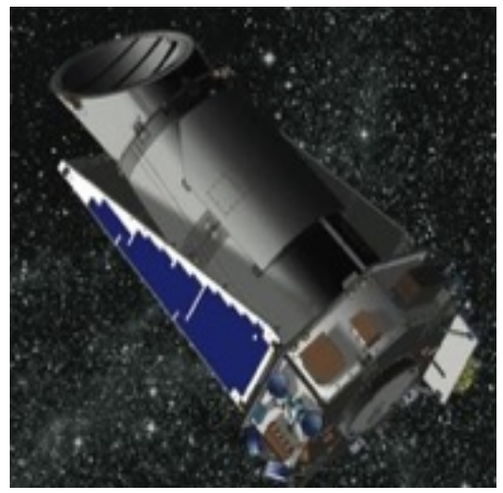
Napfogyatkozások közel és távol

Kiss László

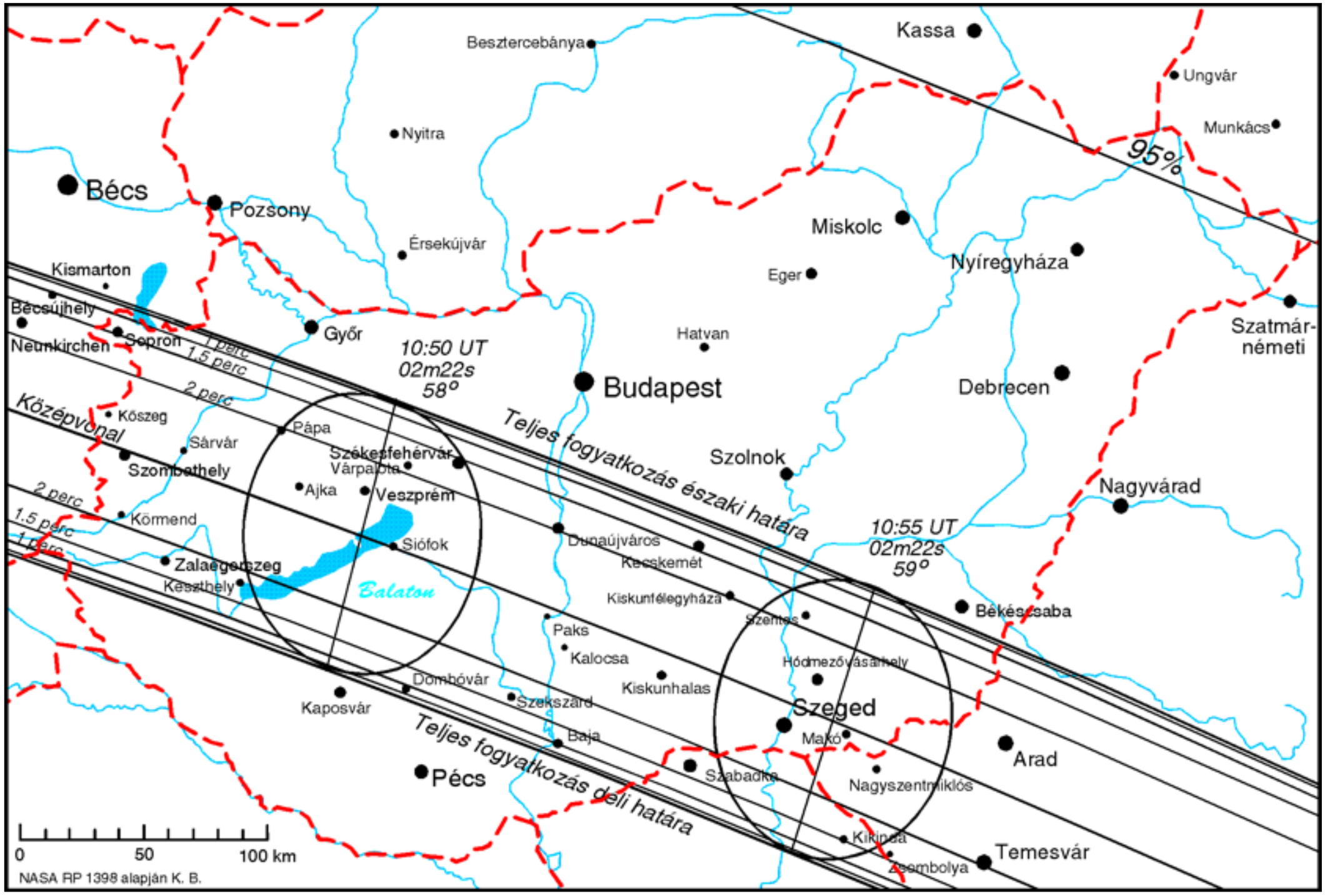
MTA CSFK KTM CSI

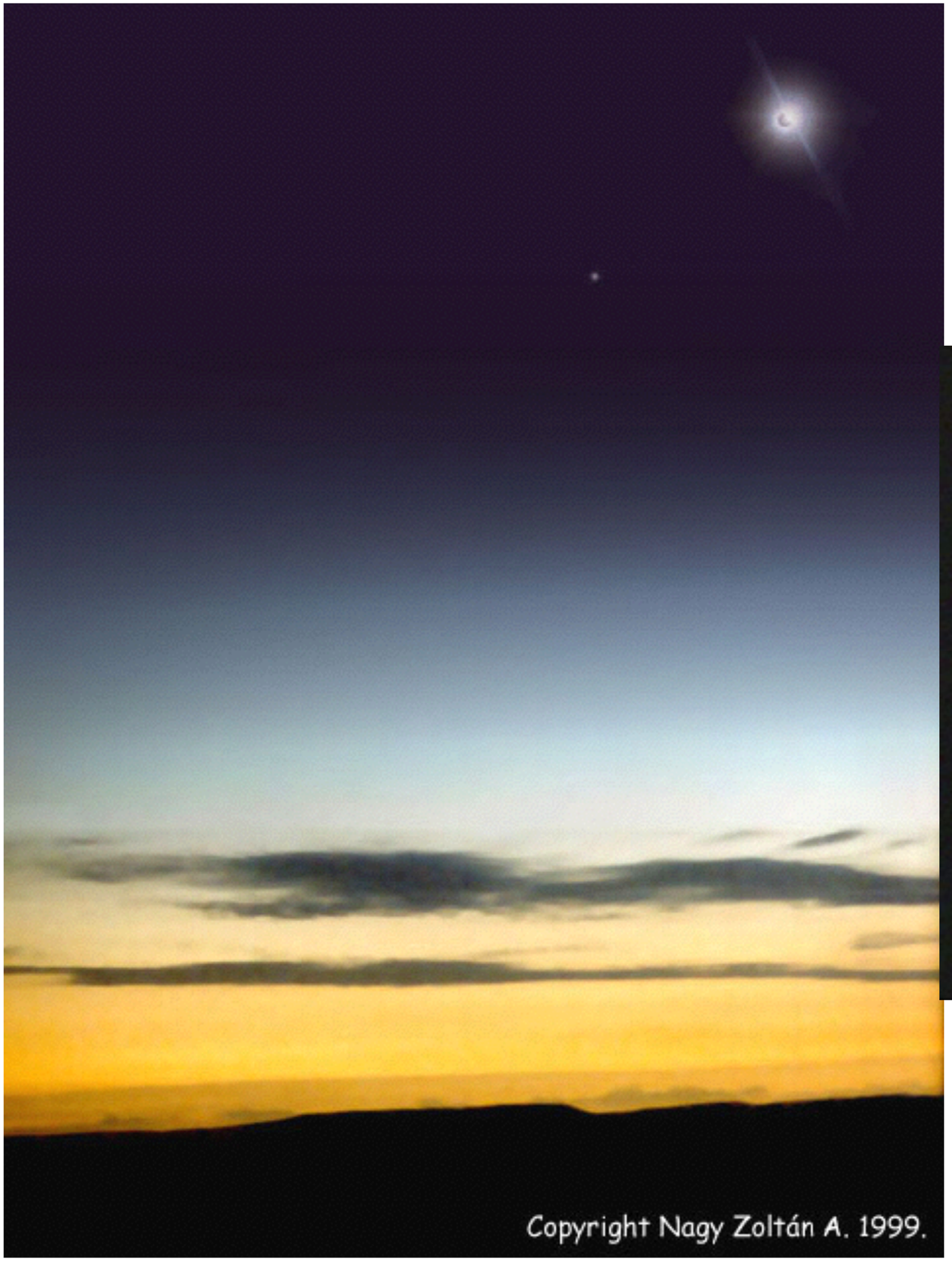
Szeged, 2014. augusztus 11.



Augusztus 11…

1999. augusztus 11.: teljes napfogyatkozás Magyarországon




Copyright Nagy Zoltán A. 1999.


Copyright Nagy Zoltán A. 1999.


Copyright Óra András 1999.


Copyright Lantos Zsolt, 1999.

Total Solar Eclipse of 2012 Nov 13

