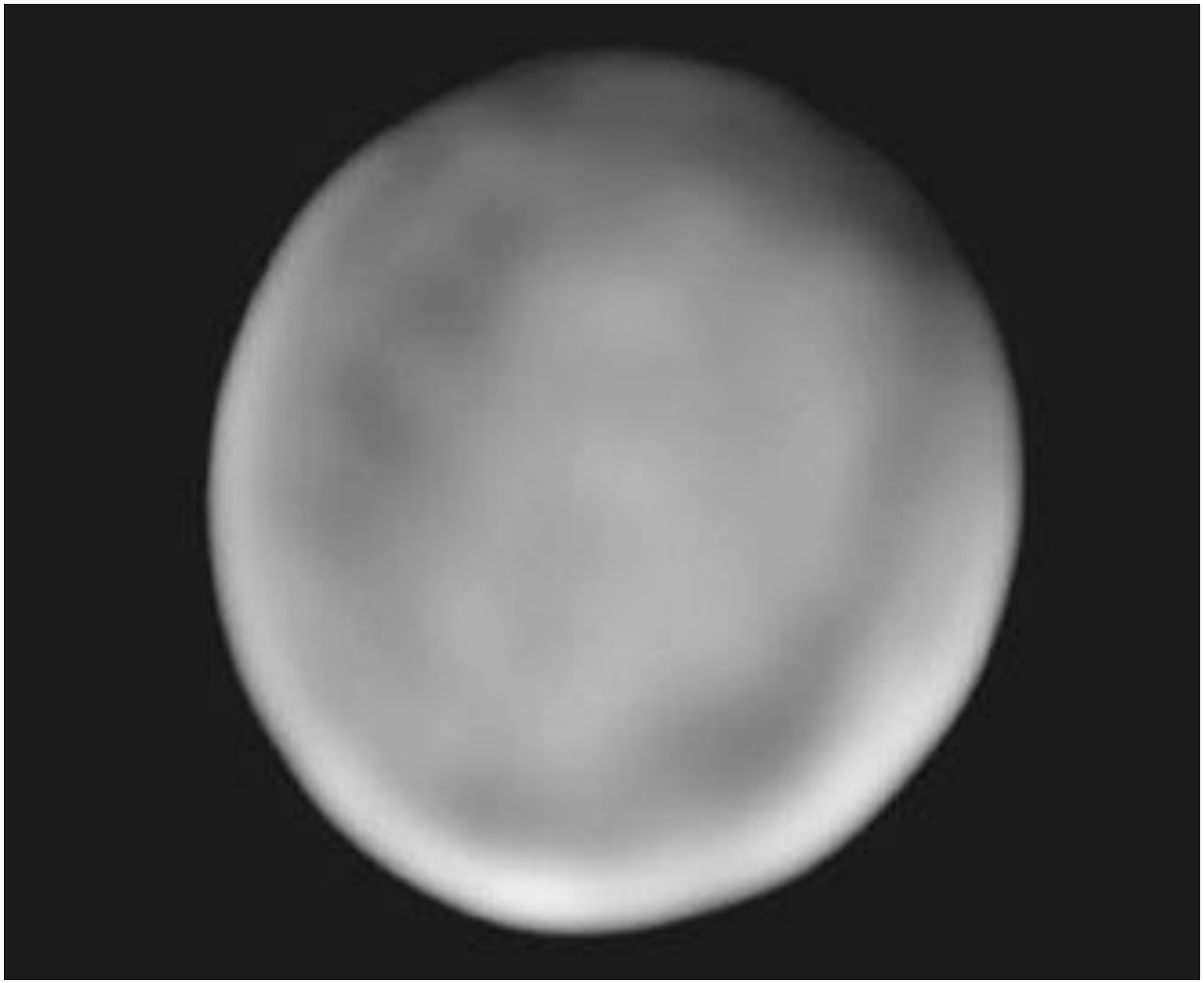

NASA



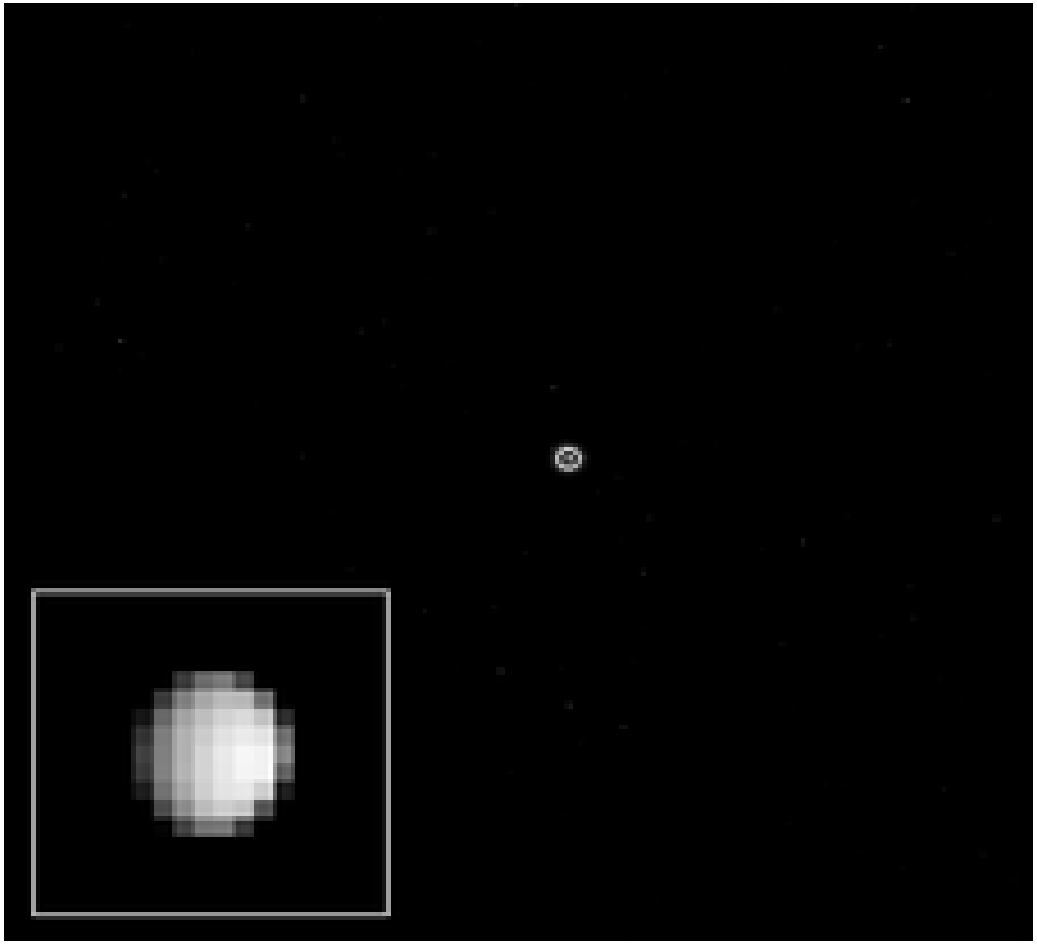

Moon
Ceres

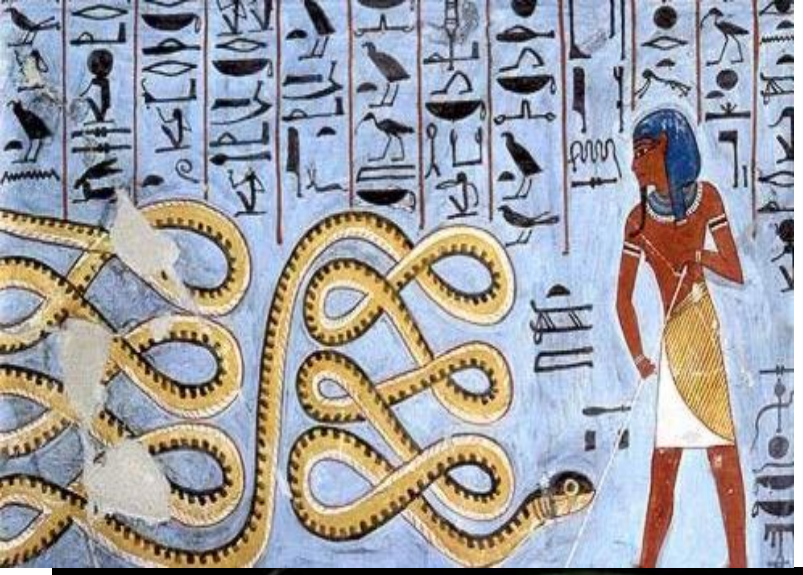

Dec. 30, 2003 15:46 UT
Dec. 30, 2003 16:21 UT
Jan. 23, 2004 23:40 UT
Jan. 24, 2004 00:15 UT
Jan. 24, 2004 02:52 UT
Jan. 24, 2004 03:27 UT
Ceres
Hubble Space Telescope ▪ ACS/HRC
NASA, ESA, and J. Parker (Southwest Research Institute)
STScI-PRC05-27c

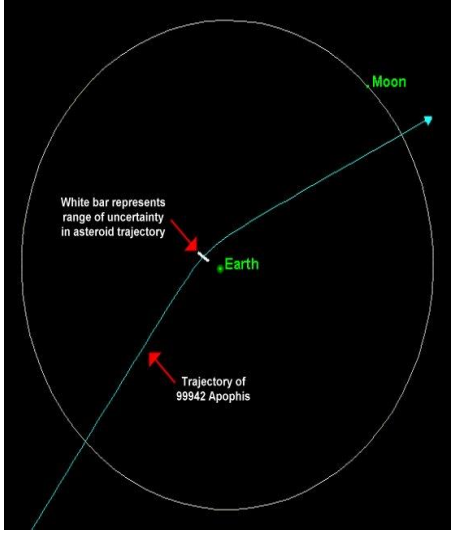
ceres

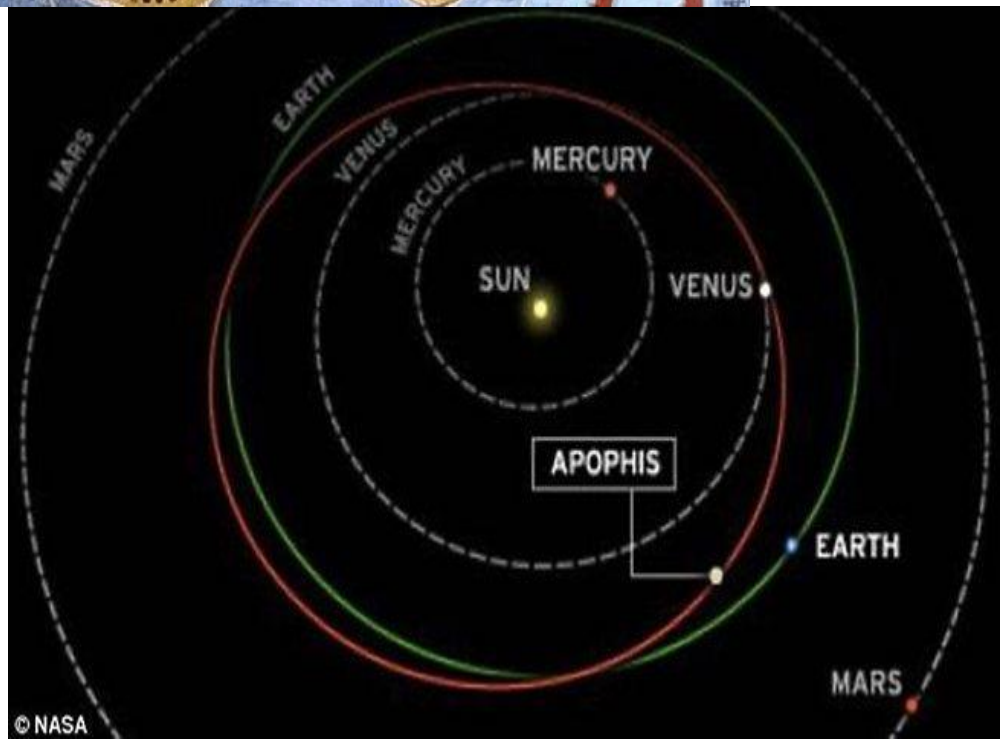


From DAWN, 2014



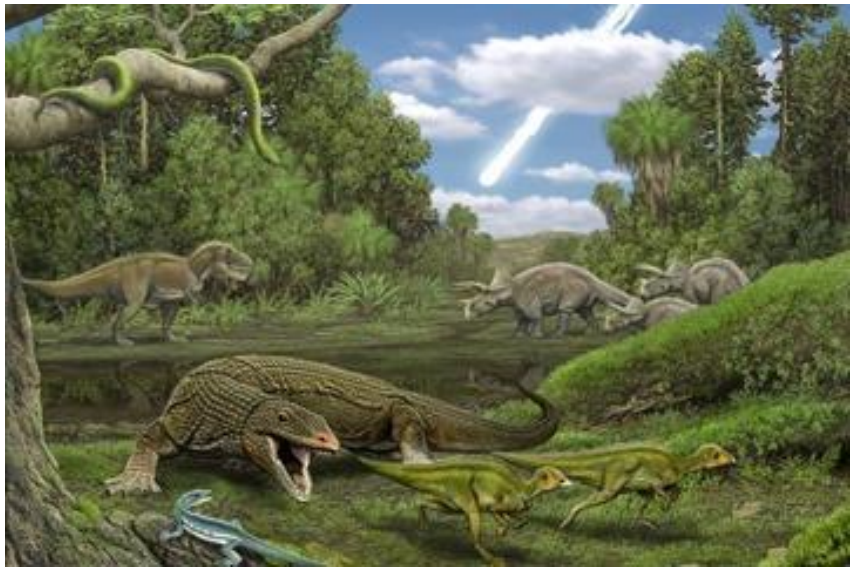


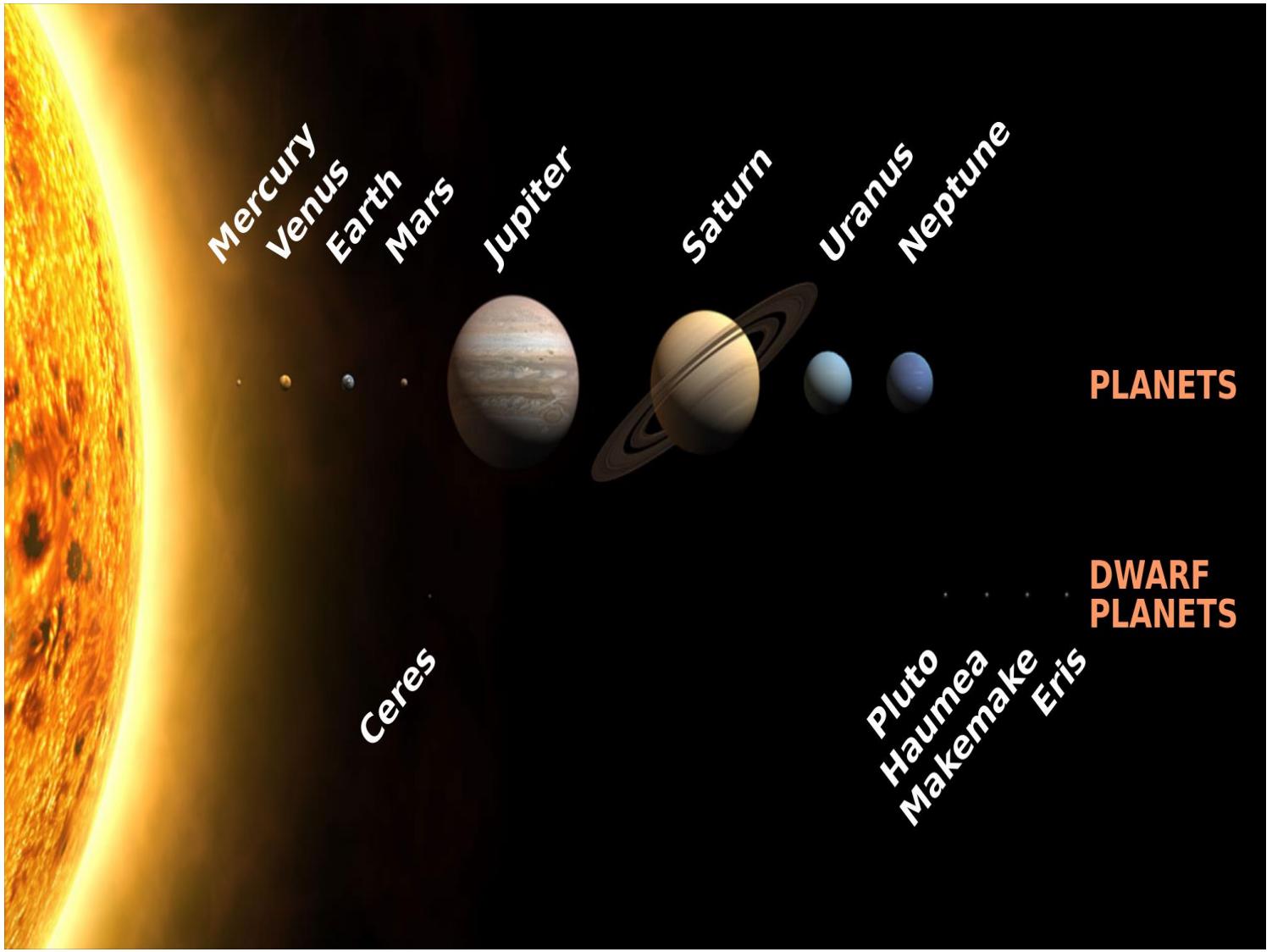

Moon
White bar represents range of uncertainty in asteroid trajectory
Earth
Trajectory of 99942 Apophis