Ecliptic Conjunction = 22:09:06.6 TD (= 22:07:59.8 UT)
Greatest Eclipse = 22:12:55.0 TD (= 22:11:48.2 UT)

Eclipse Magnitude = 1.0500 Gamma = -0.3719

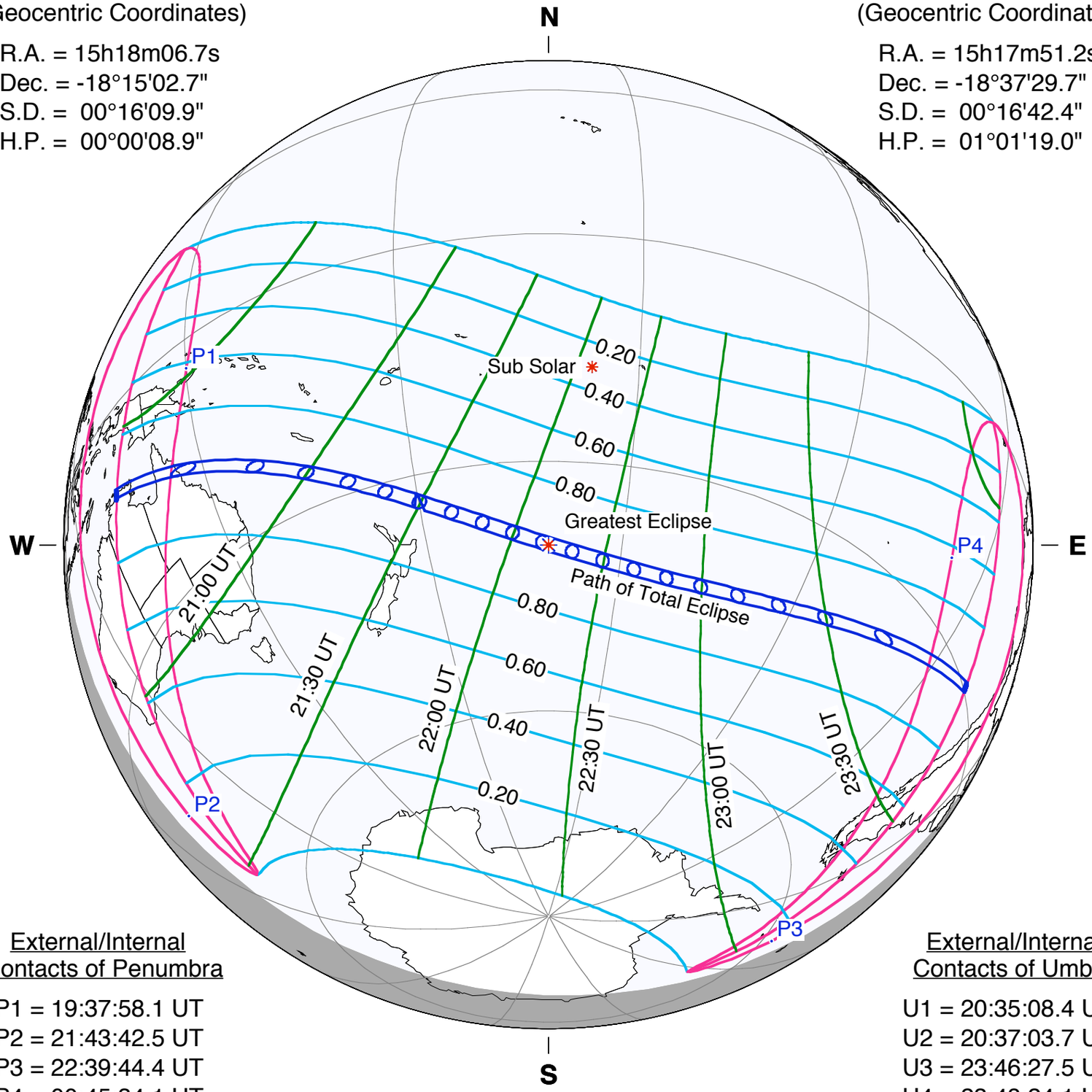
Saros Series = 133 Member = 45 of 72

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 15h18m06.7s
Dec. = -18°15'02.7"
S.D. = 00°16'09.9"
H.P. = 00°00'08.9"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 15h17m51.2s
Dec. = -18°37'29.7"
S.D. = 00°16'42.4"
H.P. = 01°01'19.0"



External/Internal Contacts of Penumbra

P1 = 19:37:58.1 UT
P2 = 21:43:42.5 UT
P3 = 22:39:44.4 UT
P4 = 00:45:34.1 UT

External/Internal Contacts of Umbra

U1 = 20:35:08.4 UT
U2 = 20:37:03.7 UT
U3 = 23:46:27.5 UT
U4 = 23:48:24.1 UT

Fényképes helyszíni tudósítás az ausztrál napfogyatkozásról

Szerző: Kiss László | 2012. november 14, szerda

Nyomtatható változat

Nehéz tárgyilagos maradni az égbolt legszebb csillagászati eseménye kapcsán: jelen sorok írójának percekig remegtek a lábai a totalitás pontosan két percig tartó gyönyörteli látványa, illetve a felvezető fényjátékok és színváltozások után. De ne szaladjunk ennyire előre a hírportál napfogyatkozás-expedíciójának eredményes megfigyelései kapcsán!

A helyi időben november 14-én, szerdán reggel bekövetkező fogyatkozásra rendkívüli alapossággal készültünk. Már a pénteki első terepfelmérő autós kirándulás során beazonosítottuk a Bob's Lookout néven ismert kilátót jó kétórás vezetésre a lakhelyünkként szolgáló Palm Cove-tól. A helyszín erősségei közül a legfontosabb a kellő távolság a tengerparttól (emiatt a partmenti gomolyfelhők már nem jutnak el idáig), a tökéletes délkeleti kilátás, illetve a Nap felé elterülő síkságra való rálátás.

Azért nem bíztunk semmit a véletlenre: hétfőn reggel innen néztük meg az 50 órás holdsarlót, s a közben begyűjtött pozitív benyomások alátámasztották az elhatározást, hogy nem a bizonytalan tengerparti övezetből kockáztatjuk meg életünk egyik legnagyobb égi jelenségének észlelését. Mindez kedd reggel csak tovább erősödött, amikor ugyan hajnal 5 és 6 között felszakadozott a felhőzet a tengerparton és sikeresen észleltük is az immár csak 25 órás holdsarlót a Csendes-óceán partjáról, ám a totalitás előtt pontosan 24 órával már zuhogó trópusi eső váltotta fel a derültes eget.

Természetesen biztosak voltunk abban is, hogy amatőrcsillagászok százai, de akár ezrei is ugyanerre a belső felföldi menekülő útvonalra gondolnak, ezért lakhelyünket már kedd este 8-kor elhagytuk. Terveink szerint kb. este tíztől reggel 5-ig


UCSB

Total Solar Eclipse of 2015 Mar 20

Ecliptic Conjunction = 09:37:18.2 TD (= 09:36:10.6 UT)
Greatest Eclipse = 09:46:46.8 TD (= 09:45:39.2 UT)