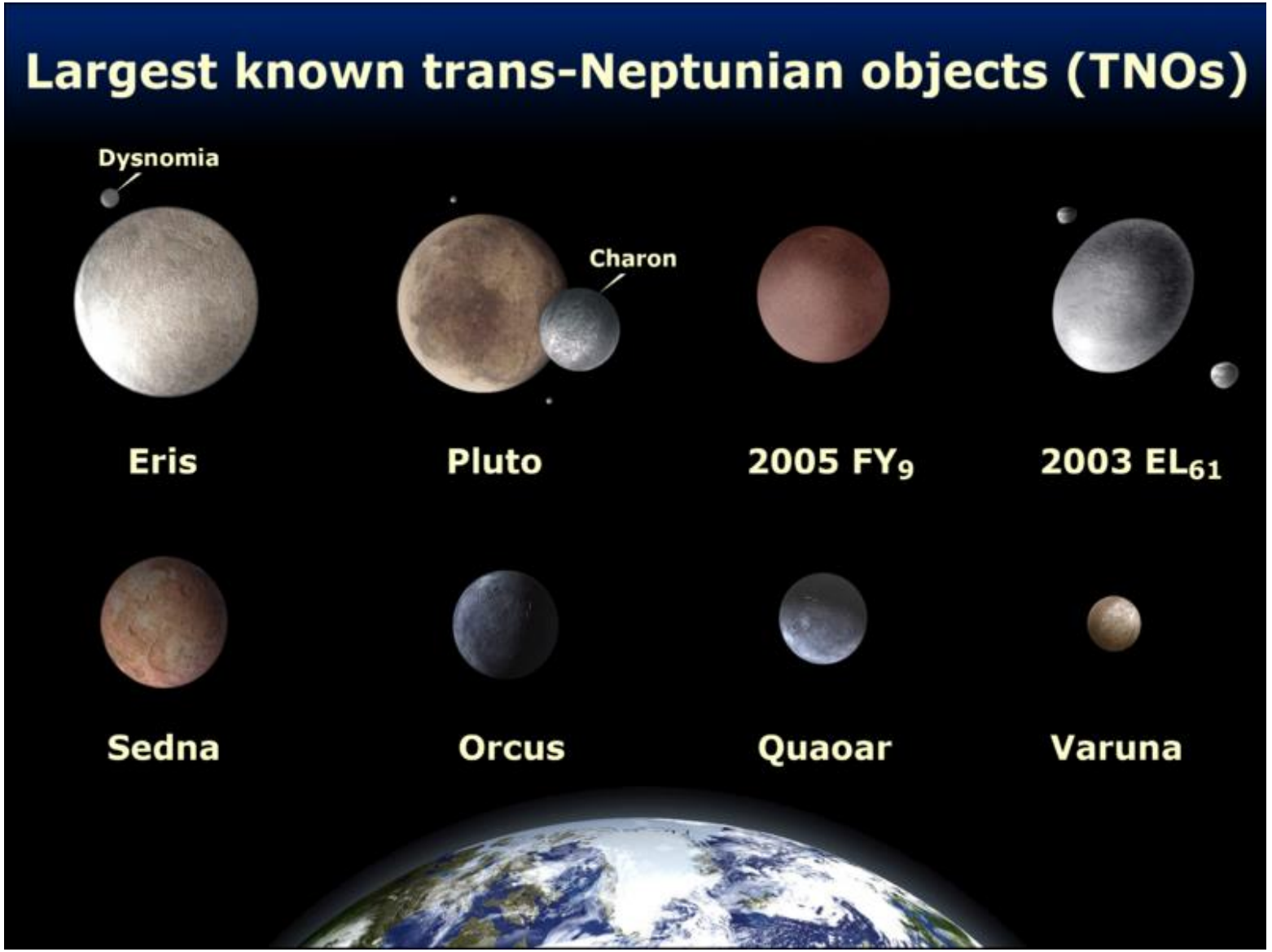

MARS
EARTH
VENUS
MERCURY
MERCURY
SUN
VENUS
APOPHIS
EARTH
MARS
© NASA

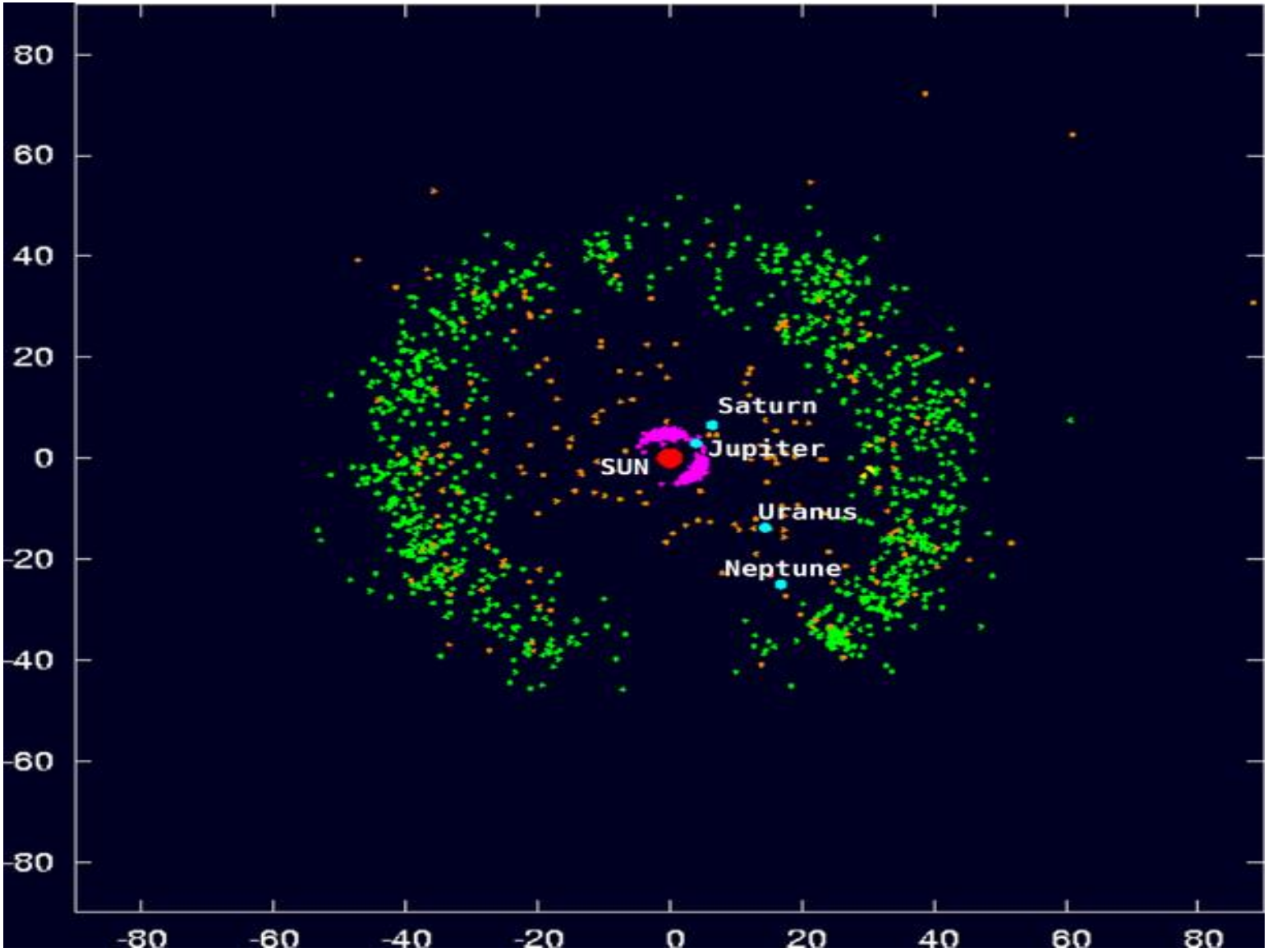

MARK GARLICK/SCIENCE PHOTO LIBRARYScience Photo Library


NSF

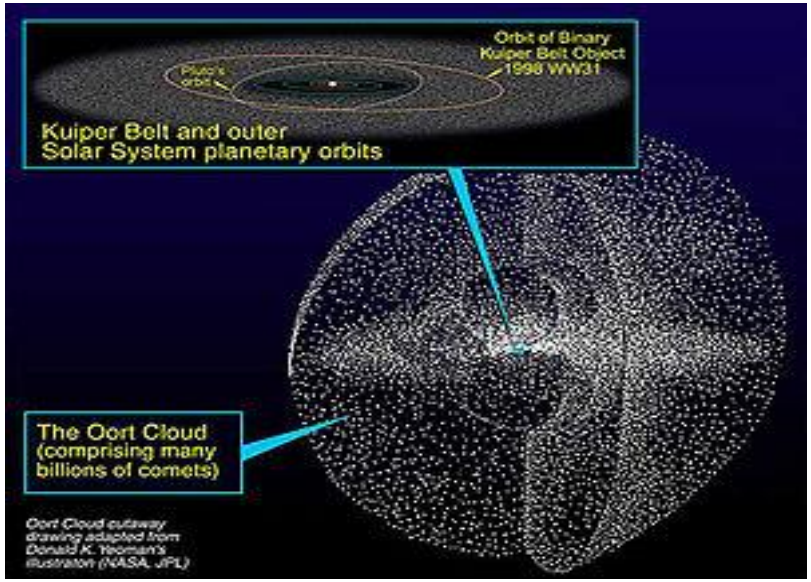


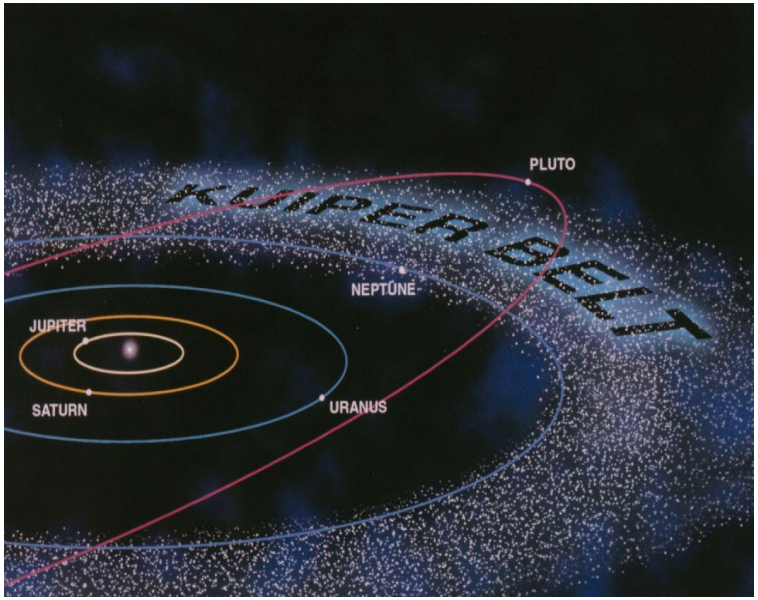

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
PLANETS
DWARF PLANETS
Ceres
Pluto
Haumea
Makemake
Eris

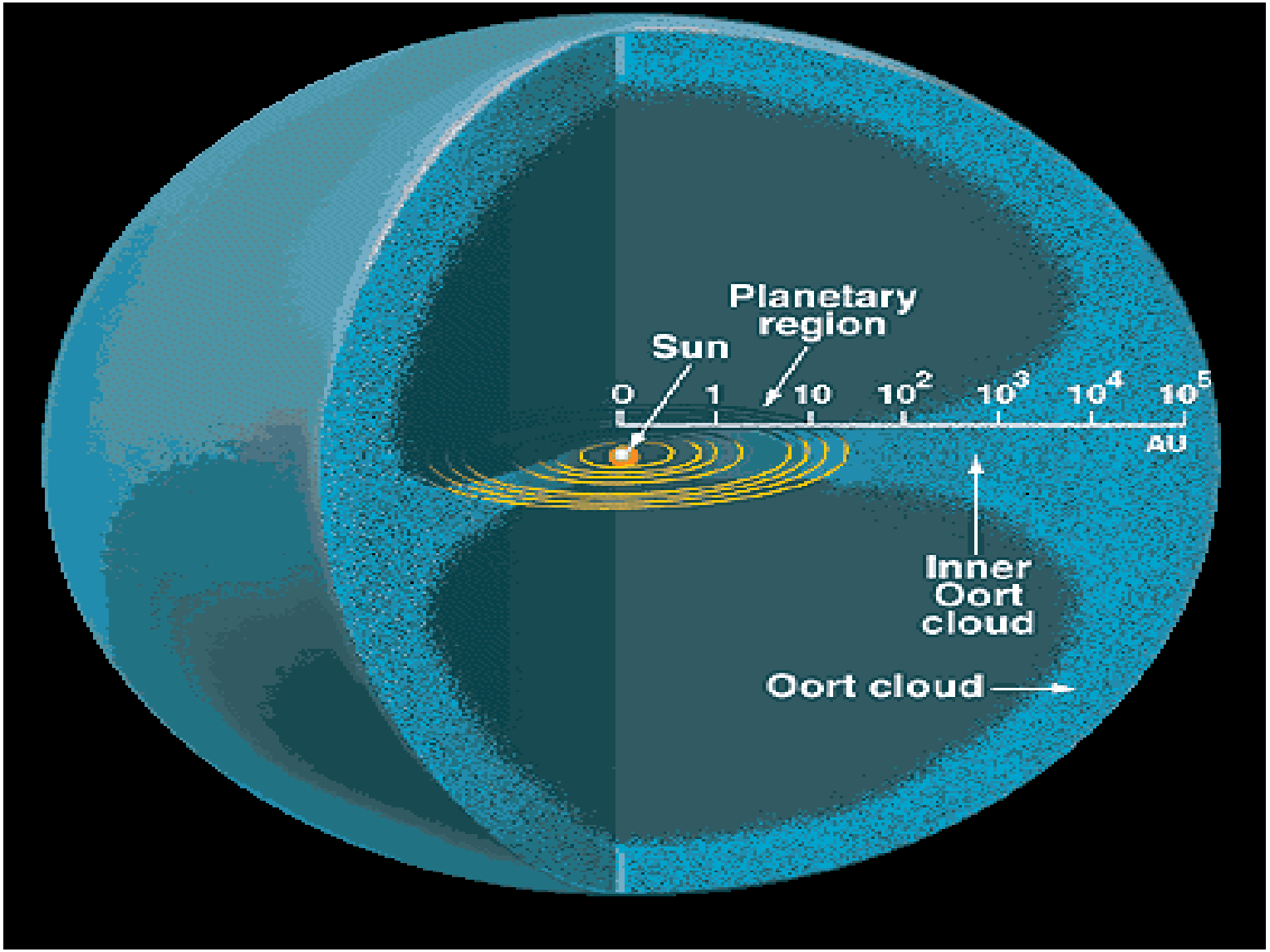

Largest known trans-Neptunian objects (TNOs)
Dysnomia
Charon
Eris
Pluto
2005 FY9
2003 EL61
Sedna
Orcus
Quaoar
Varuna


Saturn
Jupiter
SUN
Uranus
Neptune
80
60
40
20
0
-20
-40
-60
-80
-80
-60
-40
-20
0
20
40
60
80

HALE-BOPP (1997)