Eclipse Magnitude = 1.0446 Gamma = 0.9454

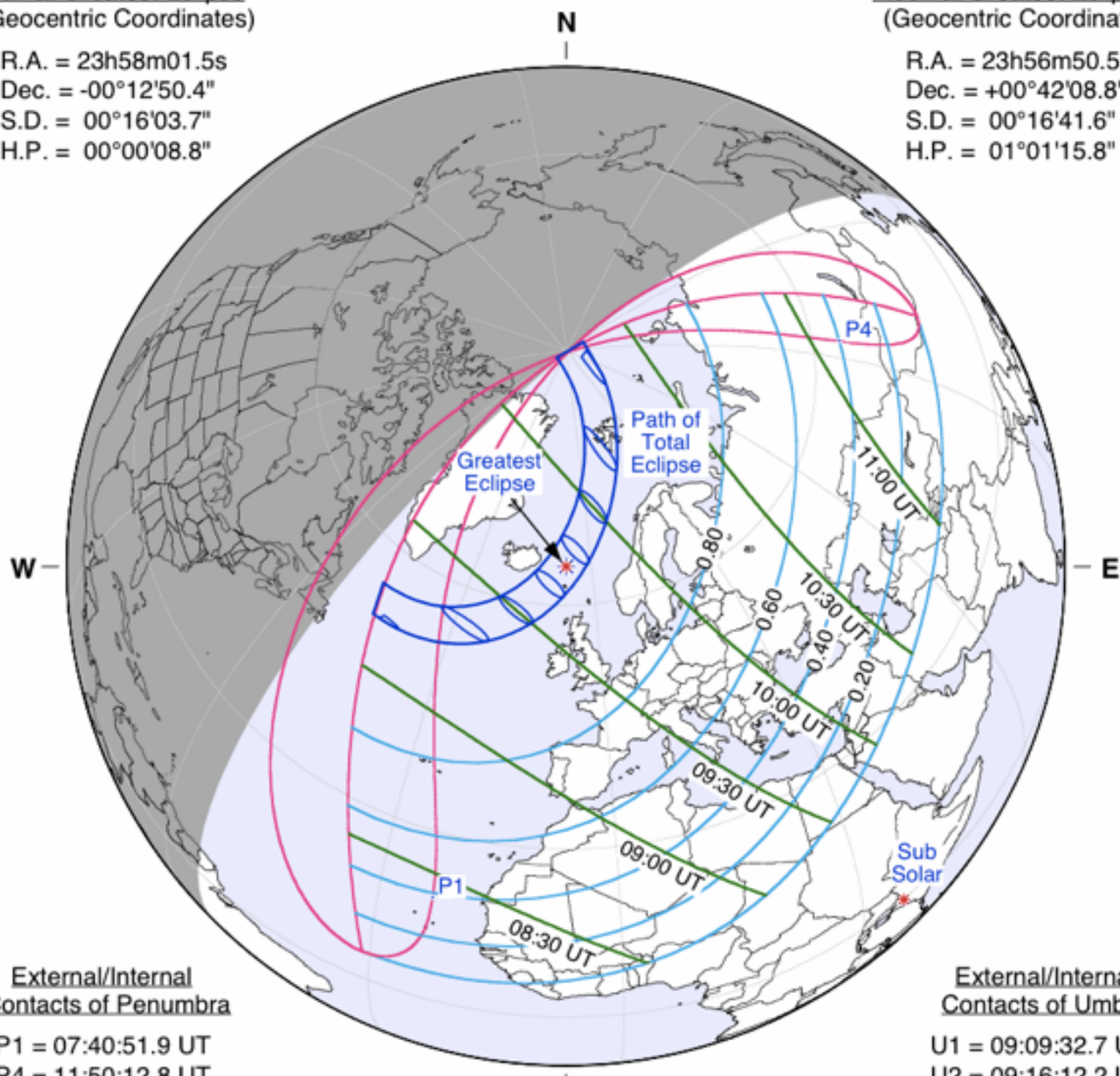
Saros Series = 120 Member = 61 of 71

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 23h58m01.5s
Dec. = -00°12'50.4"
S.D. = 00°16'03.7"
H.P. = 00°00'08.8"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 23h56m50.5s
Dec. = +00°42'08.8"
S.D. = 00°16'41.6"
H.P. = 01°01'15.8"



External/Internal Contacts of Penumbra

P1 = 07:40:51.9 UT
P4 = 11:50:12.8 UT

External/Internal Contacts of Umbra

U1 = 09:09:32.7 UT
U2 = 09:16:12.2 UT
U3 = 10:14:43.6 UT
U4 = 10:21:22.3 UT

Circumstances at Greatest Eclipse: 09:45:39.2 UT

Total Solar Eclipse of 2016 Mar 09

Ecliptic Conjunction = 01:55:37.5 TD (= 01:54:29.5 UT)
Greatest Eclipse = 01:58:19.5 TD (= 01:57:11.5 UT)

Eclipse Magnitude = 1.0450 Gamma = 0.2609

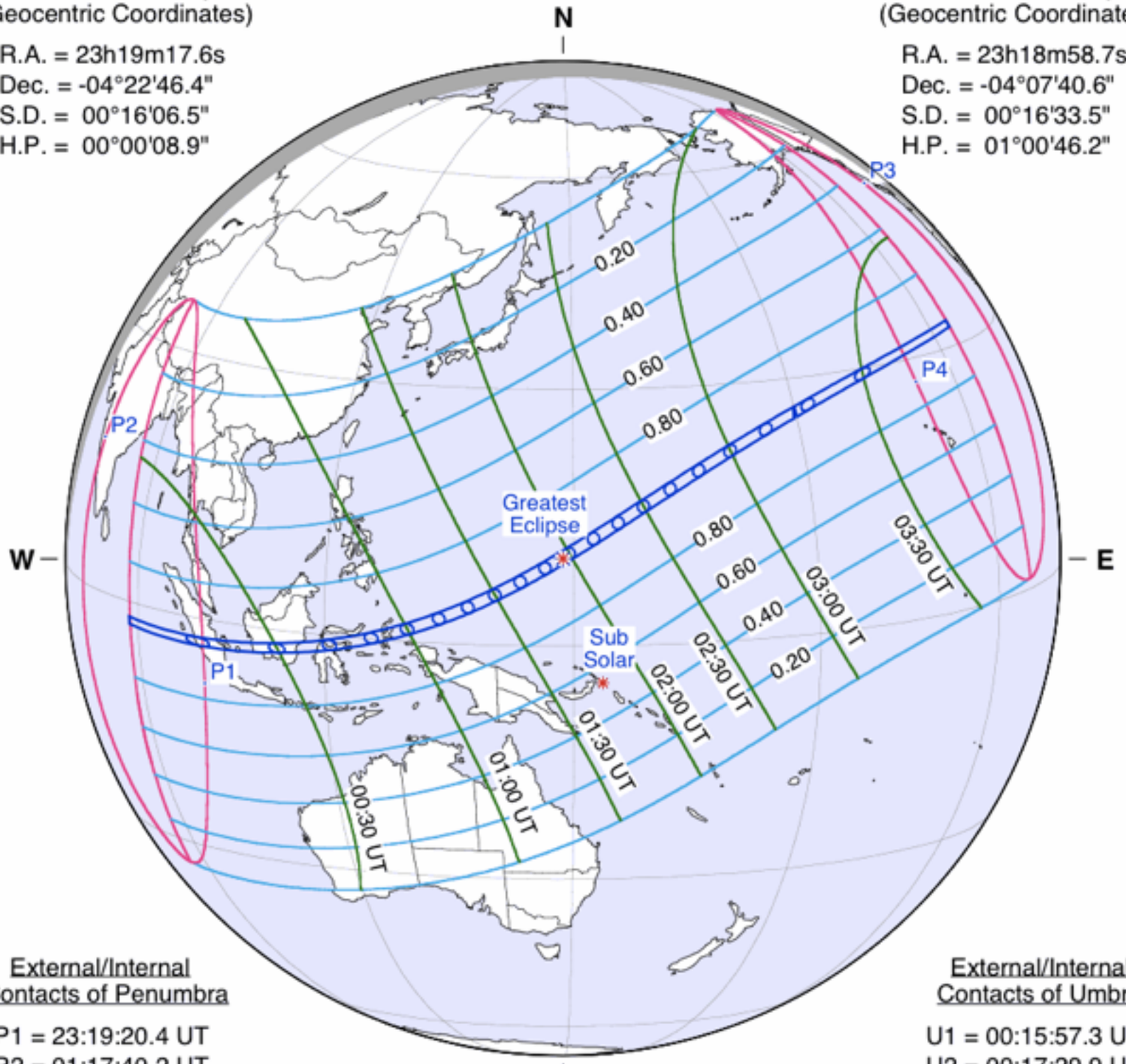
Saros Series = 130 Member = 52 of 73

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 23h19m17.6s
Dec. = -04°22'46.4"
S.D. = 00°16'06.5"
H.P. = 00°00'08.9"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 23h18m58.7s
Dec. = -04°07'40.6"
S.D. = 00°16'33.5"
H.P. = 01°00'46.2"



External/Internal Contacts of Penumbra

P1 = 23:19:20.4 UT
P2 = 01:17:40.2 UT
P3 = 02:36:30.0 UT
P4 = 04:34:55.4 UT

External/Internal Contacts of Umbra

U1 = 00:15:57.3 UT
U2 = 00:17:29.9 UT
U3 = 03:36:45.1 UT
U4 = 03:38:20.7 UT

Total Solar Eclipse of 2017 Aug 21

Ecliptic Conjunction = 18:31:19.6 TD (= 18:30:11.2 UT)
Greatest Eclipse = 18:26:40.3 TD (= 18:25:31.8 UT)

Eclipse Magnitude = 1.0306 Gamma = 0.4367

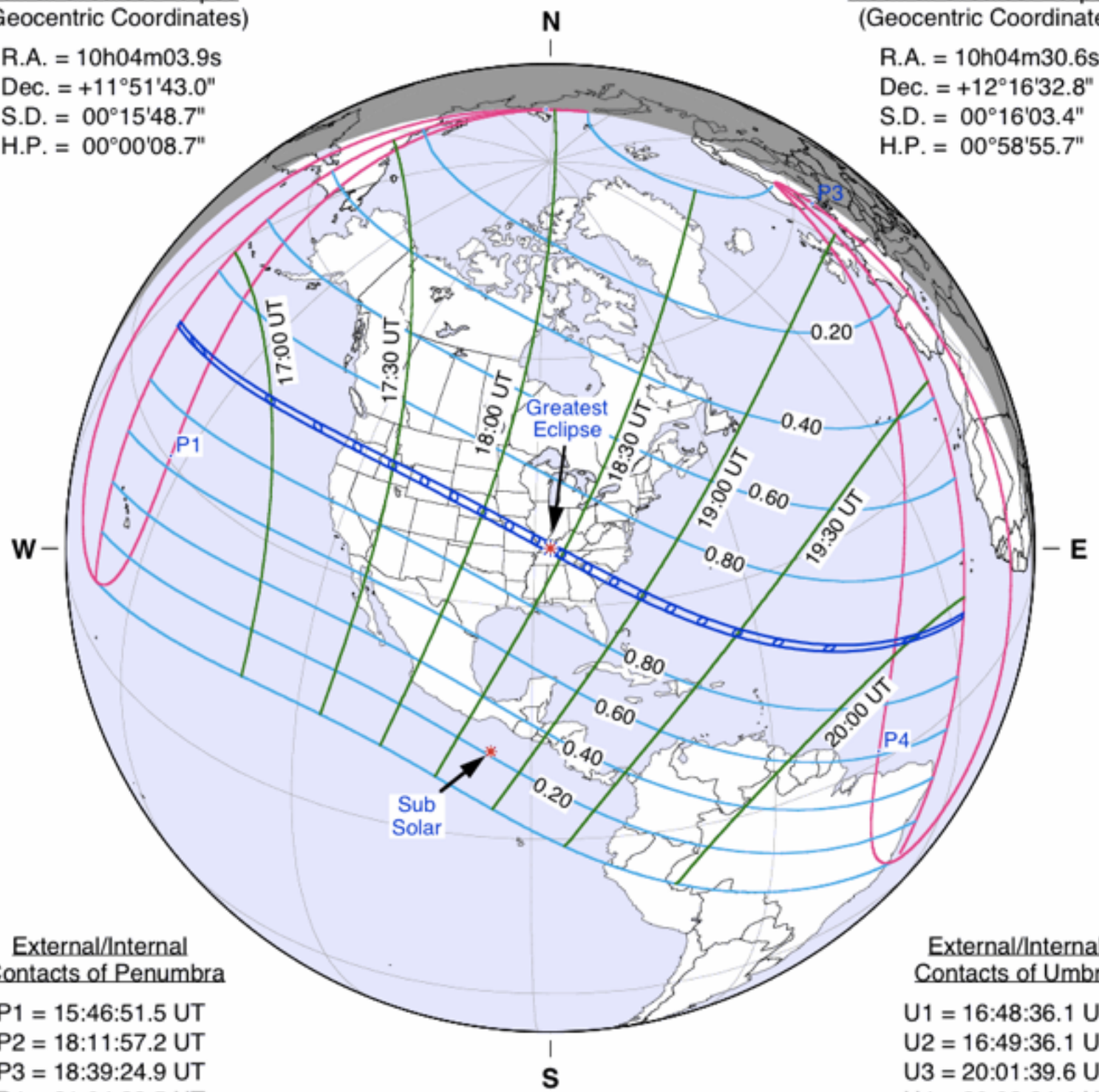
Saros Series = 145 Member = 22 of 77

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 10h04m03.9s
Dec. = +11°51'43.0"
S.D. = 00°15'48.7"
H.P. = 00°00'08.7"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 10h04m30.6s
Dec. = +12°16'32.8"
S.D. = 00°16'03.4"
H.P. = 00°58'55.7"