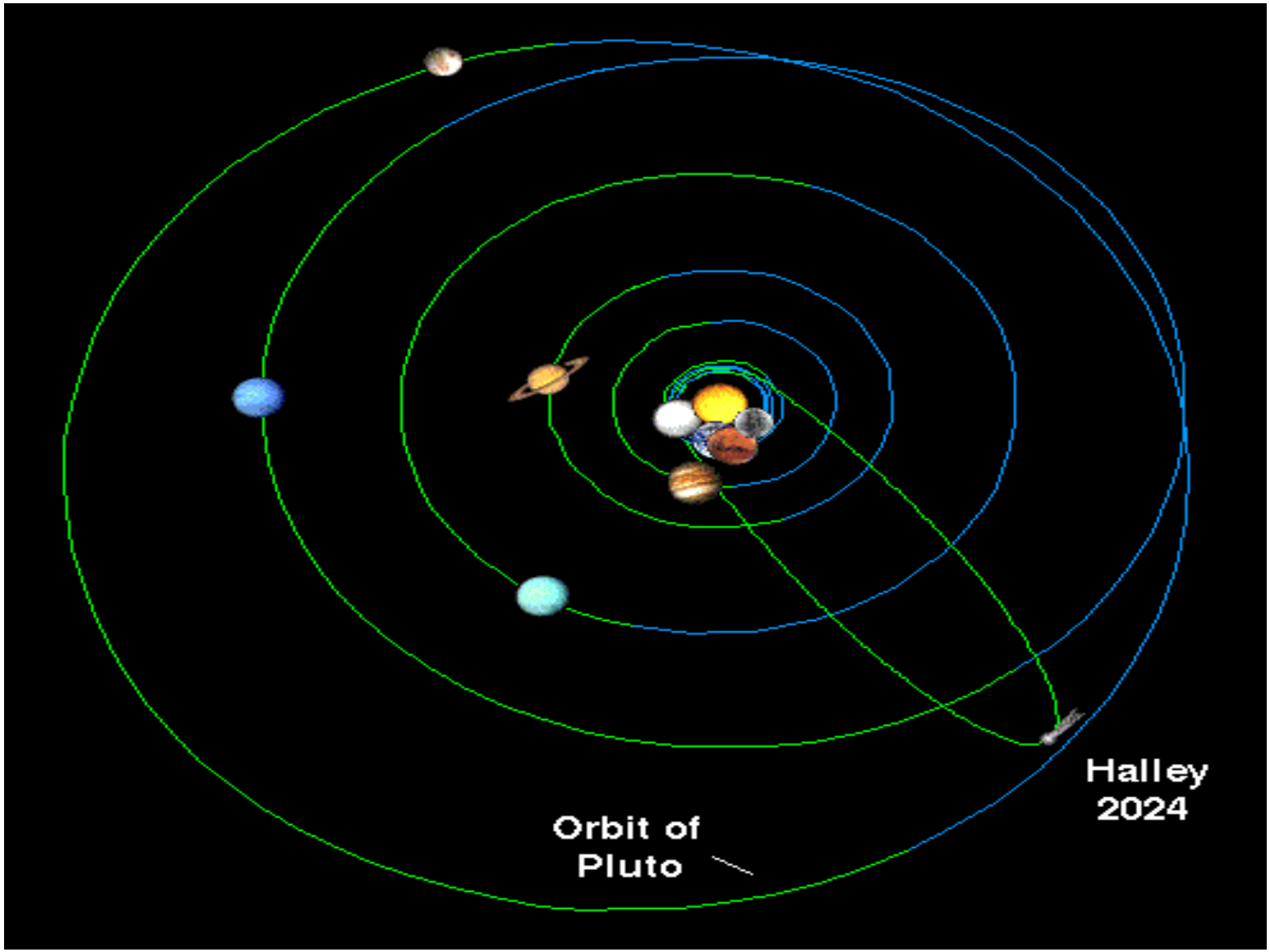


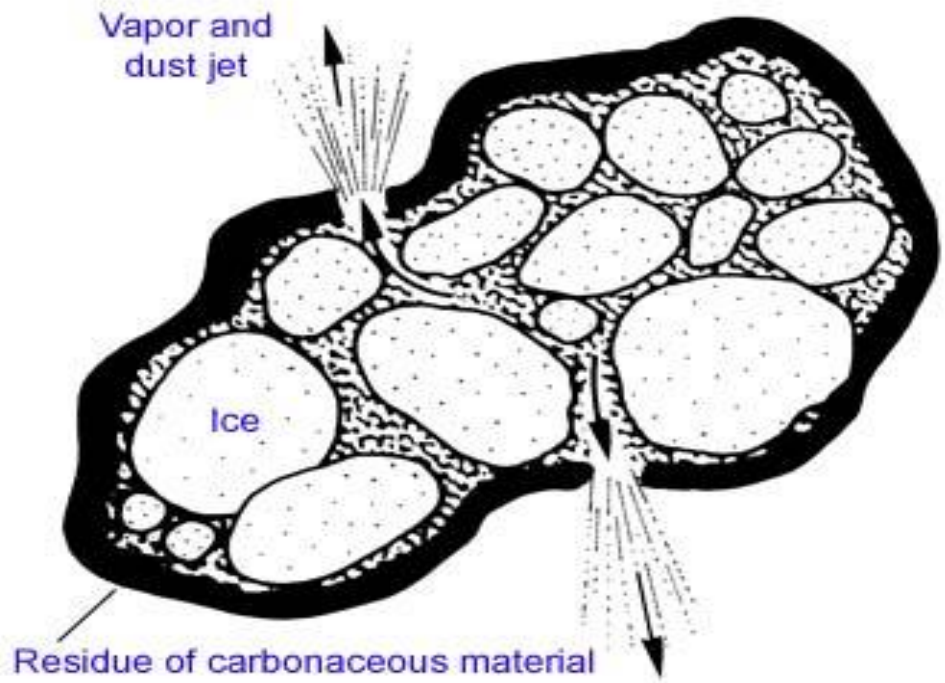


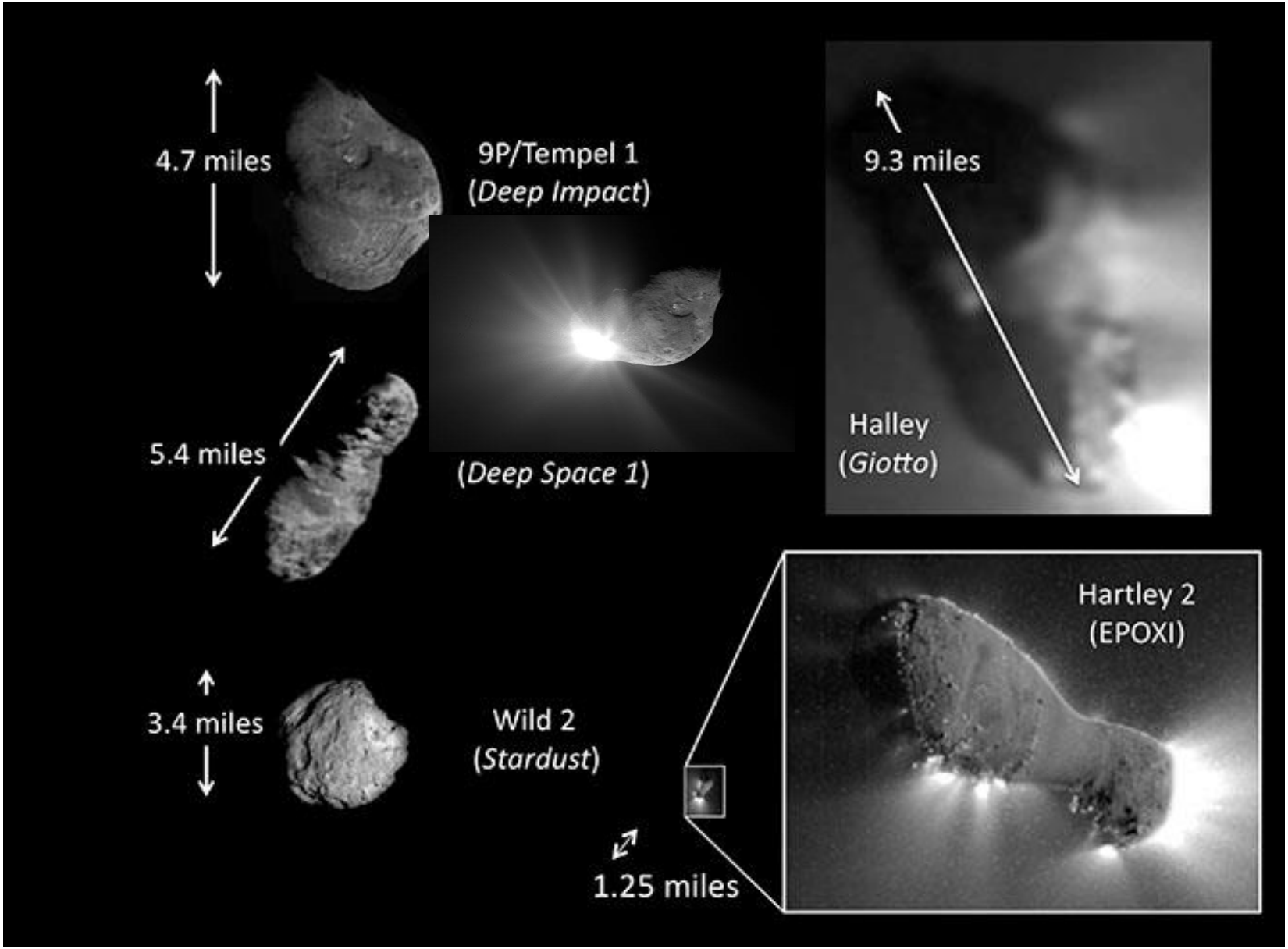

Planetary region
Sun
0
1
10
10^2
10^3
10^4
10^5
AU
Inner Oort cloud
Oort cloud

Comet Halley, 1910

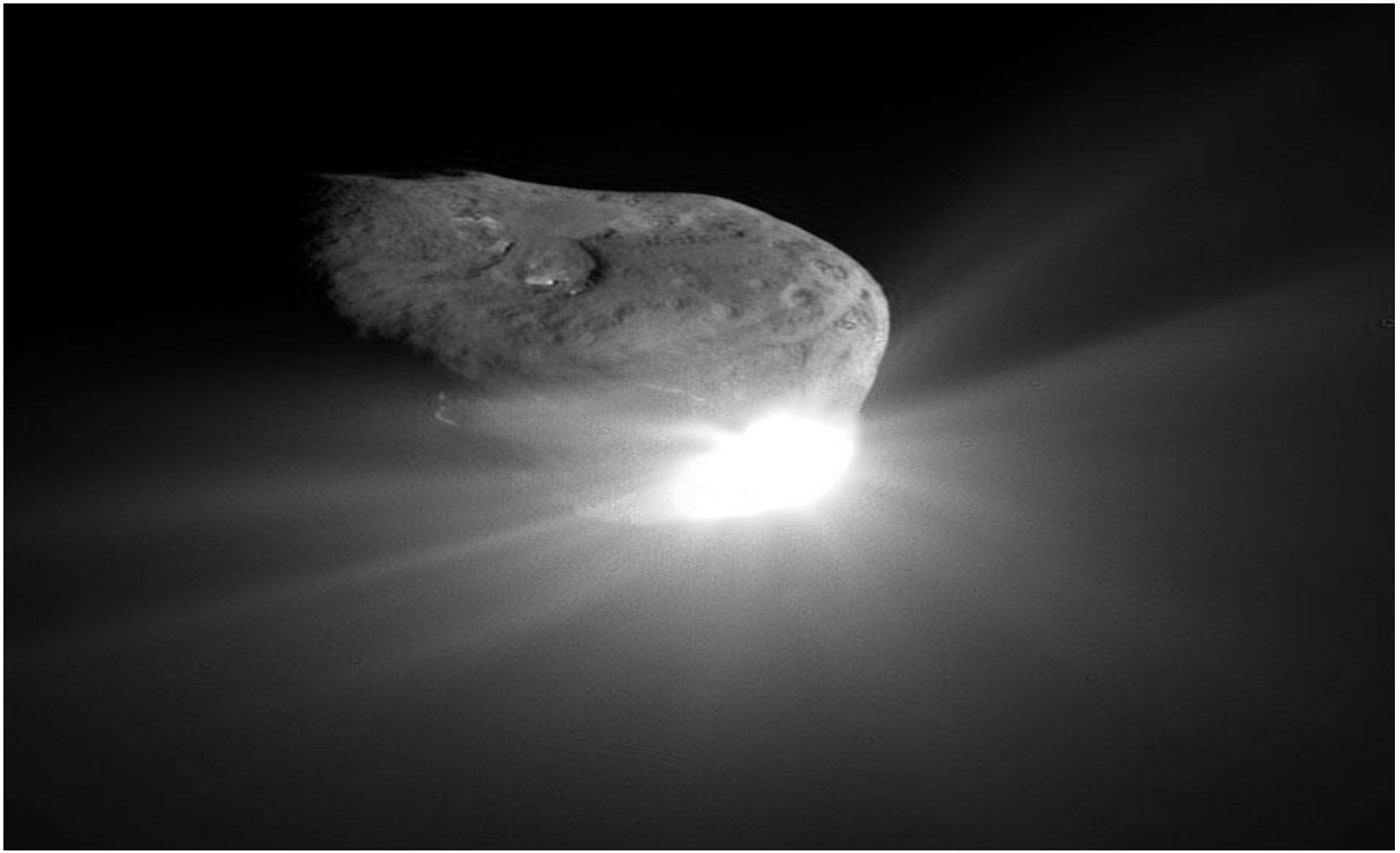
HALLEY COMET (1986)


Halley
2024
Orbit of
Pluto

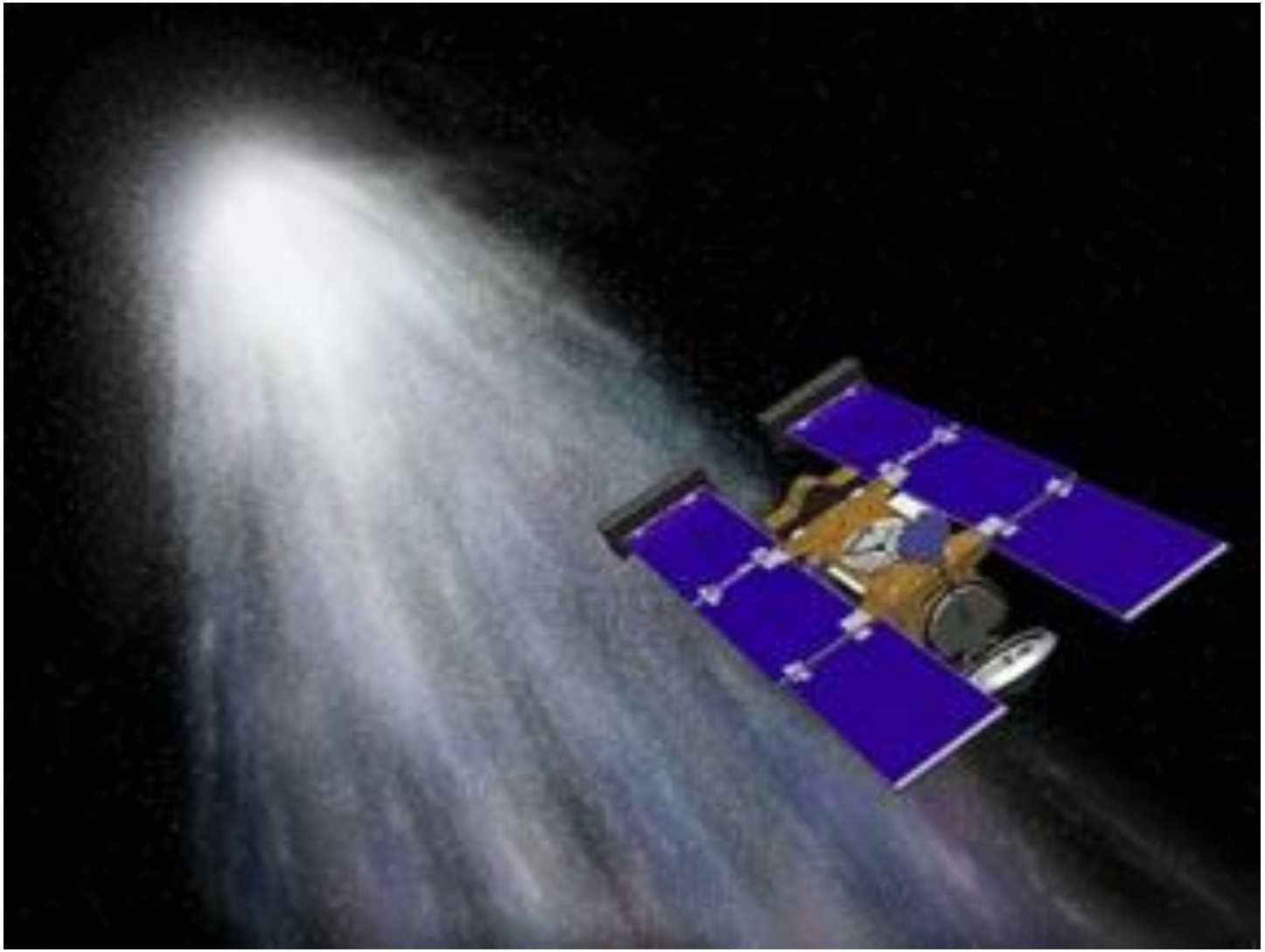

Vapor and
dust jet
Ice
Residue of carbonaceous material


4.7 miles
9P/Tempel 1
(Deep Impact)
9.3 miles
5.4 miles
(Deep Space 1)
Halley
(Giotto)
Hartley 2
(EPOXI)
3.4 miles
Wild 2
(Stardust)
1.25 miles