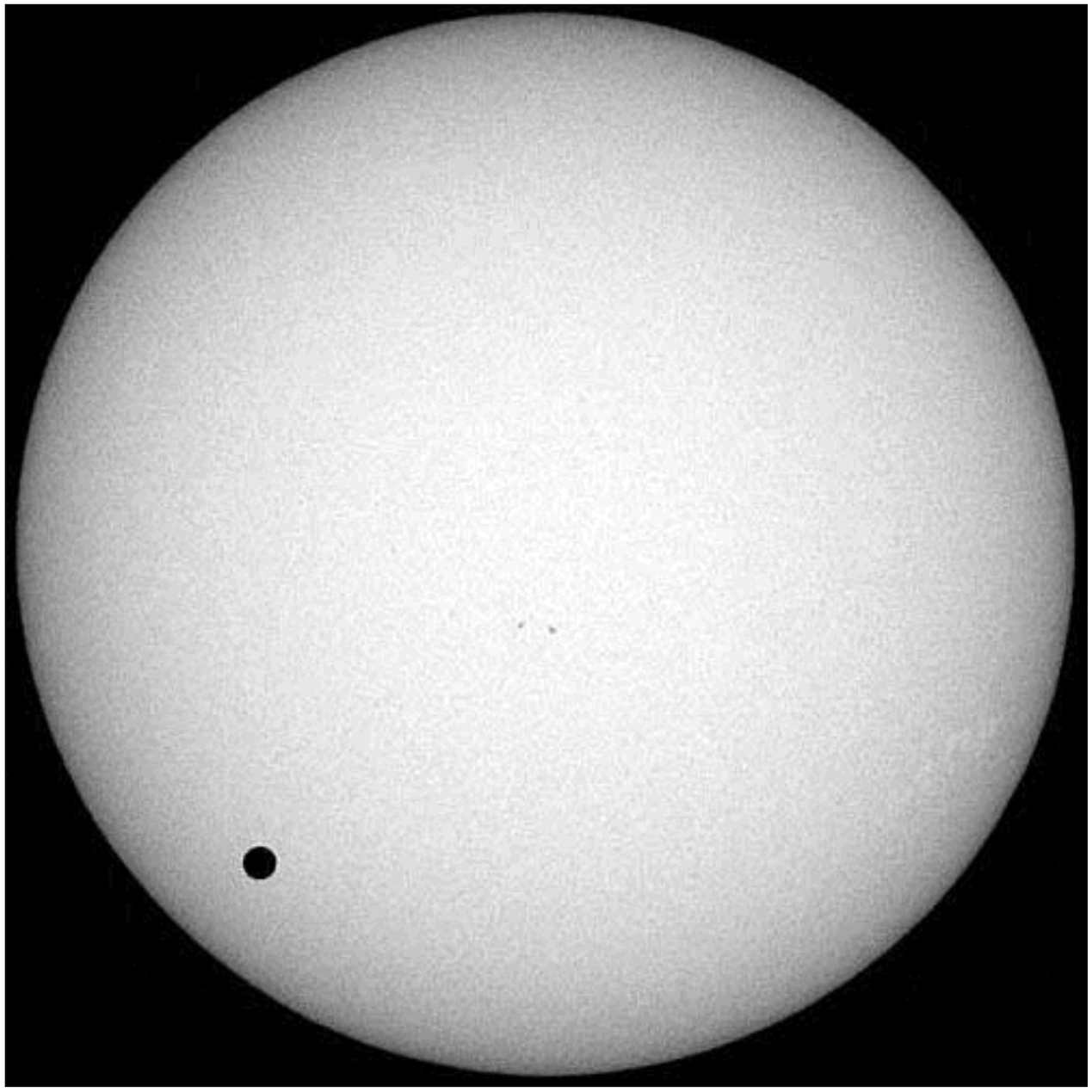
External/Internal Contacts of Penumbra

P1 = 15:46:51.5 UT
P2 = 18:11:57.2 UT
P3 = 18:39:24.9 UT
P4 = 21:04:23.5 UT

External/Internal Contacts of Umbra

U1 = 16:48:36.1 UT
U2 = 16:49:36.1 UT
U3 = 20:01:39.6 UT
U4 = 20:02:34.4 UT

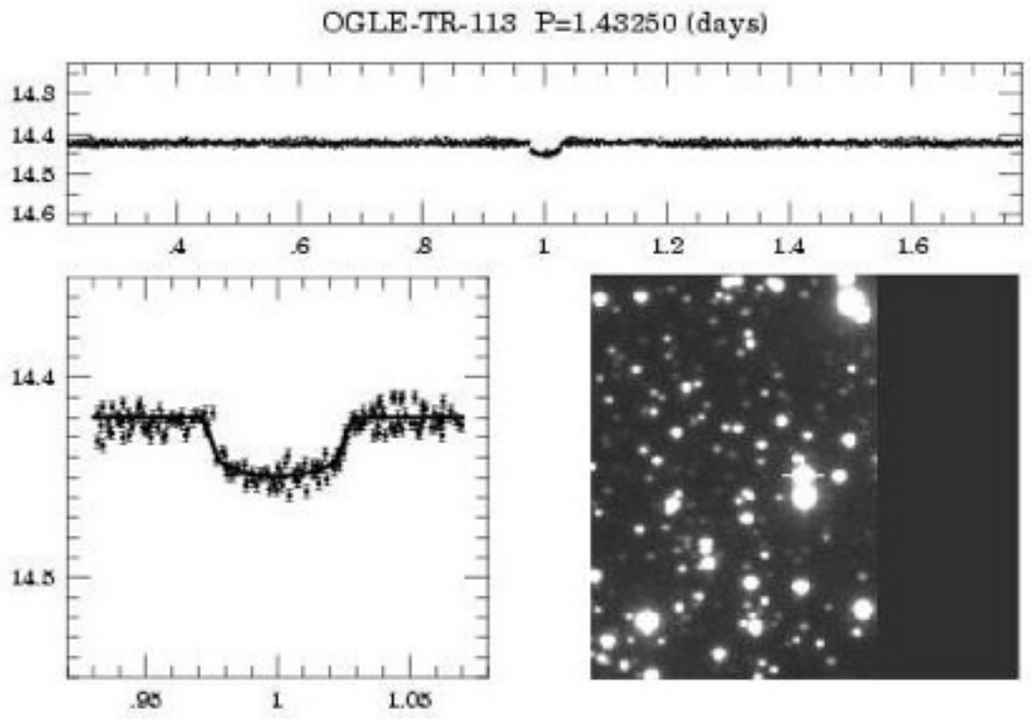
Vénusz a Nap előtt (2004, 2012)

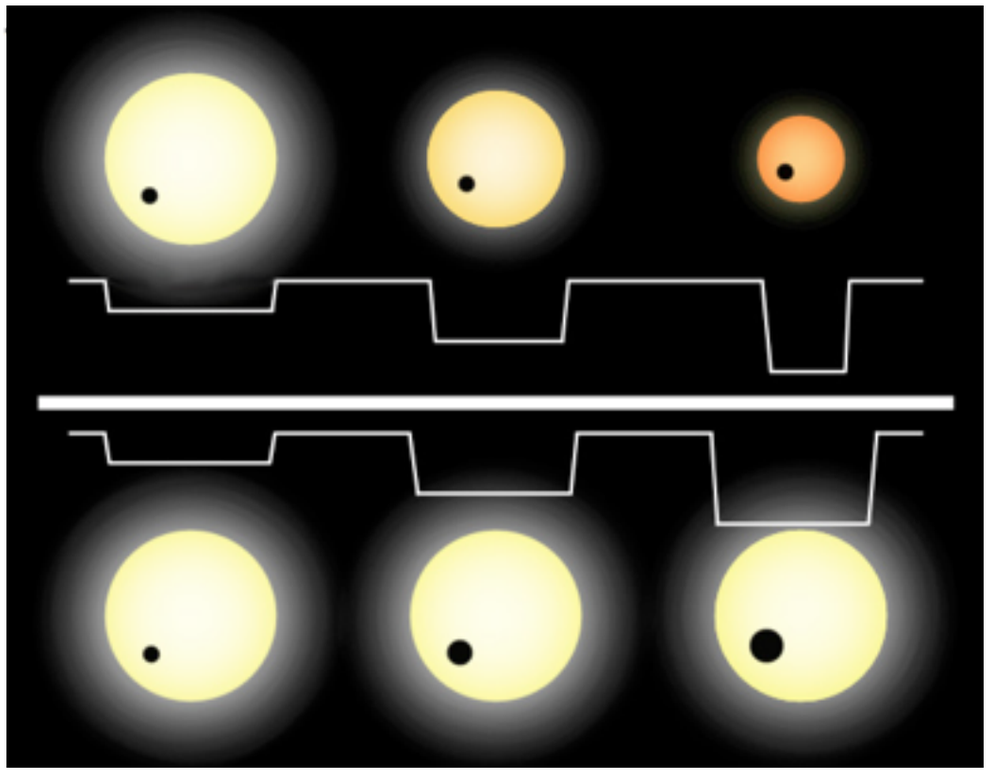


A bolygó átvonulása (tranzitja)

A bolygó elhalad a csillag előtt és kitakarja

- valós méret (a csillagsugár arányában)
- sűrűség
- bolygó szerkezete!
- bolygólégkör színképe
- visszavert fény
- bolygólégkör szerkezete
- csillag légkörének szerkezete



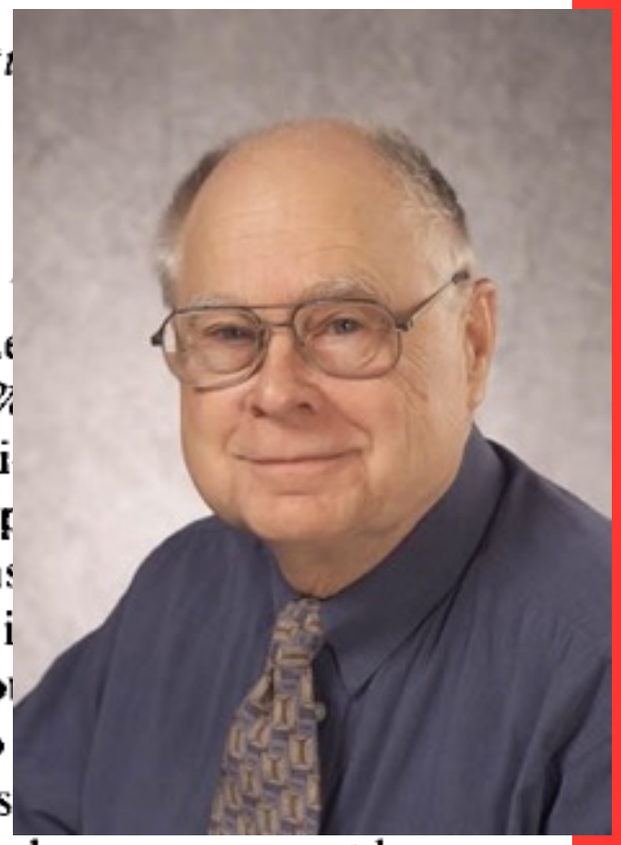


ICARUS 58, 121–134 (1984)

The Photometric Method of Detecting Other Planetary Systems

WILLIAM J. BORUCKI AND AUDREY L. SUMMERS

Theoretical and Planetary Studies Branch, NASA–Ames Research Center, Moffett



Received August 10, 1983; revised January 18, 1984

The photometric method detects planets orbiting other stars by searching for
light flux or the change in the color of the stellar flux that occurs when a plane
transit by Jupiter or Saturn would reduce the stellar flux by approximately 1%
Uranus or Neptune would reduce the stellar flux by 0.1%. A highly characteristi
an amplitude approximately 0.1 of that for the flux reduction would also accomp
could be used to verify that the source of the flux reduction was a planetary trans
other phenomenon. Although the precision required to detect major planets i
with state-of-the-art photometers, the detection of terrestrial-sized planets wo
sion substantially greater than the state-of-the-art and a spaceborne platform to
variations in sky transparency and scintillation. Because the probability is so s
planetary transit during a single observation of a randomly chosen star, the search program must be designed to continuously monitor hundreds or thousands of stars. The most promising approach is to search for large planets with a photometric system that has a single-measurement precision of 0.1%. If it is assumed that large planets will have long-period orbits, and that each star has an average of one large planet, then approximately 10^4 stars must be monitored continuously. To monitor such a large groups of stars simultaneously while maintaining the required photometric precision, a detector array coupled by a fiber-optic bundle to the focal plane of a moderate aperture (≈1 m), wide field of view (≈50°) telescope is required. Based on the stated assumptions, a detection rate of one planet per year of observation appears possible.