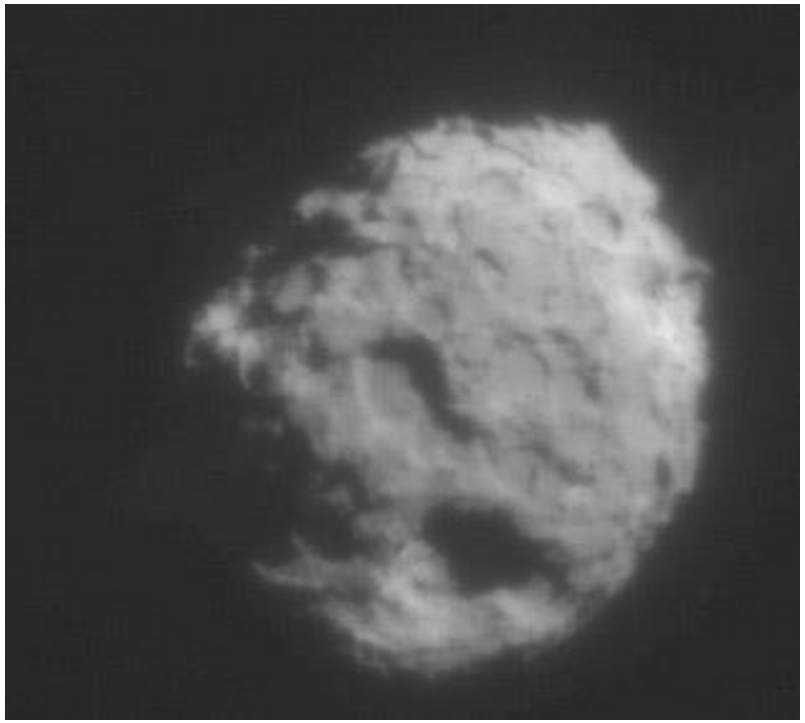
COMET Tempel 1

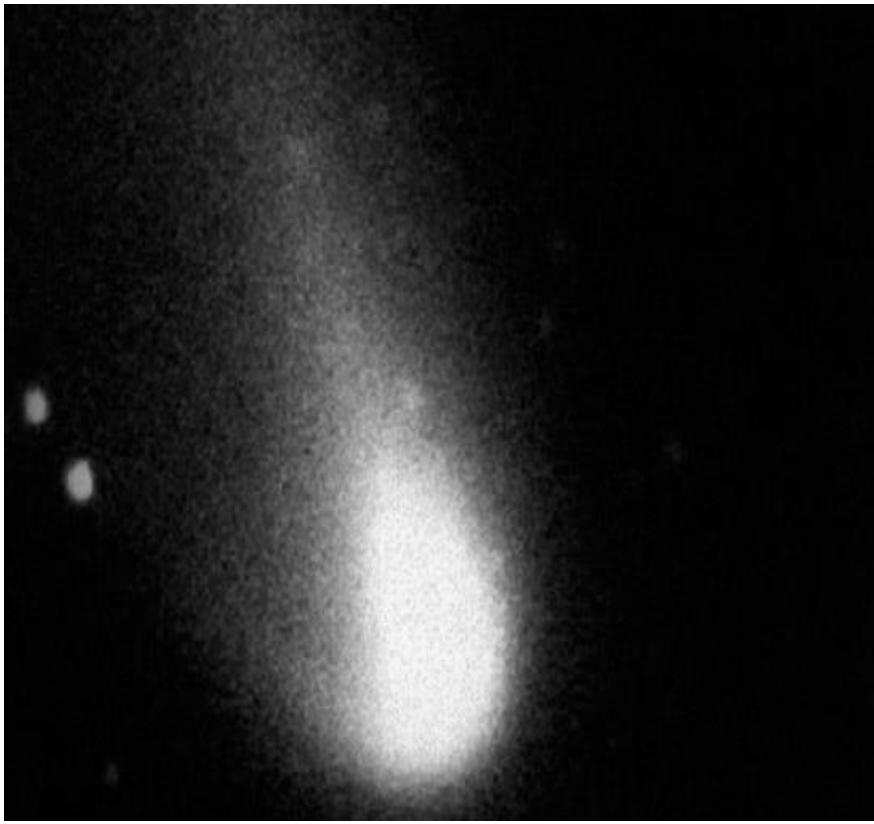


STARDUST MISSION

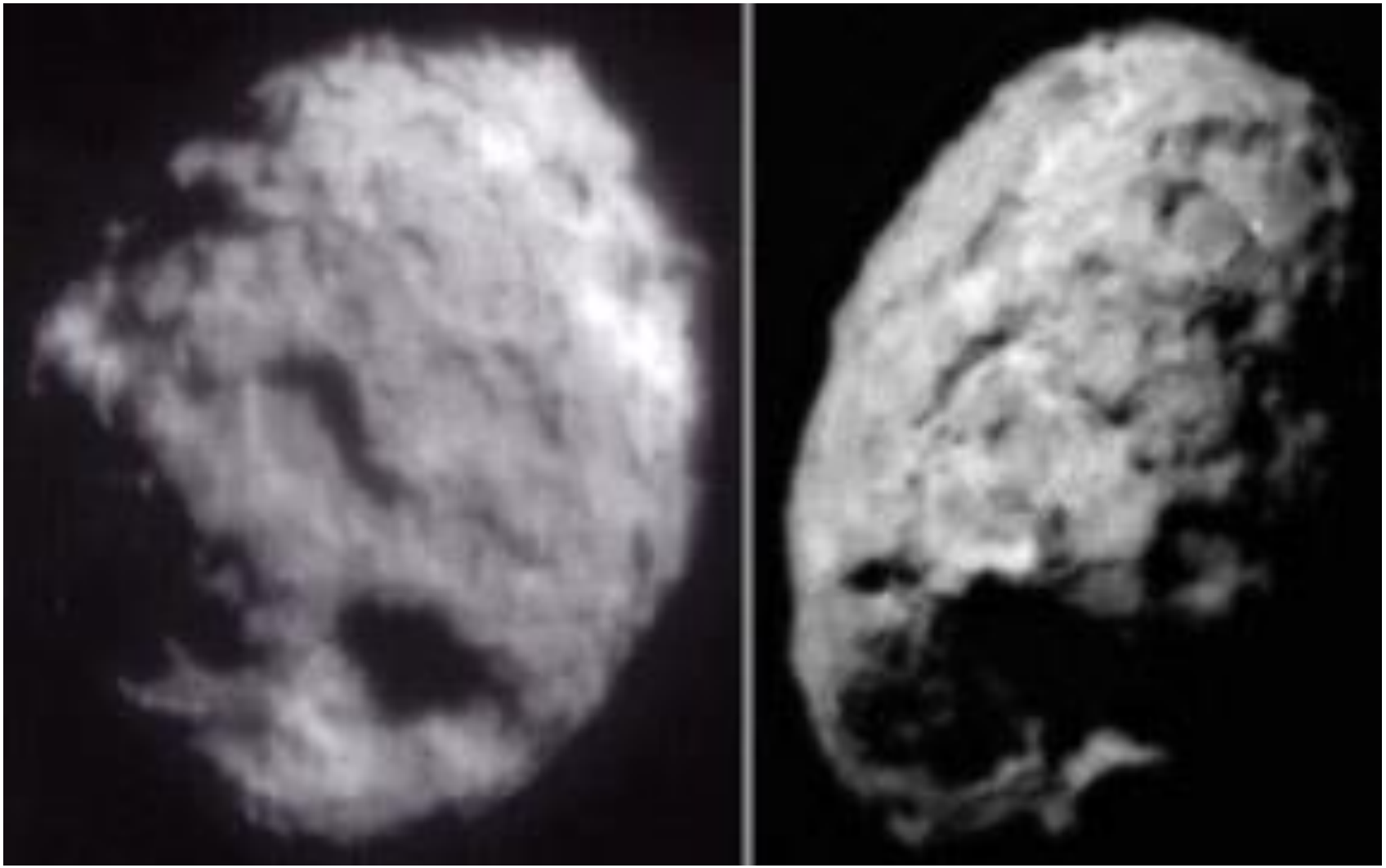


Comet Wild, stardust mission

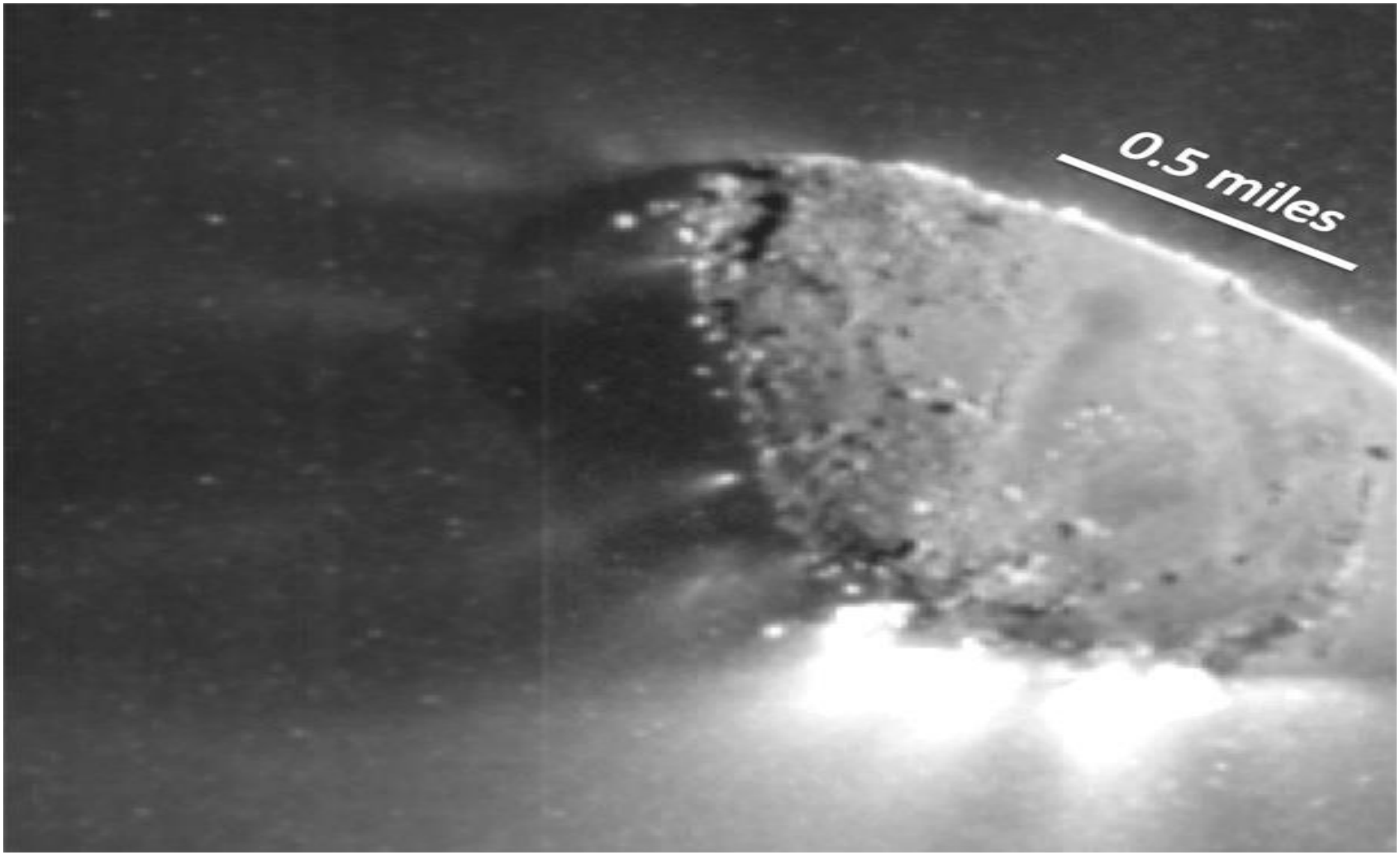


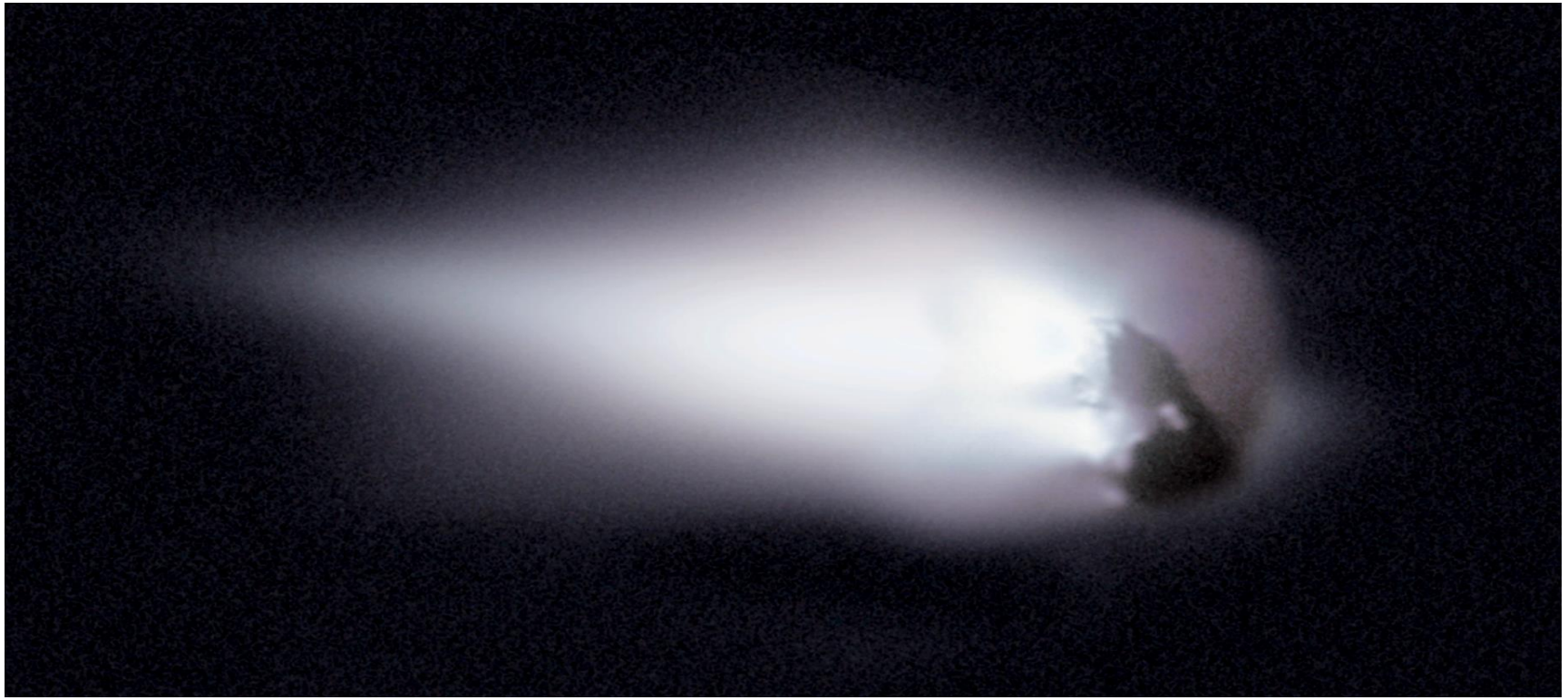


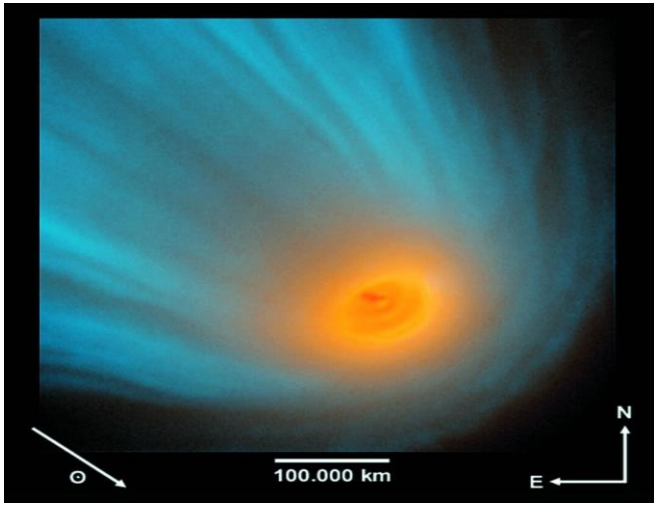
Comet Wild



HARTLEY 2

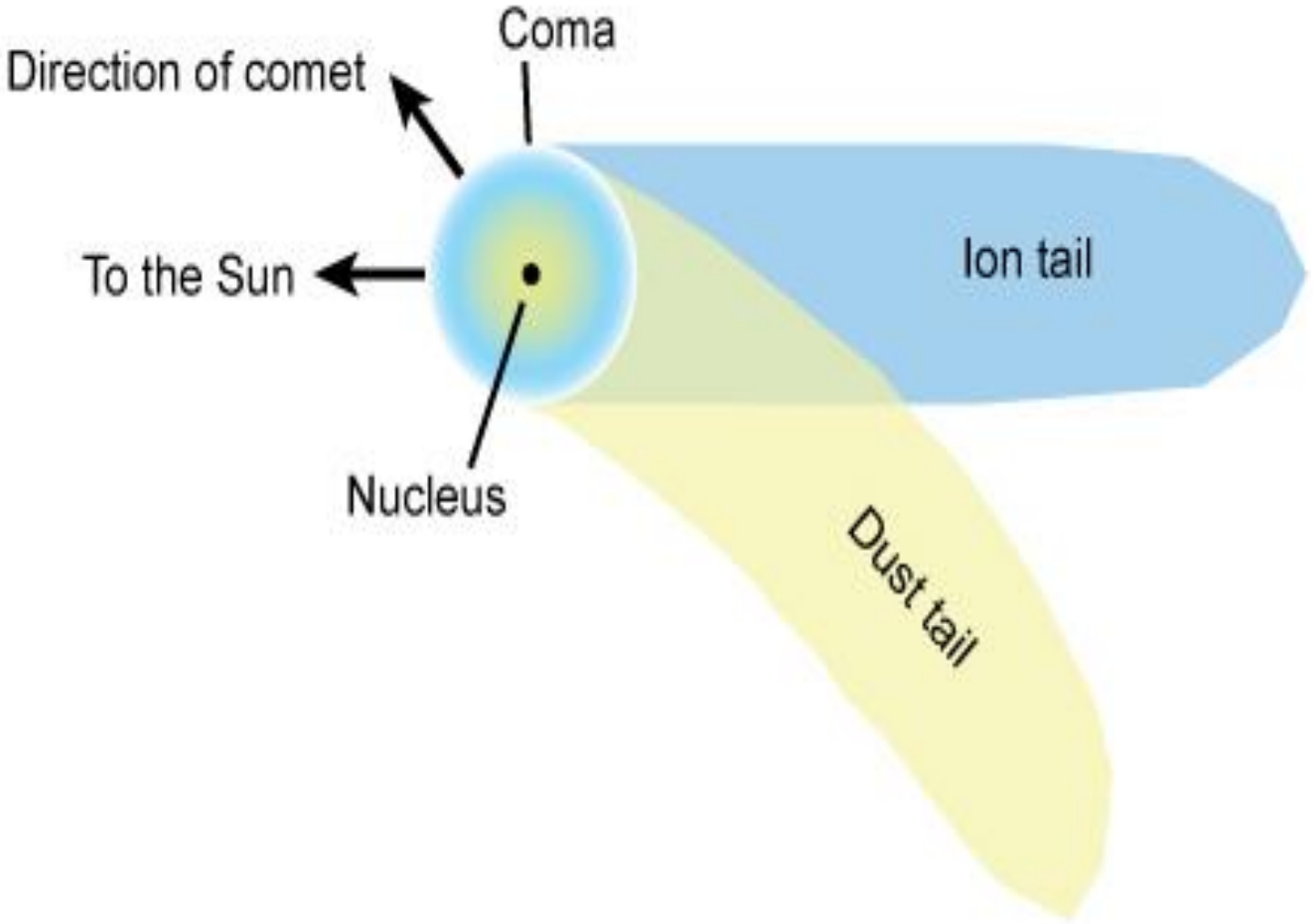


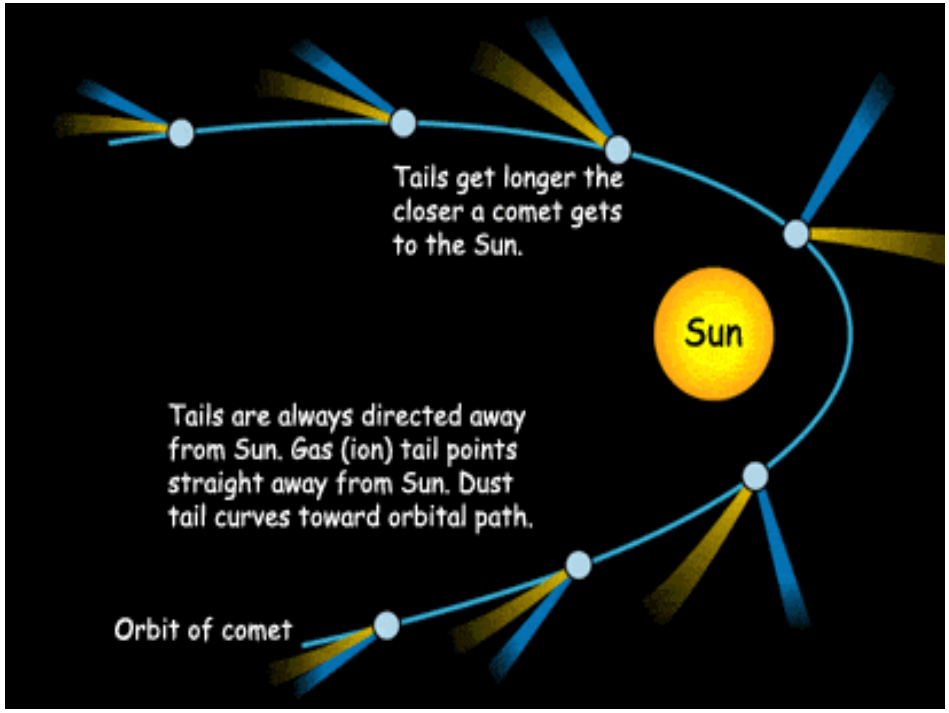


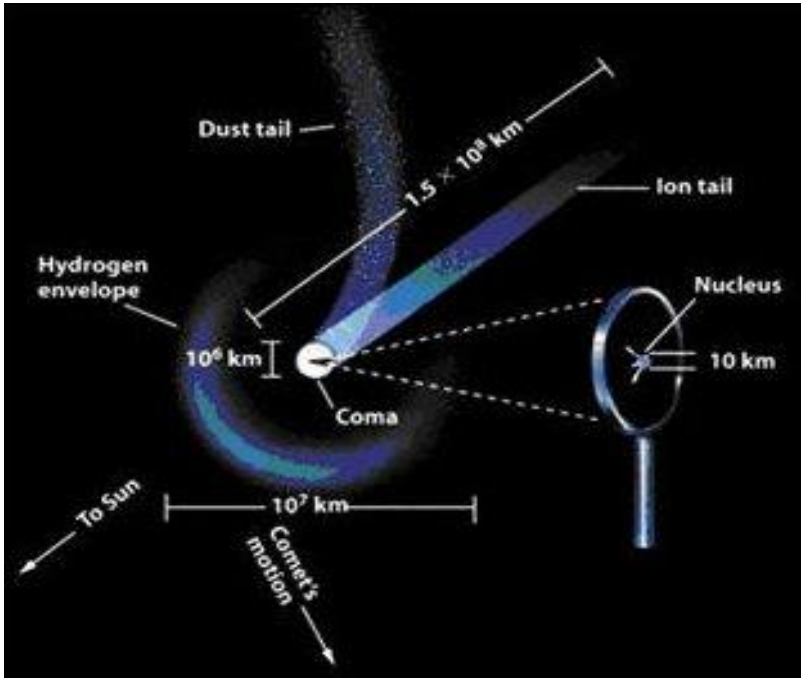

100.000 km
N
E

COMET HALLEY

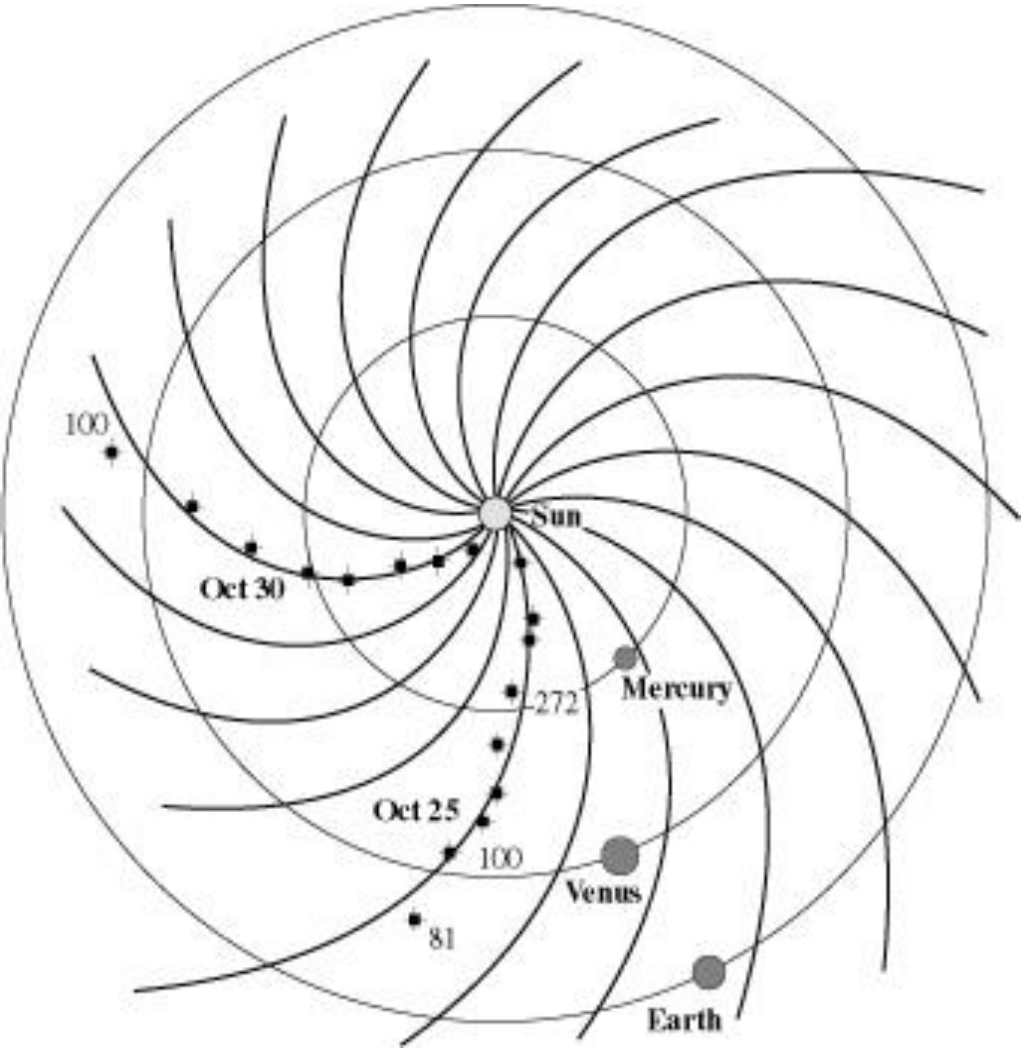
HYAKUTAKE- WEST

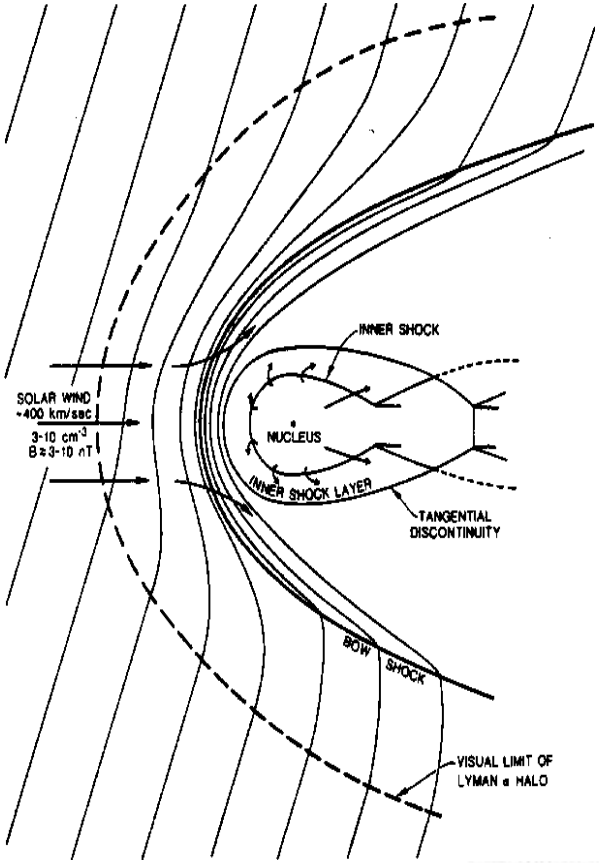

Direction of comet
Coma
To the Sun
Ion tail
Nucleus
Dust tail

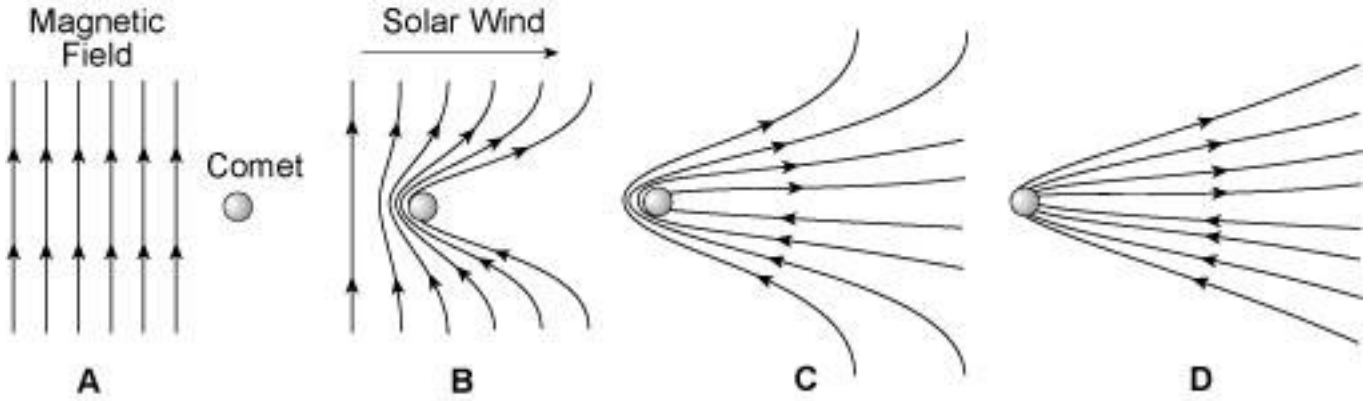

Tails get longer the closer a comet gets to the Sun.
Sun
Tails are always directed away from Sun. Gas (ion) tail points straight away from Sun. Dust tail curves toward orbital path.
Orbit of comet


Dust tail
1.5×10^8 km
Ion tail
Hydrogen envelope
Nucleus
10^6 km
10 km
Coma
To Sun
10^7 km
Comet's motion

Solar wind




INNER SHOCK
SOLAR WIND
~400 km/sec
3-10 cm⁻³
B≈3-10 nT
NUCLEUS
INNER SHOCK LAYER
TANGENTIAL
DISCONTINUITY
BOW
SHOCK
VISUAL LIMIT OF
LYMAN α HALO


Magnetic
Field
Solar Wind
Comet
A
B
C
D

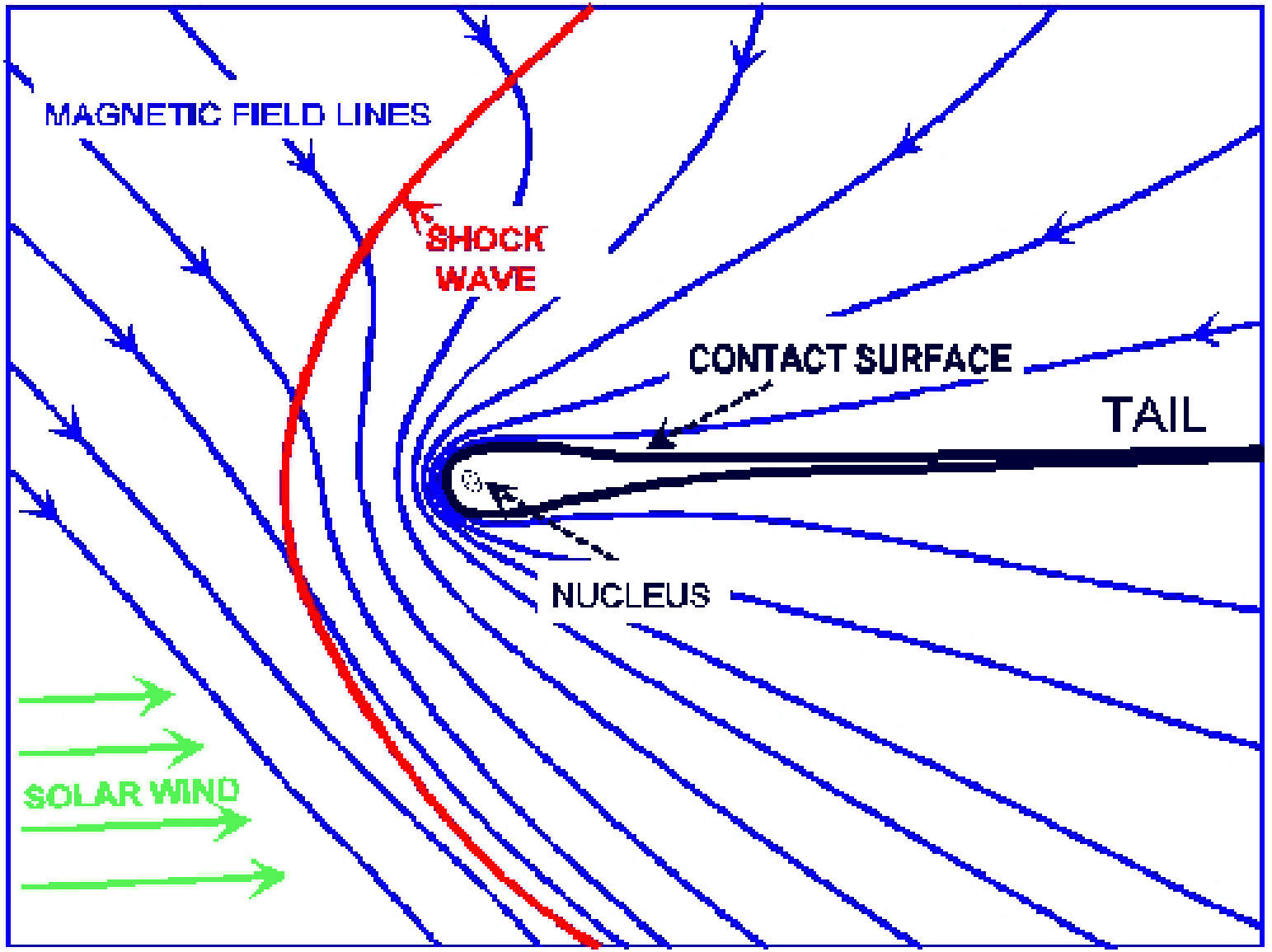
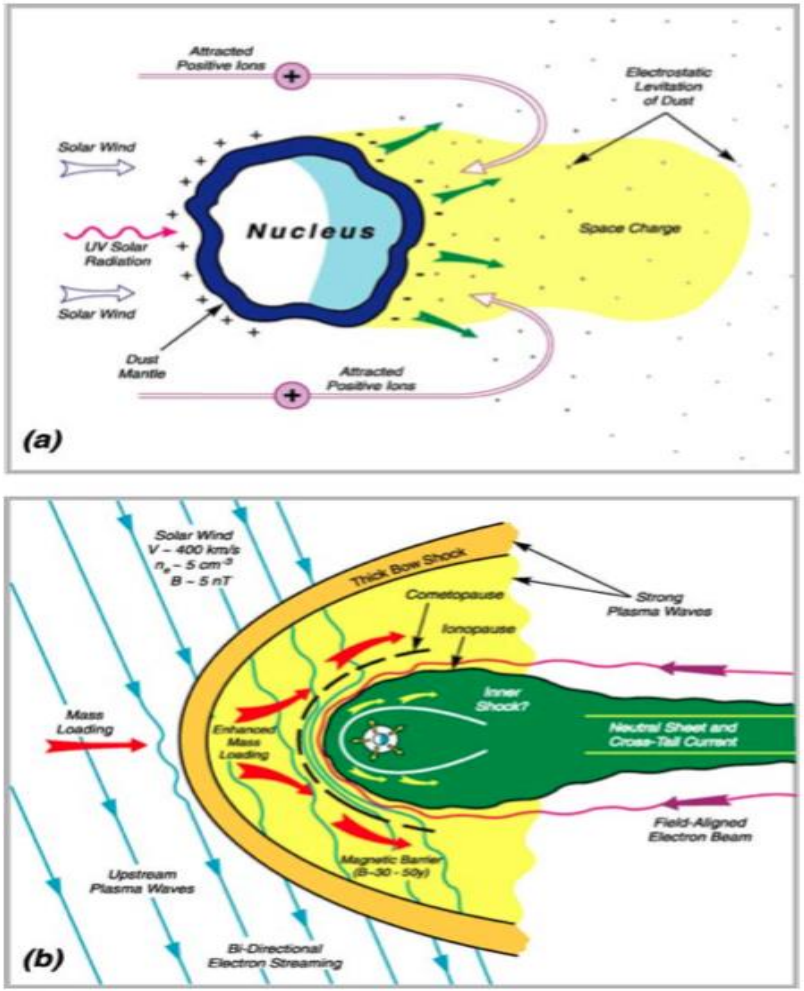
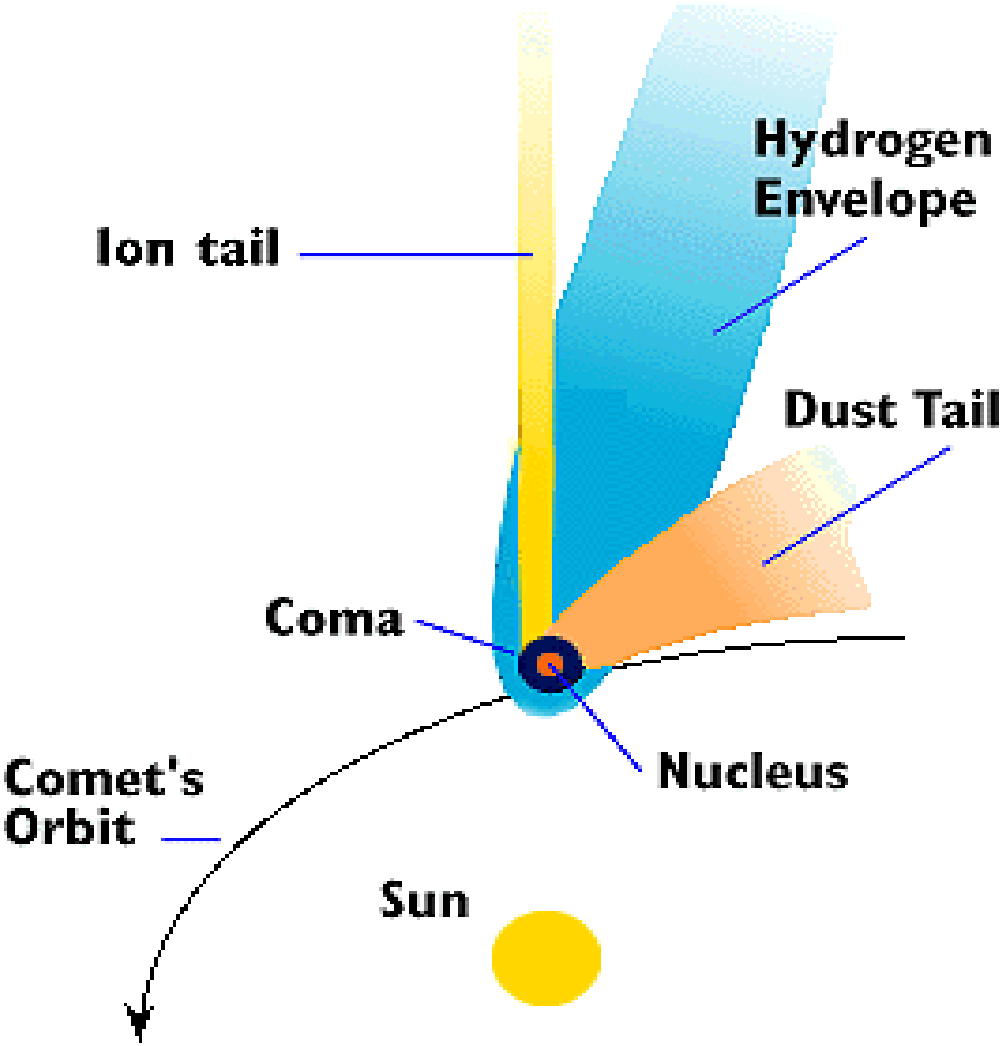
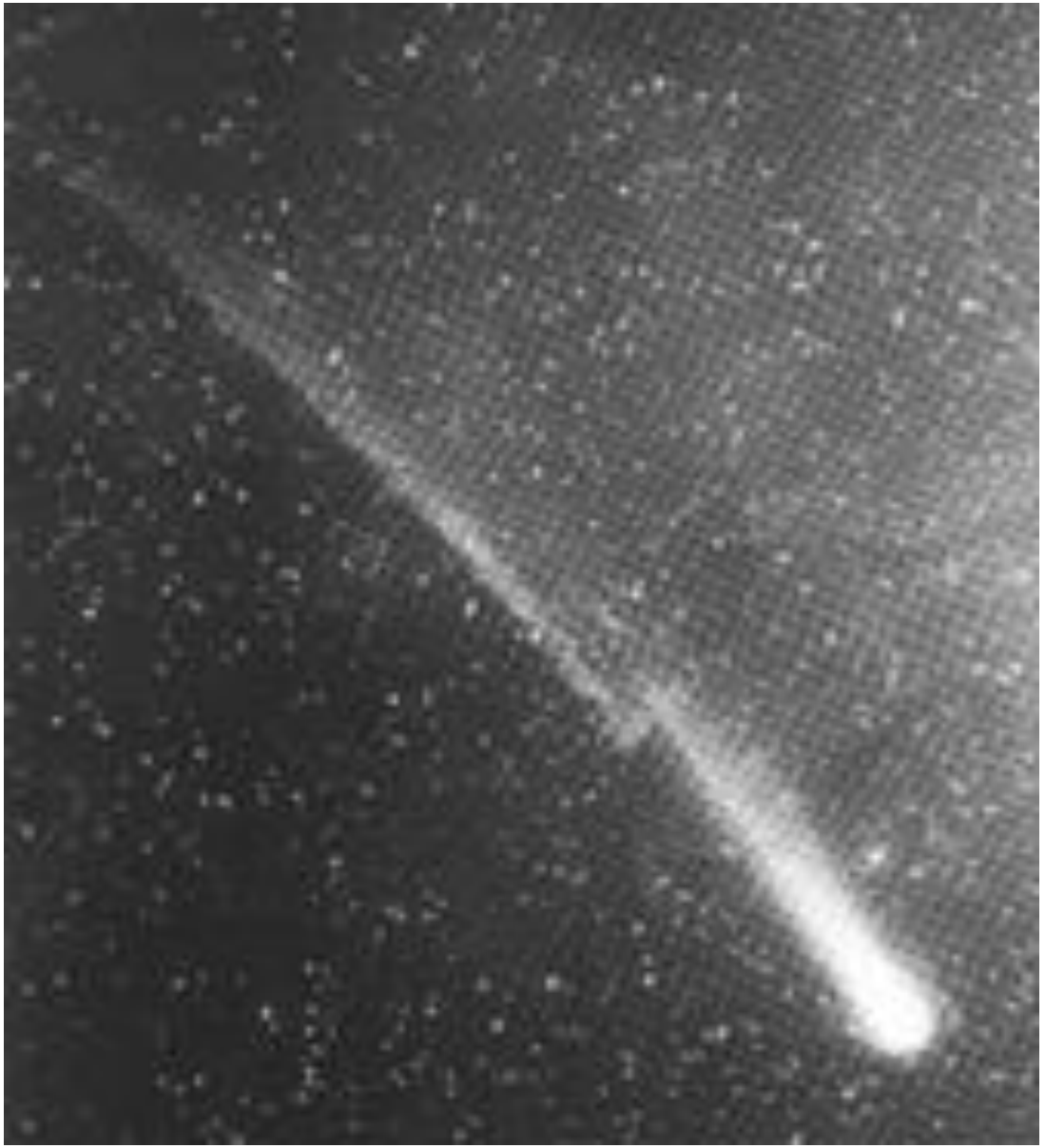

MAGNETIC FIELD LINES
SHOCK WAVE
CONTACT SURFACE
TAIL
NUCLEUS
SOLAR WIND

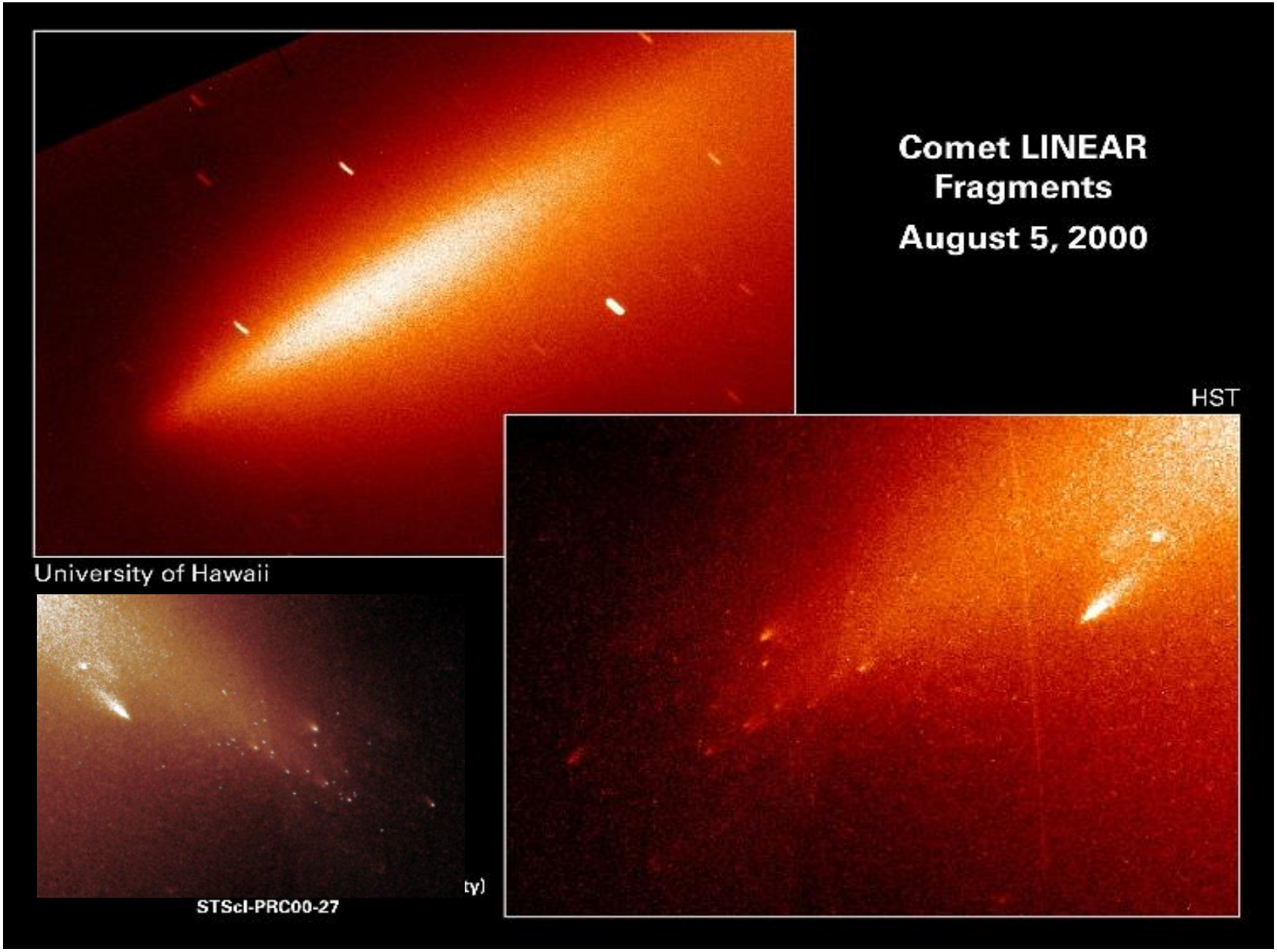
Figure 1. (a) Solar wind interaction with a bare nucleus at large heliospheric distances (d > 3 AU). (b) Plasma environment of an active comet near perihelion; Burch, J. L., et al. "RPC-IES: The ion and electron sensor of the rosetta plasma consortium." Space science reviews 128.1-4 (2007): 697-712.; ,



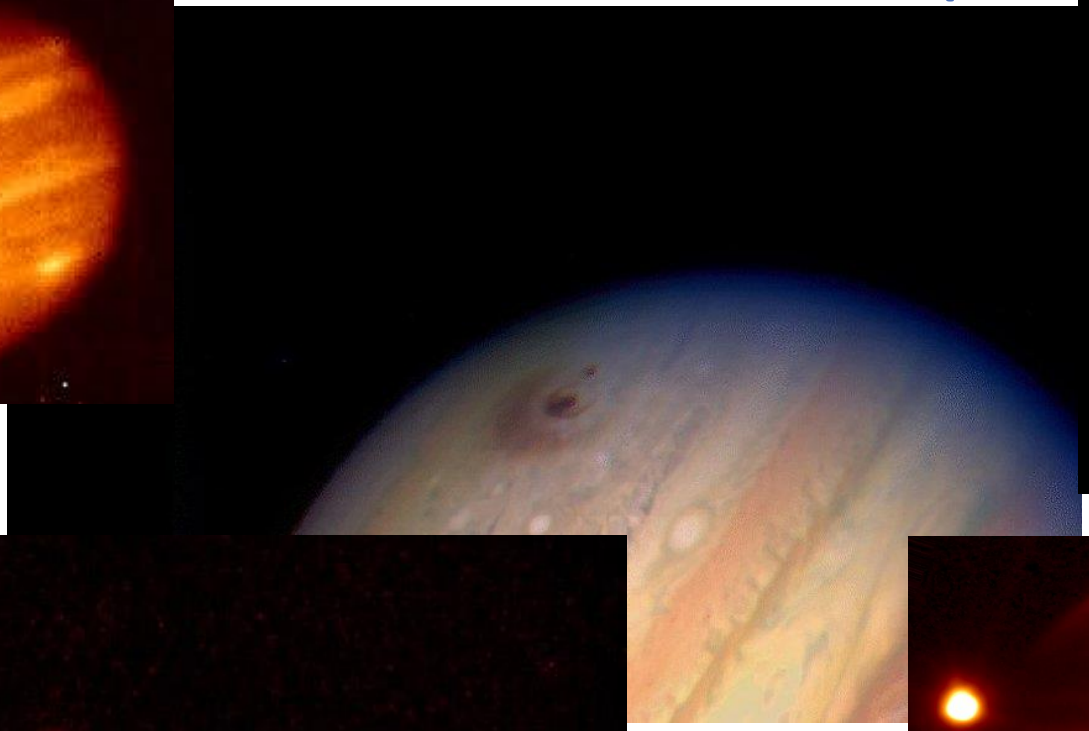
Components of Comets

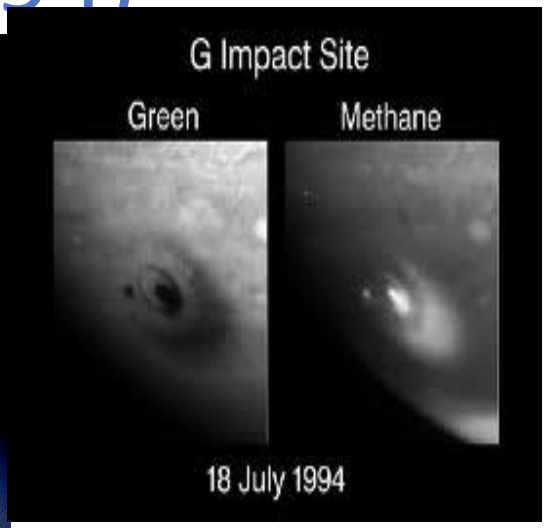


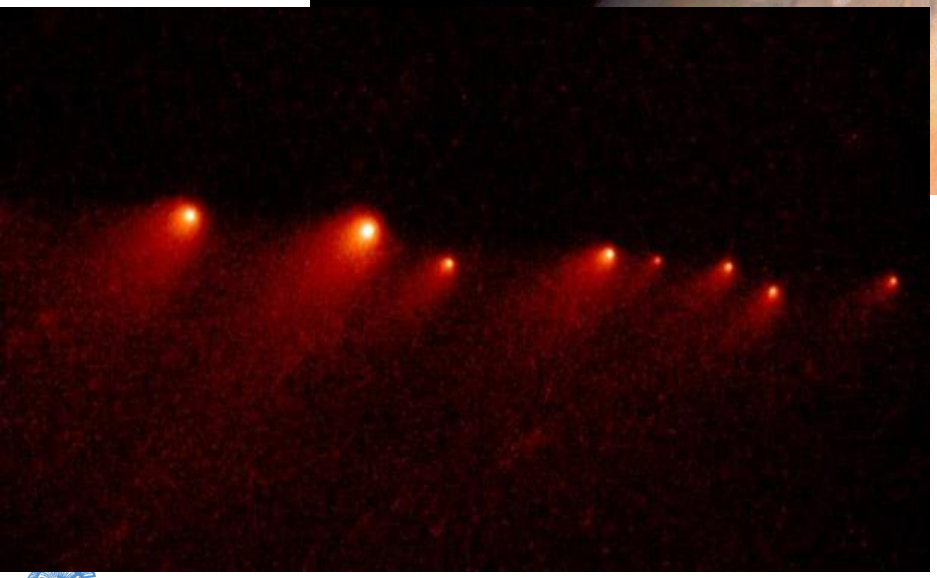


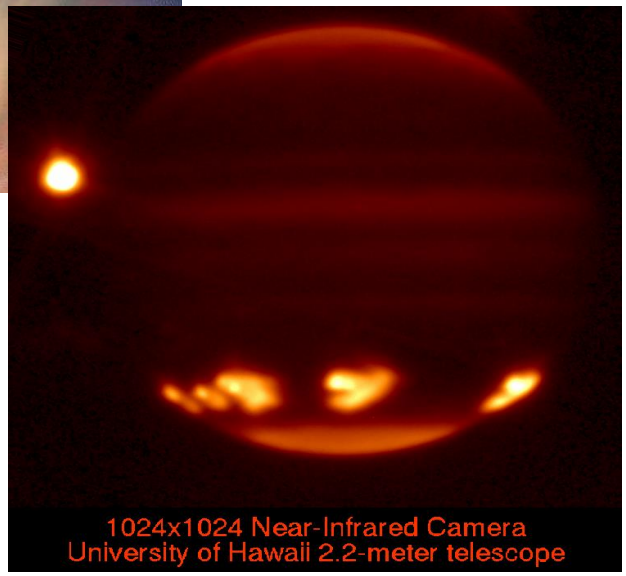

Comet LINEAR
Fragments
August 5, 2000
HST
University of Hawaii
STScI-PRC00-27

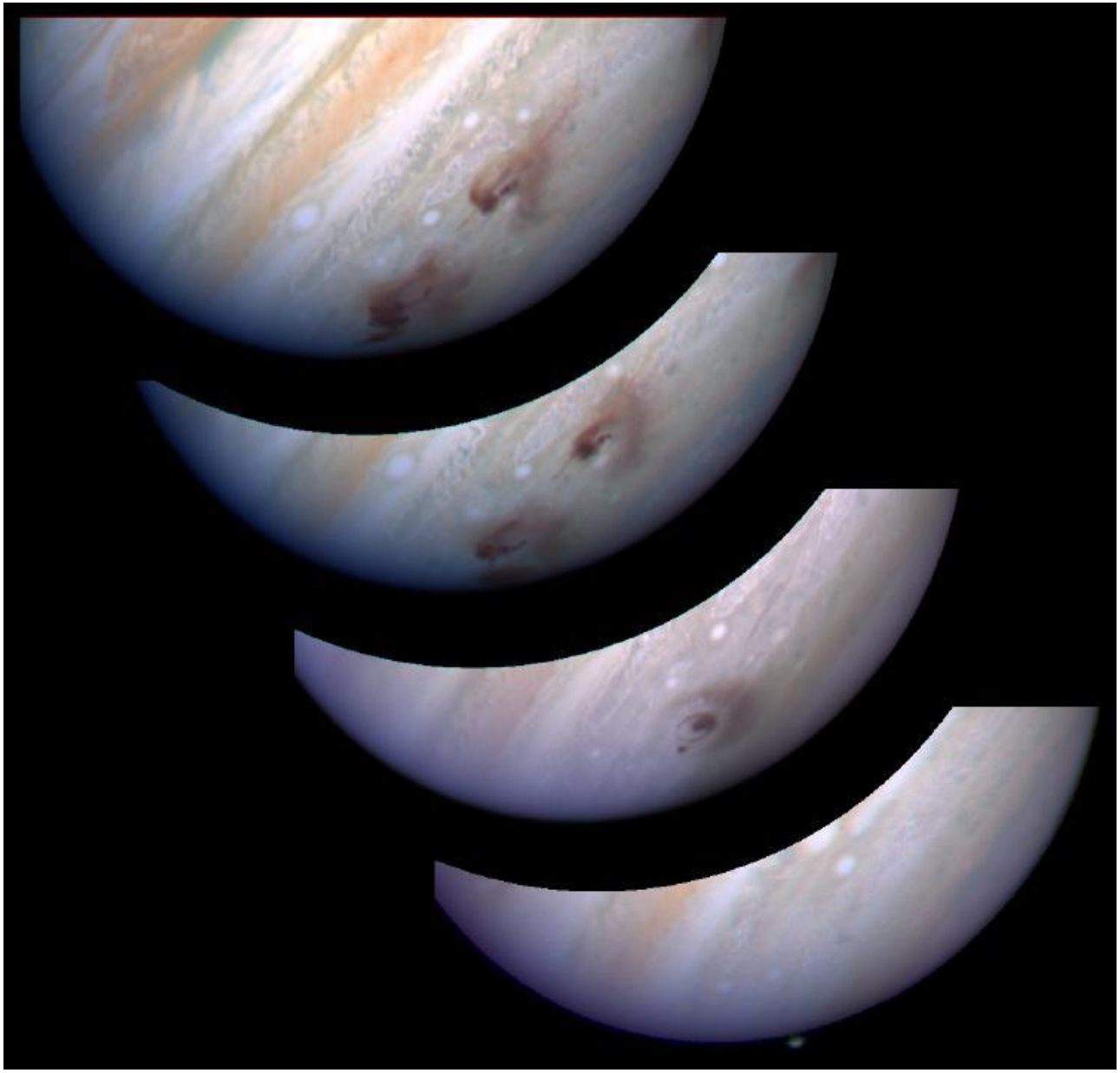
HOEMAKER-LEVY (1994)



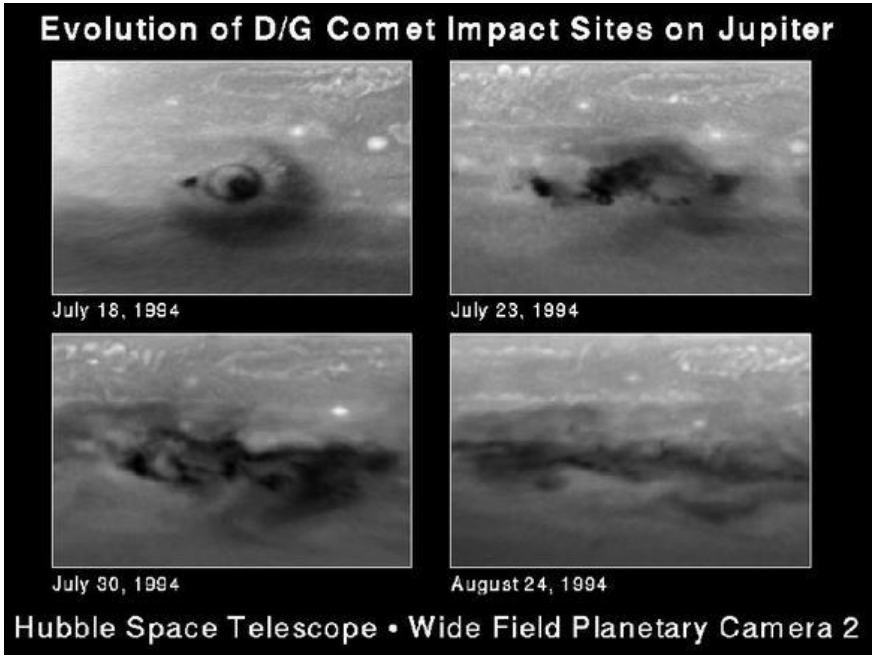


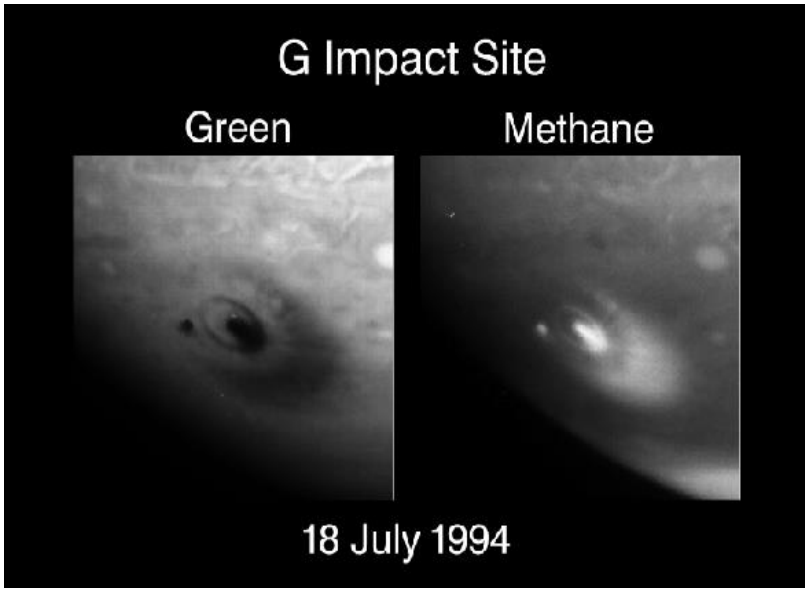


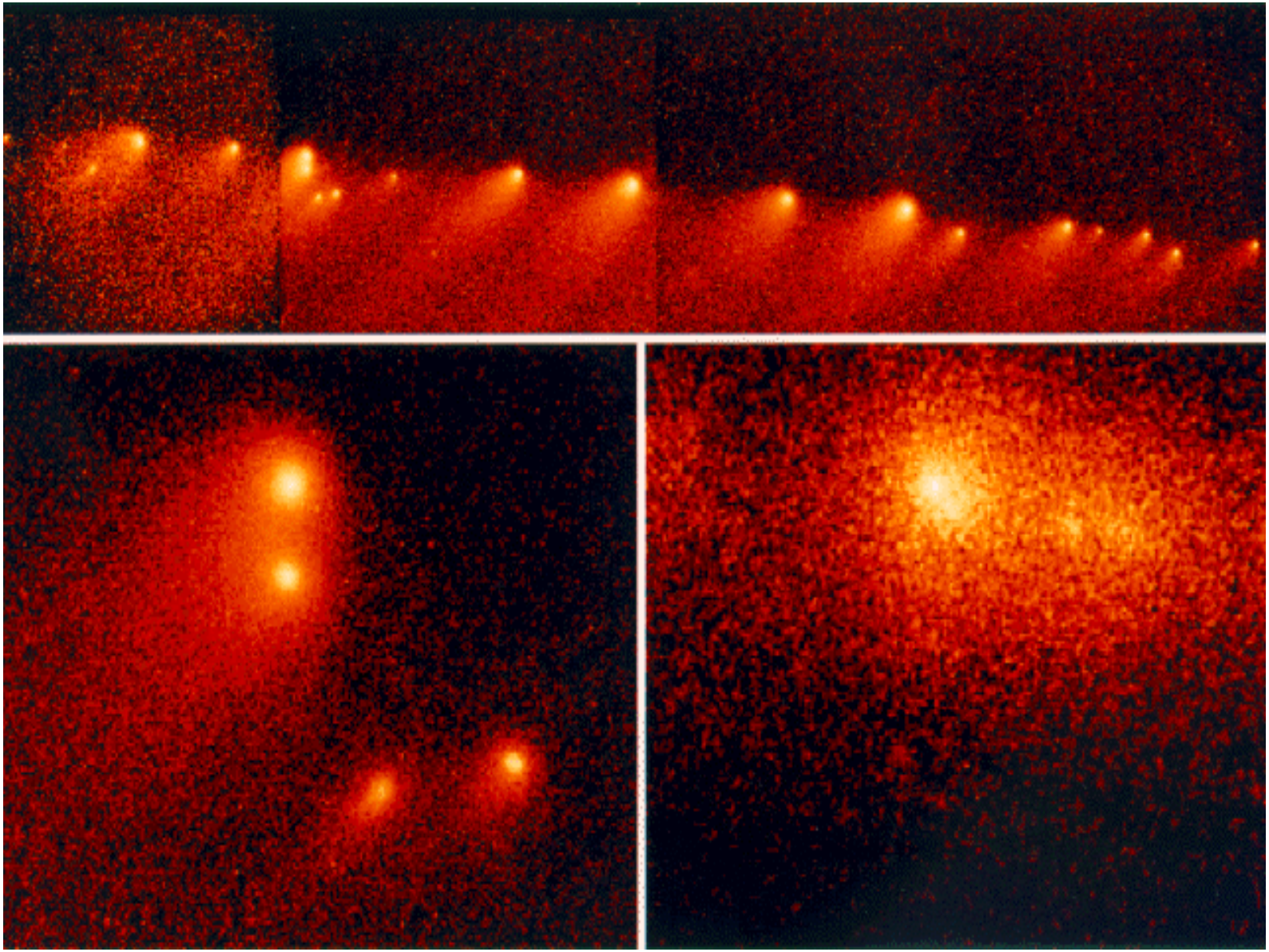




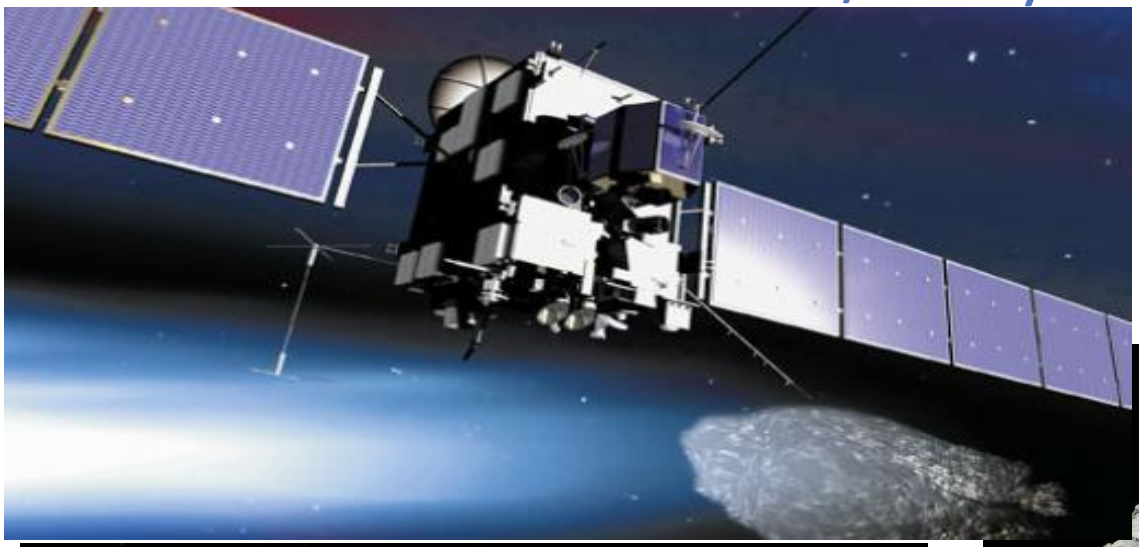
S-L ON JUPITER



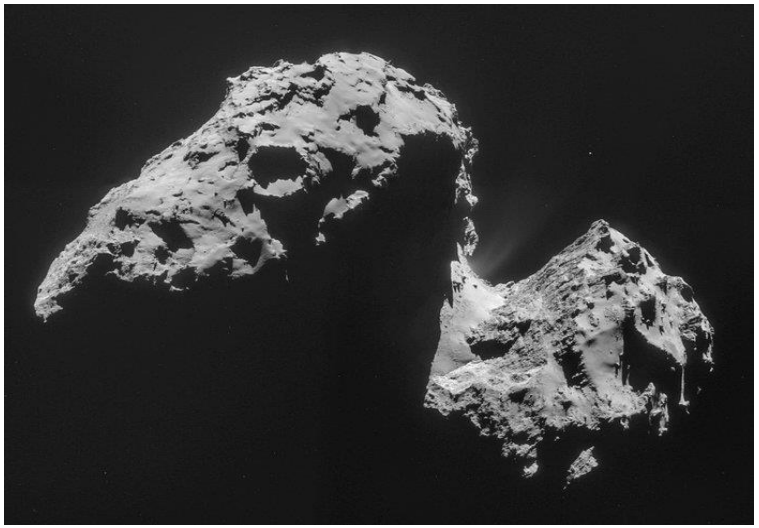


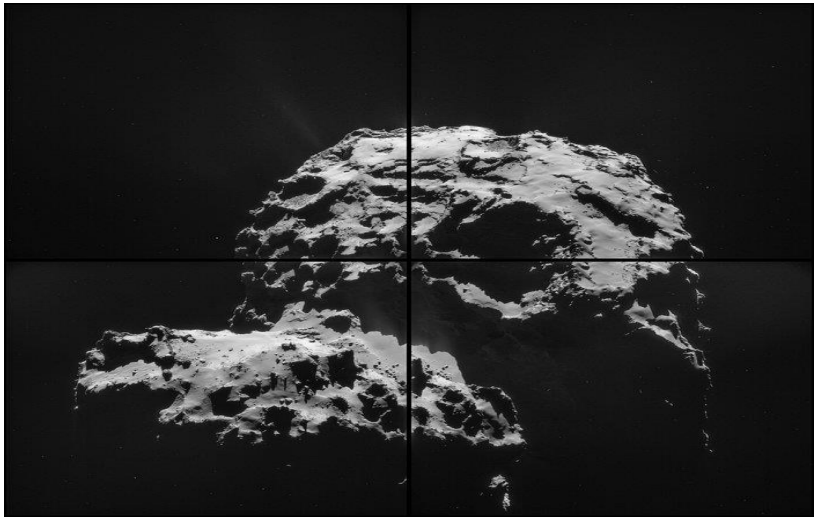


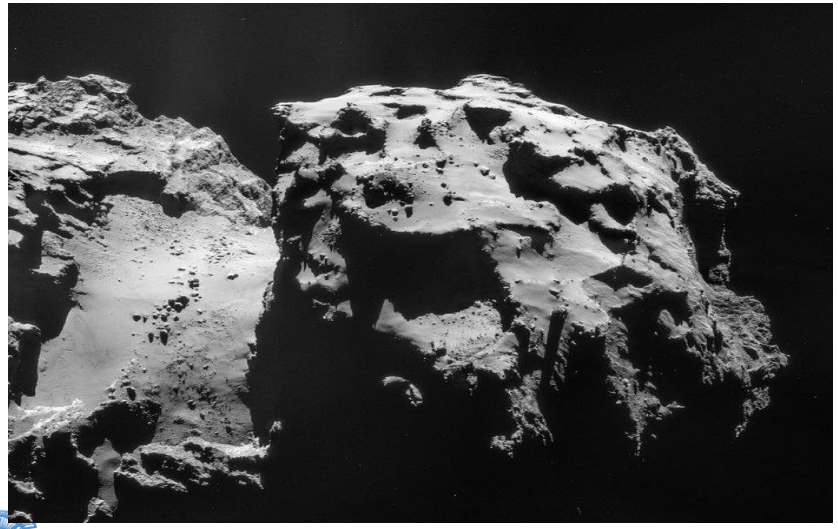
Rosetta-Philae in 67P/Churyumov-Gerasimenko

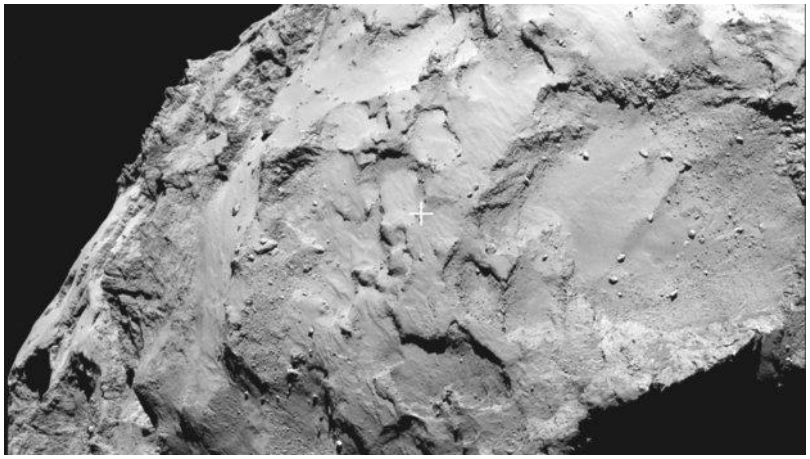


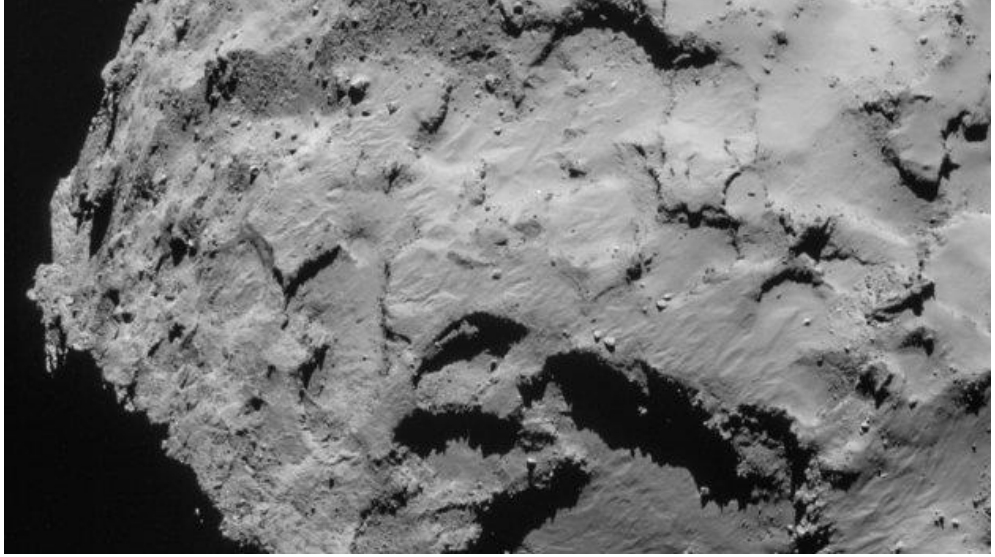
COMET 67P/C CHURYUMOV-GERASIMENKO

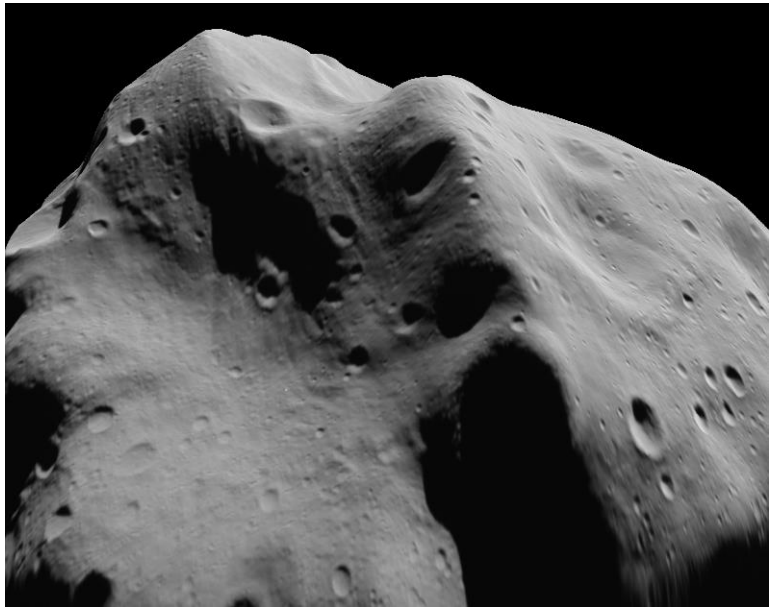


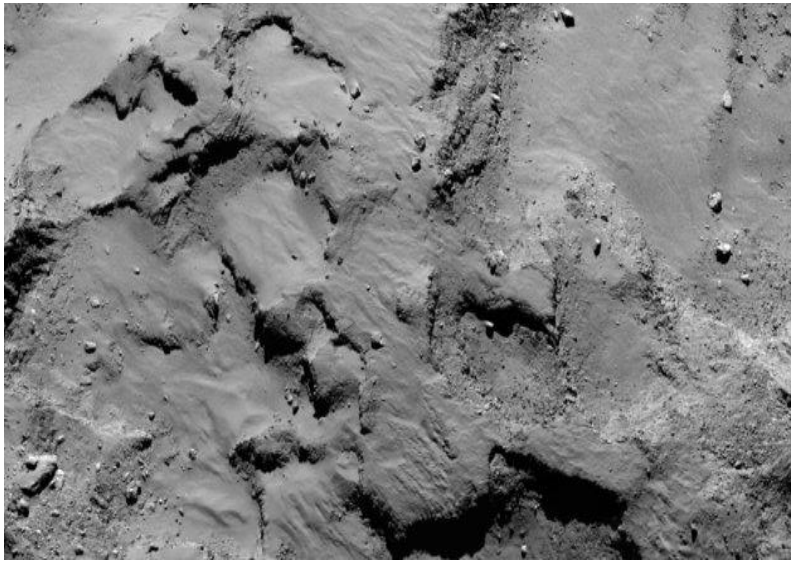


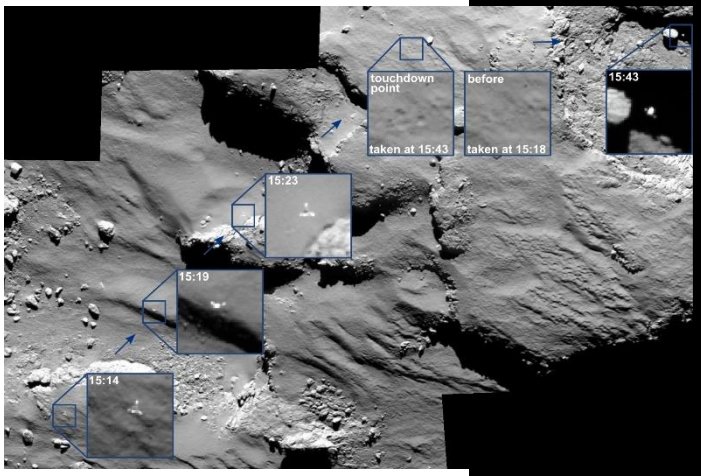


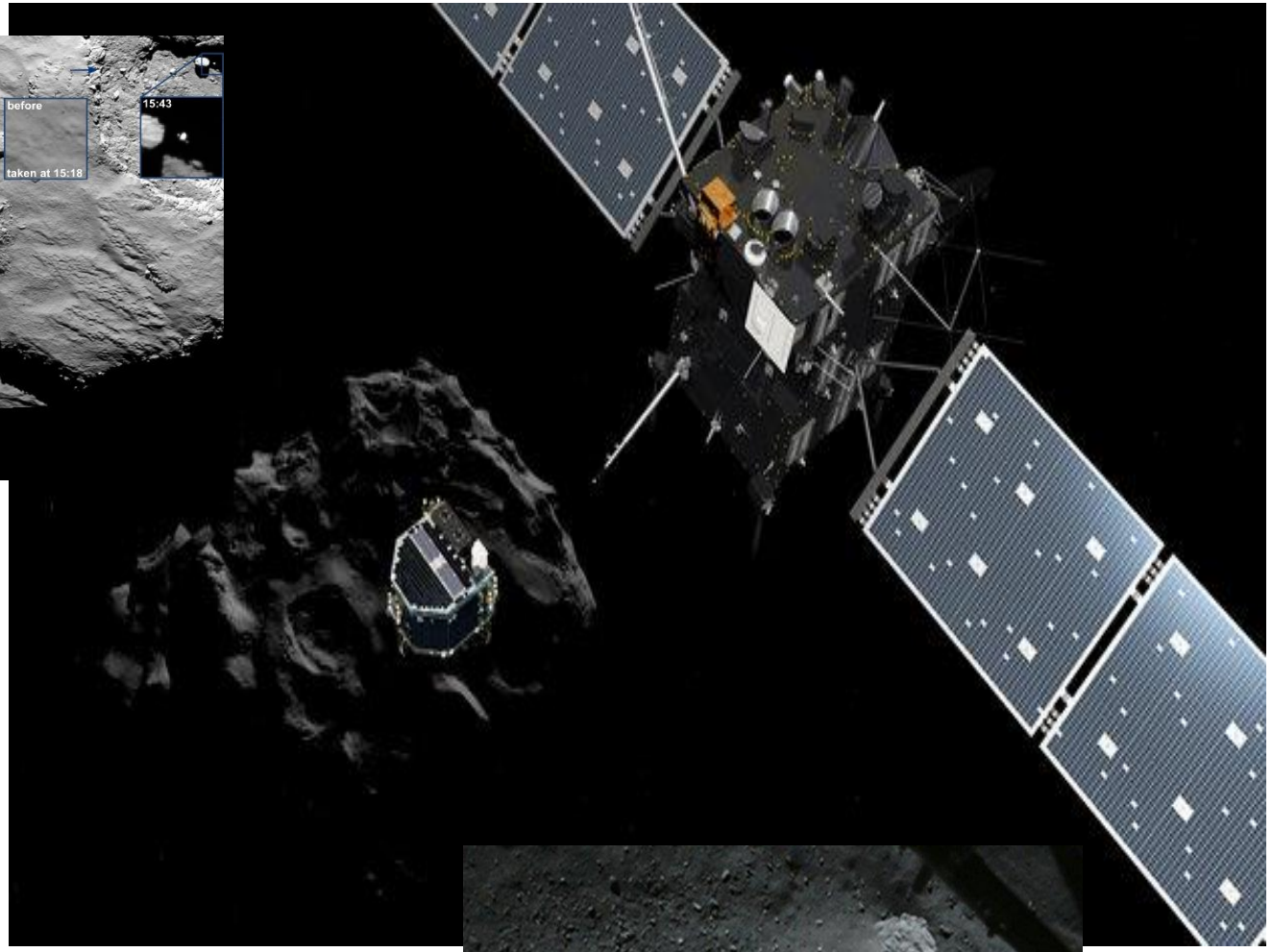


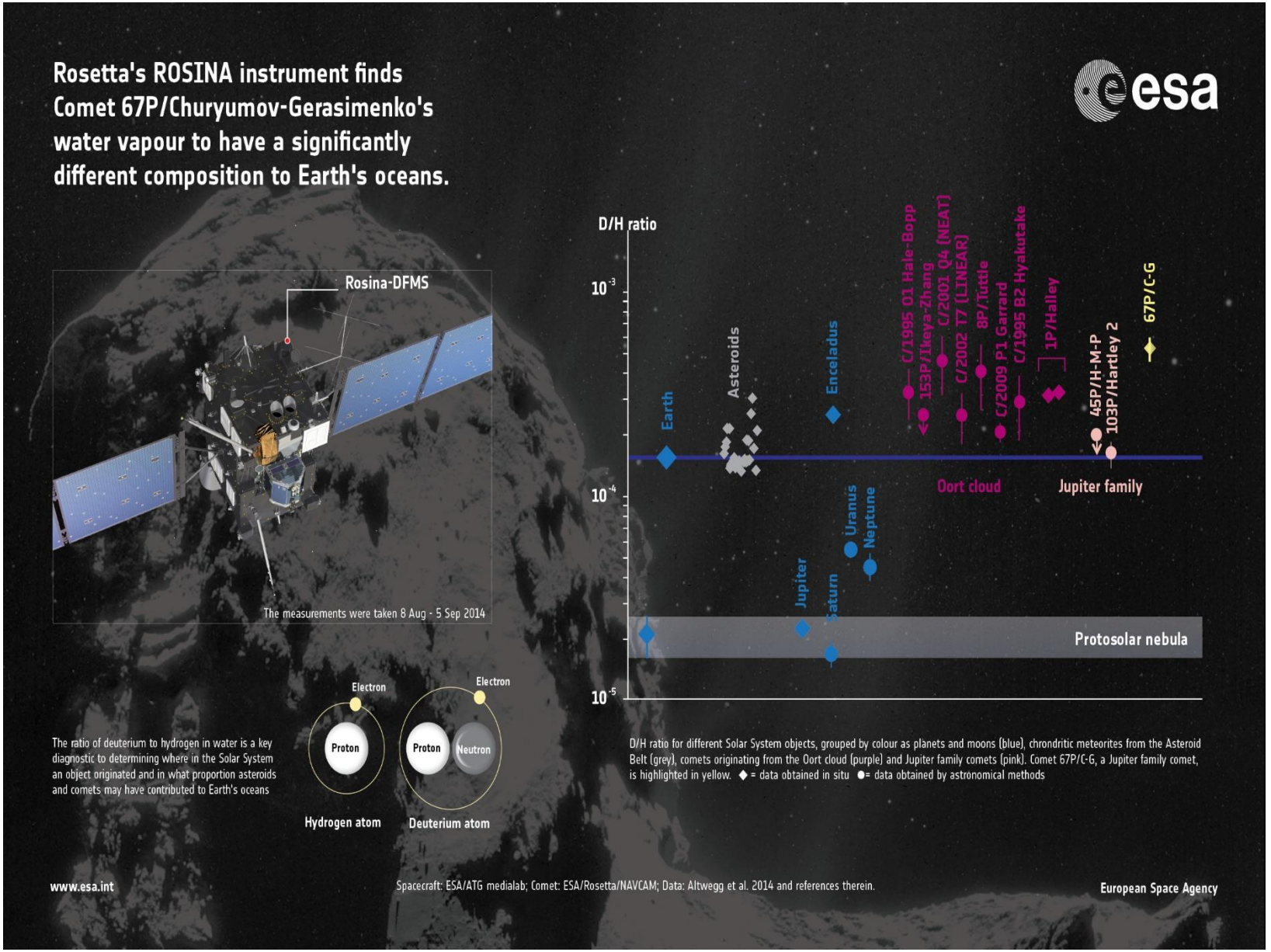


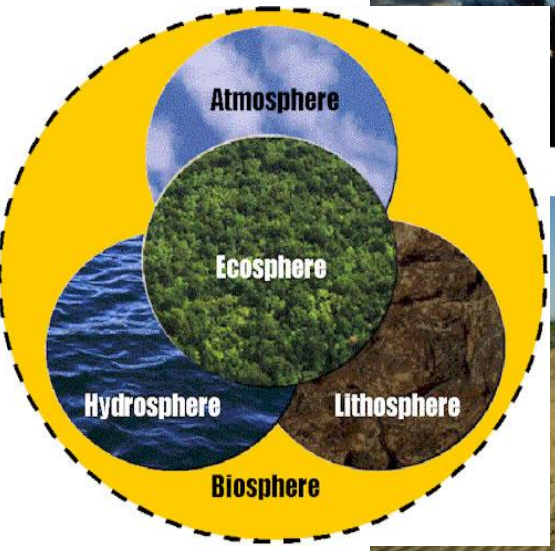


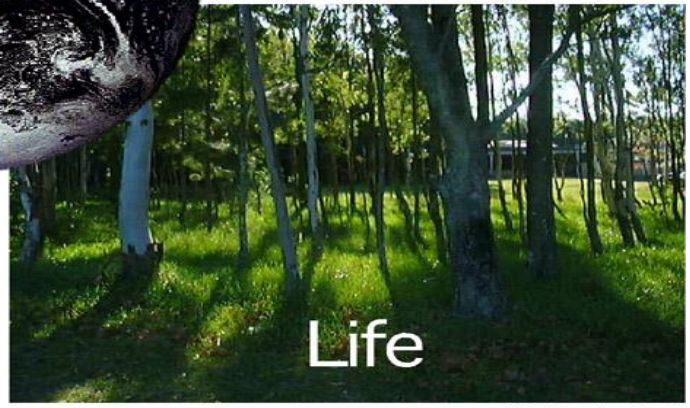



touchdown point
taken at 15:43
before
taken at 15:18
15:43
15:23
15:19
15:14



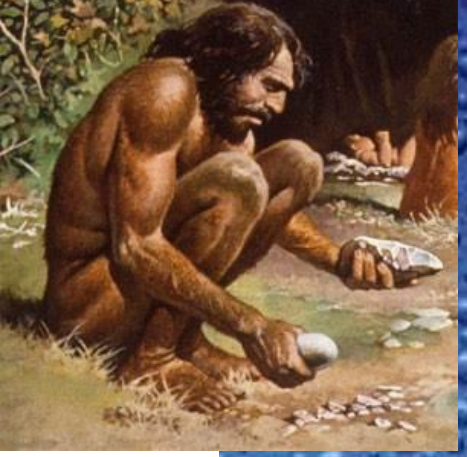

Rosetta's ROSINA instrument finds Comet 67P/Churyumov-Gerasimenko's water vapour to have a significantly different composition to Earth's oceans.
esa
Rosina-DFMS
The measurements were taken 8 Aug - 5 Sep 2014
D/H ratio
10^{-3}
10^{-4}
10^{-5}
Earth
Asteroids
Enceladus
C/1995 O1 Hale-Bopp
153P/Ikeya-Zhang
C/2001 Q4 (NEAT)
C/2002 T7 (LINEAR)
8P/Tuttle
C/2009 P1 Garrard
C/1995 B2 Hyakutake
1P/Halley
45P/H-M-P
103P/Hartley 2
67P/C-G
Oort cloud
Jupiter family
Uranus
Neptune
Jupiter
Saturn
Protosolar nebula
Electron
Proton
Electron
Proton
Neutron
Hydrogen atom
Deuterium atom
The ratio of deuterium to hydrogen in water is a key diagnostic to determining where in the Solar System an object originated and in what proportion asteroids and comets may have contributed to Earth's oceans
D/H ratio for different Solar System objects, grouped by colour as planets and moons (blue), chrondritic meteorites from the Asteroid Belt (grey), comets originating from the Oort cloud (purple) and Jupiter family comets (pink). Comet 67P/C-G, a Jupiter family comet, is highlighted in yellow. ◆= data obtained in situ ●= data obtained by astronomical methods
www.esa.int
Spacecraft: ESA/ATG medialab; Comet: ESA/Rosetta/NAVCAM; Data: Altwegg et al. 2014 and references therein.
European Space Agency



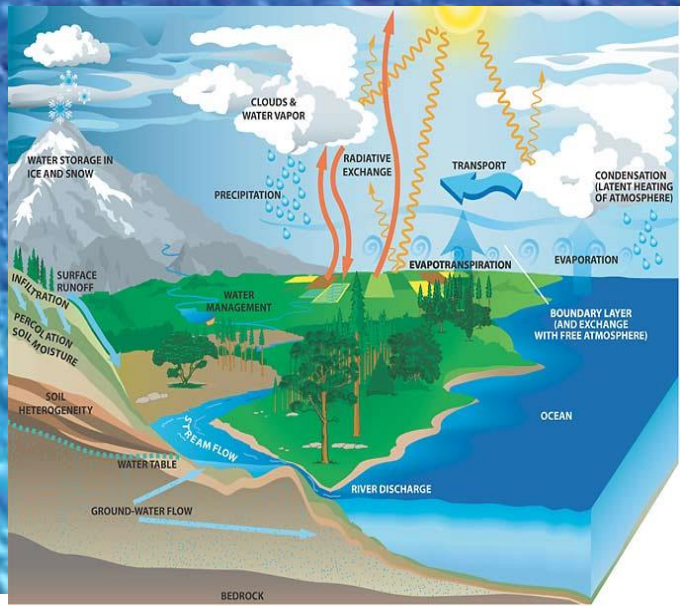


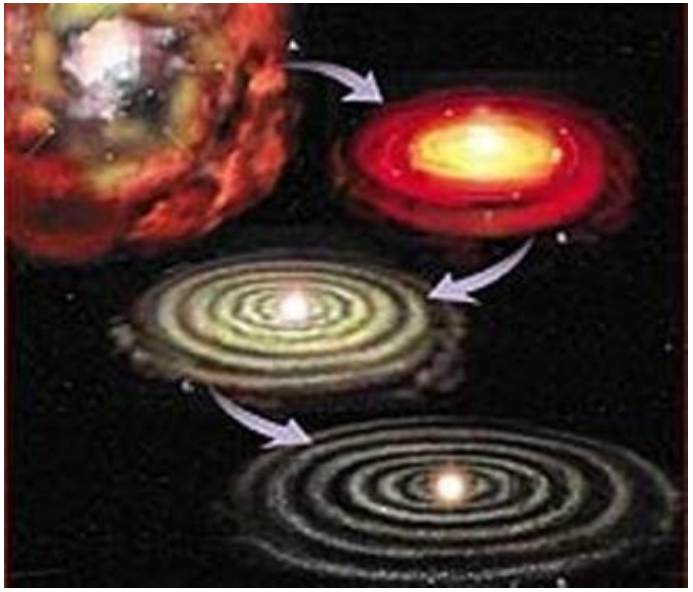
M. Ruzek, 1999

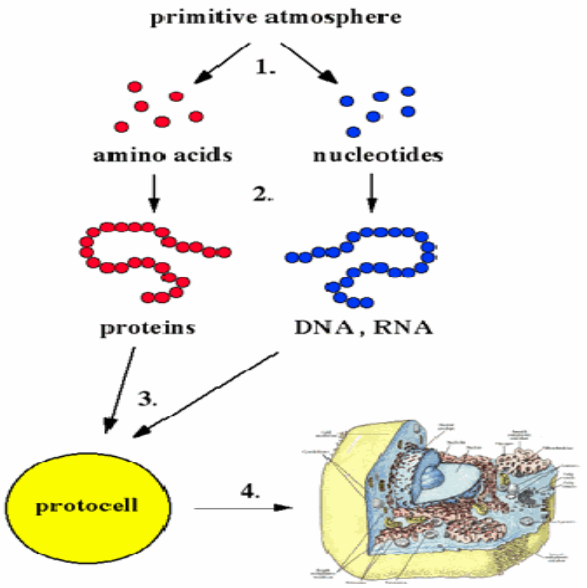
The Earth System




Equator


CLOUDS & WATER VAPOR
WATER STORAGE IN ICE AND SNOW
RADIATIVE EXCHANGE
TRANSPORT
CONDENSATION (LATENT HEATING OF ATMOSPHERE)
PRECIPITATION
EVAPOTRANSPIRATION
EVAPORATION
SURFACE RUNOFF
INFILTRATION
WATER MANAGEMENT
BOUNDARY LAYER (AND EXCHANGE WITH FREE ATMOSPHERE)
PERCOLATION
SOIL MOISTURE
SOIL HETEROGENEITY
STREAM FLOW
OCEAN
WATER TABLE
RIVER DISCHARGE
GROUND-WATER FLOW
BEDROCK

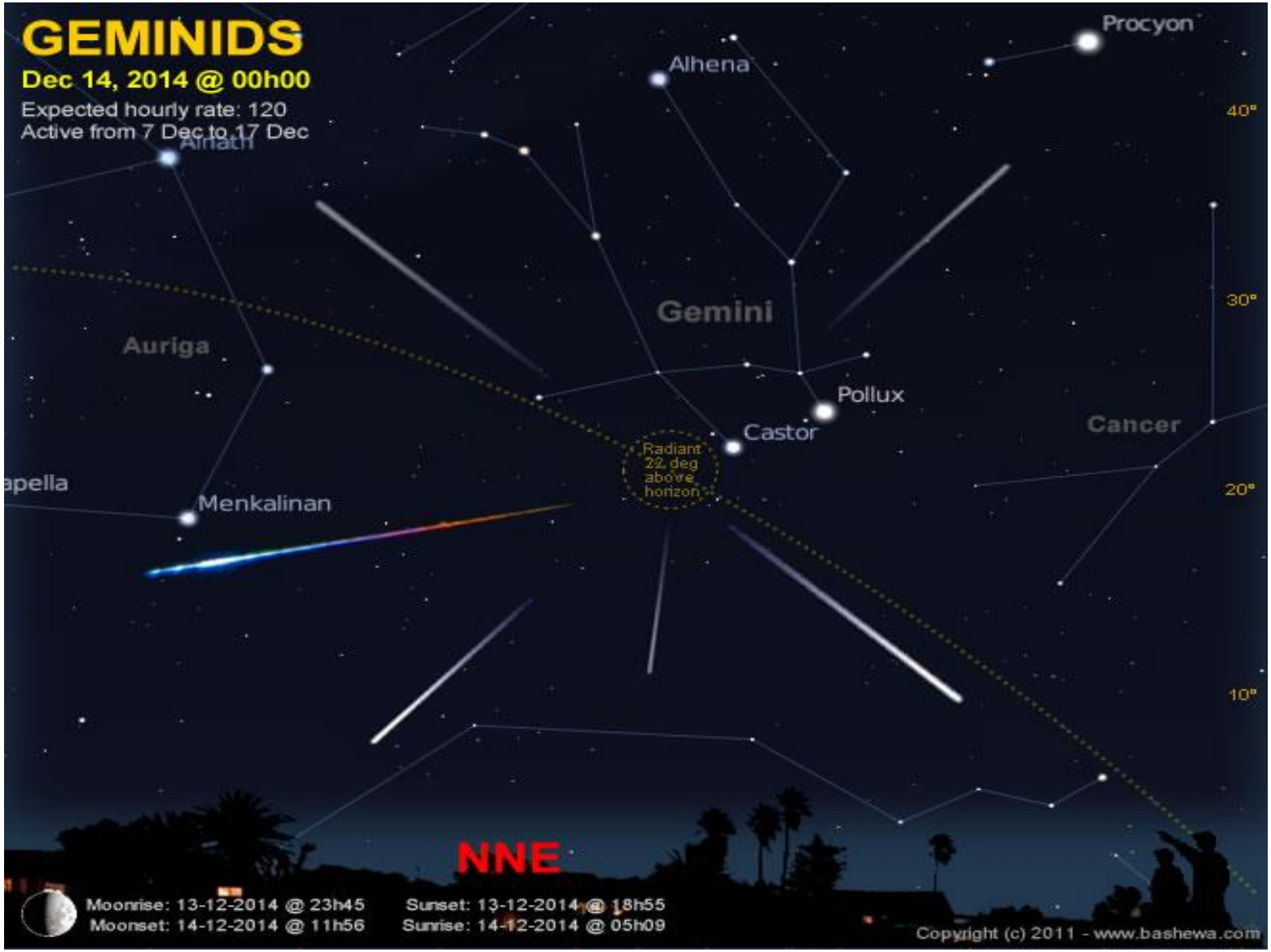


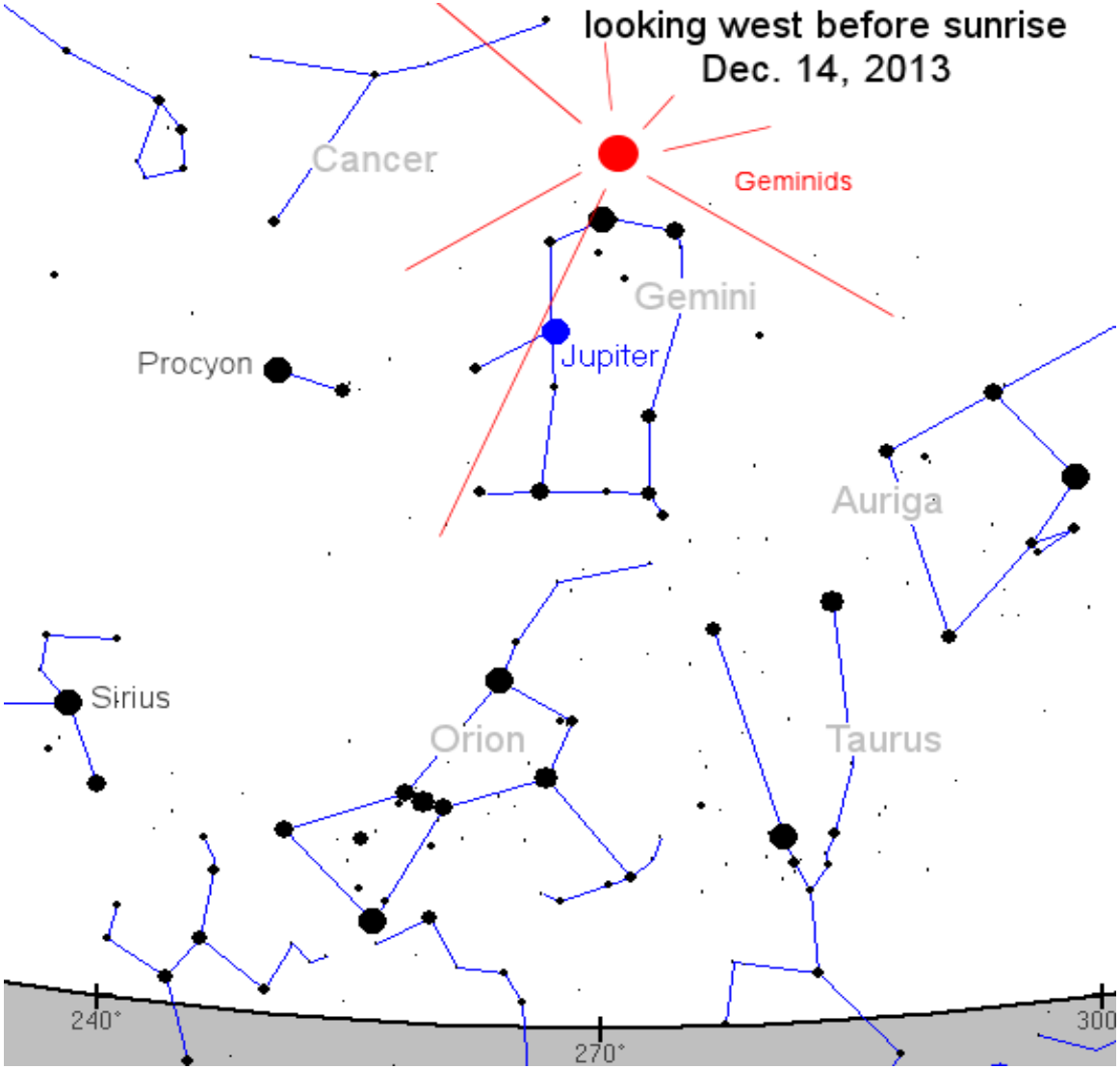

primitive atmosphere
1.
amino acids
nucleotides
2.
proteins
DNA, RNA
3.
protocell
4.

PERSEID METEORS OVER METEORA

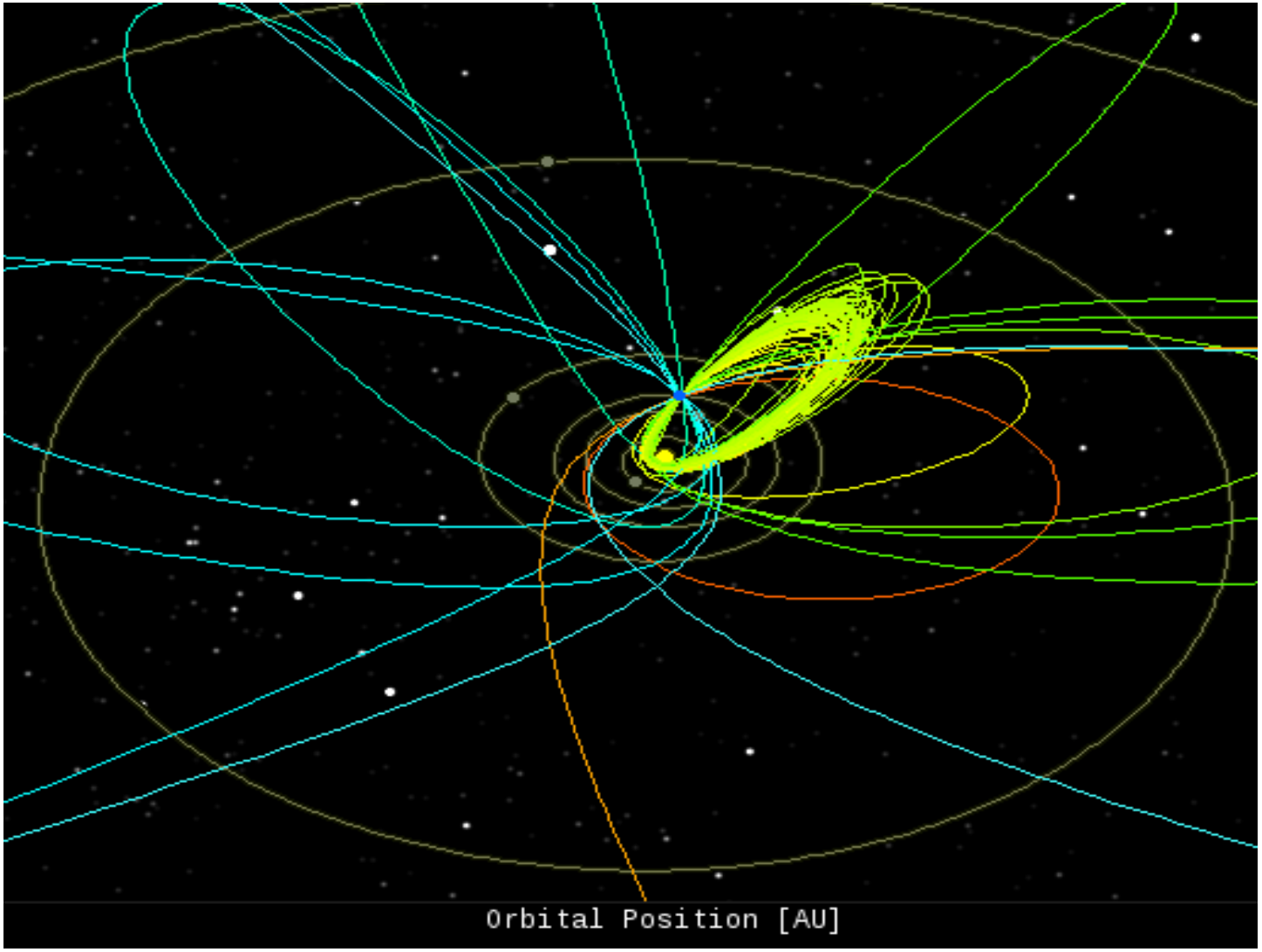
LEONID


Image © by AEROLITE METEORITES www.aerolite.org All rights reserved


GEMINIDS
Dec 14, 2014 @ 00h00
Expected hourly rate: 120
Active from 7 Dec to 17 Dec
Procyon
Alhena
Alnath
40°
Gemini
30°
Auriga
Pollux
Castor
Cancer
Radiant
22 deg
above
horizon
apella
Menkalinan
20°
10°
NNE
Moonrise: 13-12-2014 @ 23h45
Moonset: 14-12-2014 @ 11h56
Sunset: 13-12-2014 @ 18h55
Sunrise: 14-12-2014 @ 05h09
Copyright (c) 2011 - www.bashewa.com


looking west before sunrise
Dec. 14, 2013
Cancer
Geminids
Gemini
Procyon
Jupiter
Auriga
Sirius
Orion
Taurus
240°
270°
300

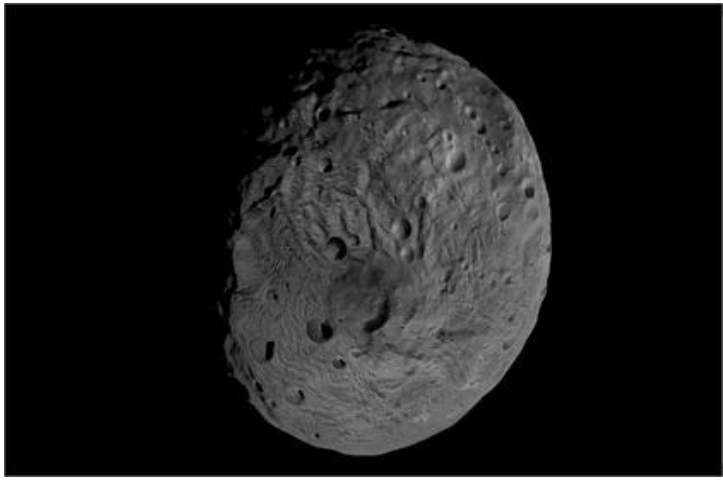
13 December 2013

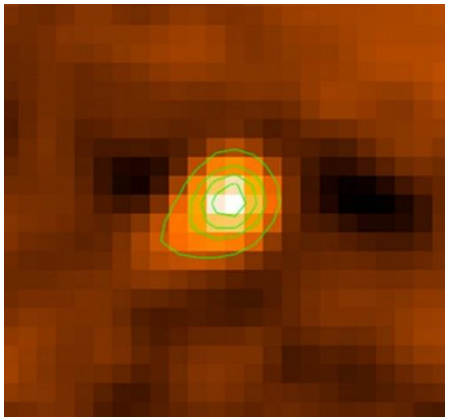


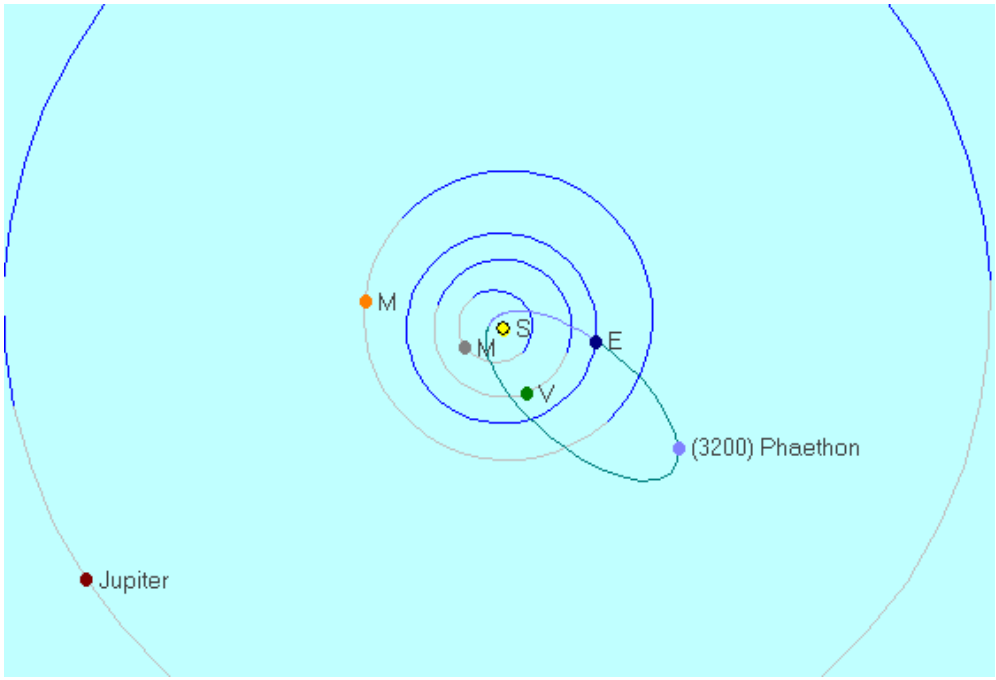
Geminids

1862

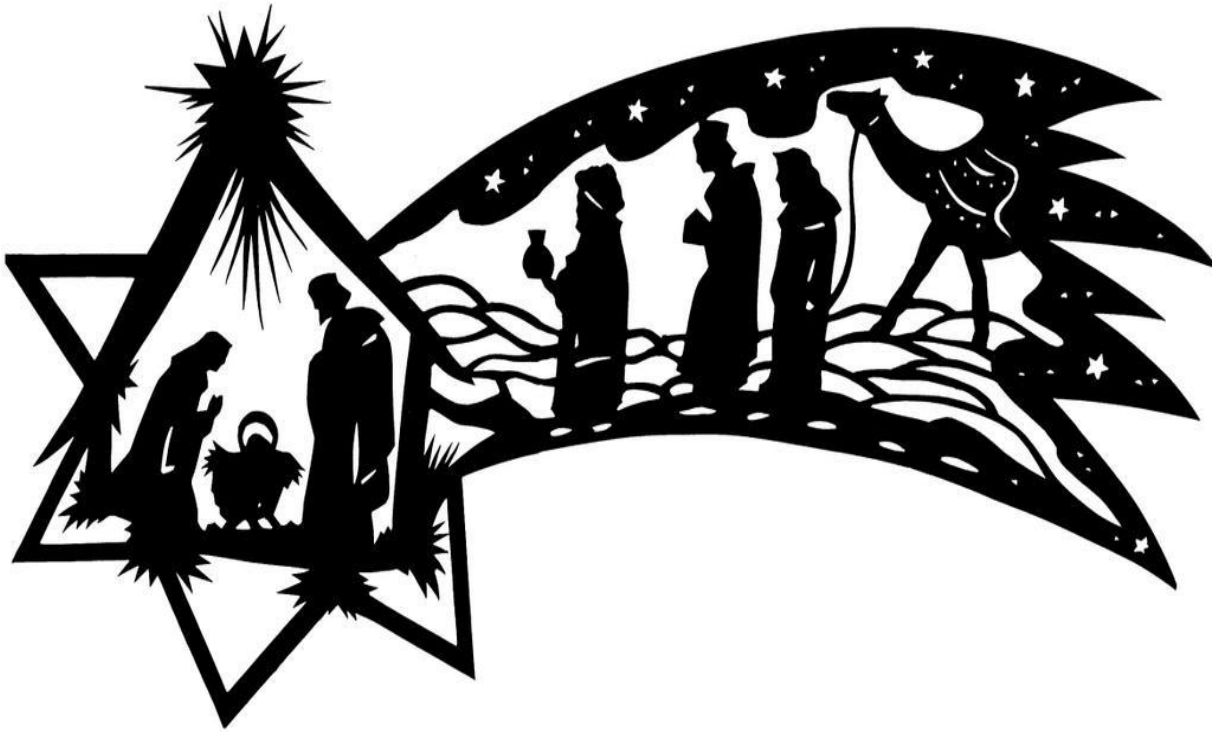
2012






M
S
M
E
V
(3200) Phaethon
Jupiter


AstroPodcast



Τέλος Ενότητας

Χρηματοδότηση

- Το παρόν εκπαιδευτικό υλικό έχει αναπτυχθεί στο πλαίσιο του εκπαιδευτικού έργου του διδάσκοντα.
- Το έργο «**Ανοικτά Ακαδημαϊκά Μαθήματα στο Πανεπιστήμιο Αθηνών**» έχει χρηματοδοτήσει μόνο την αναδιαμόρφωση του εκπαιδευτικού υλικού.
- Το έργο υλοποιείται στο πλαίσιο του Επιχειρησιακού Προγράμματος «Εκπαίδευση και Δια Βίου Μάθηση» και συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση (Ευρωπαϊκό Κοινωνικό Ταμείο) και από εθνικούς πόρους.

Σημειώματα

Σημείωμα Ιστορικού Εκδόσεων Έργου

Το παρόν έργο αποτελεί την έκδοση 1.0.0.

Σημείωμα Αναφοράς

Σημείωμα Αδειοδότησης

Διατήρηση Σημειωμάτων

Οποιαδήποτε αναπαραγωγή ή διασκευή του υλικού θα πρέπει να συμπεριλαμβάνει:

- το Σημείωμα Αναφοράς
- το Σημείωμα Αδειοδότησης
- τη δήλωση Διατήρησης Σημειωμάτων
- το Σημείωμα Χρήσης Έργων Τρίτων (εφόσον υπάρχει)

μαζί με τους συνοδευόμενους υπερσυνδέσμους.