Kepler-űrtávcső

A Kepler célja Föld típusú, lakható bolygók felfedezése a fedési módszerrel

Szimultán észlelt több mint 150 ezer csillagot

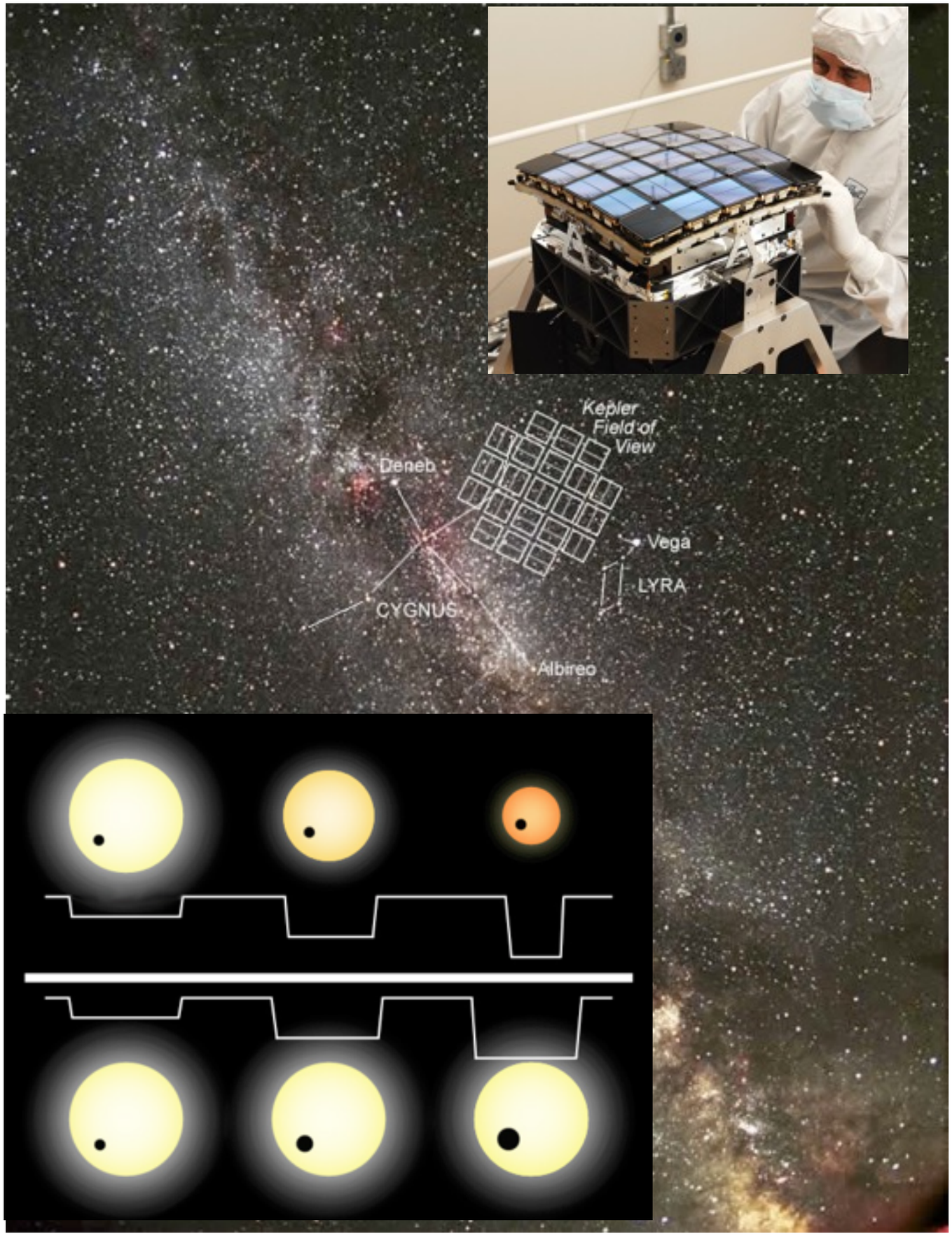
95 cm-es belépő nyílású Schmidt-távcső, látómezeje mintegy 100 négyzetfok, 42 CCD-ből álló mozaikkal

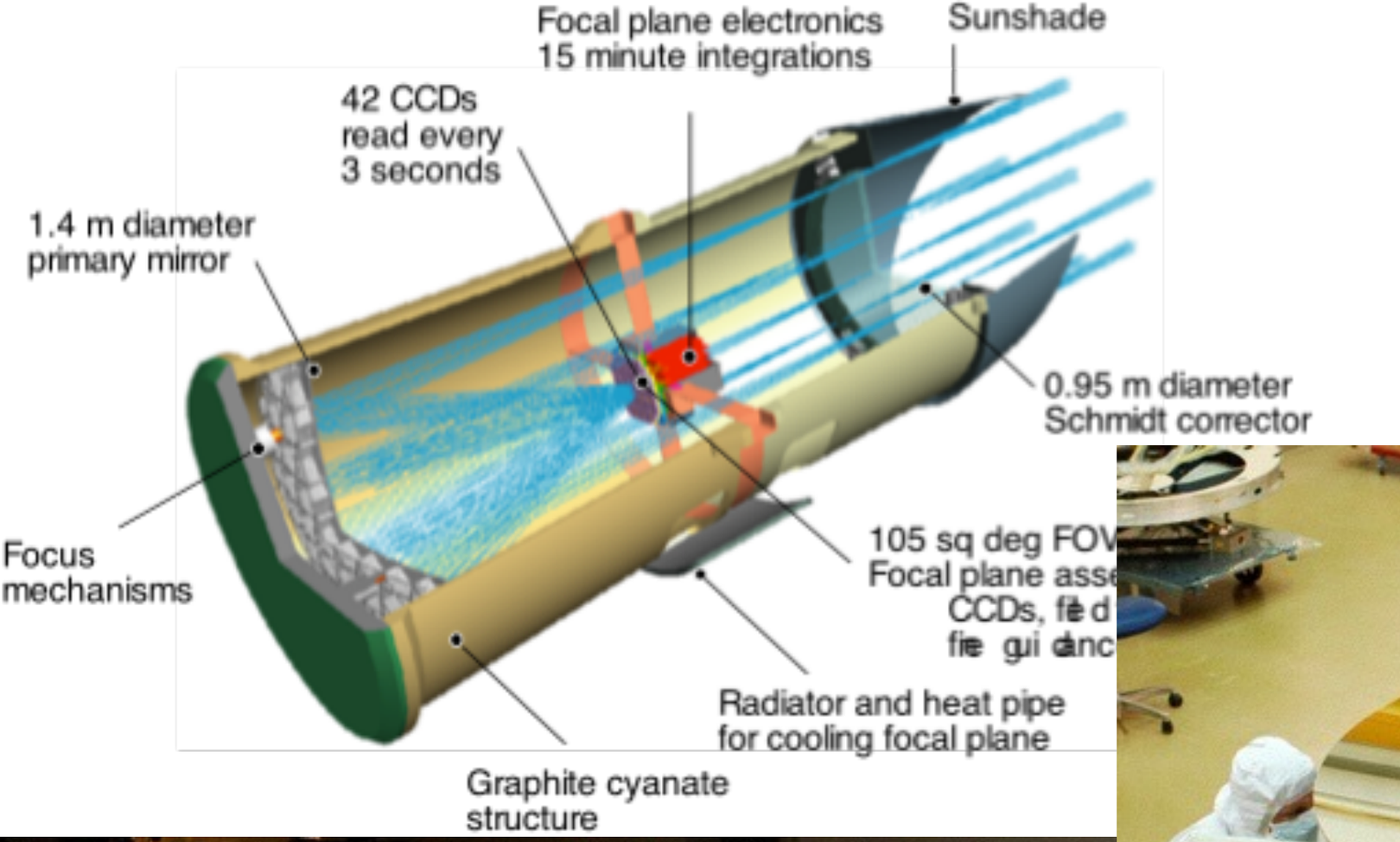
Fotometriai pontosság:

A zaj < 20 ppm 6,5 órányi mérés után egy 12 magn. Nap típusú csillagra

=> 4-szigma detektálás egy exoföld tranzitja esetén.

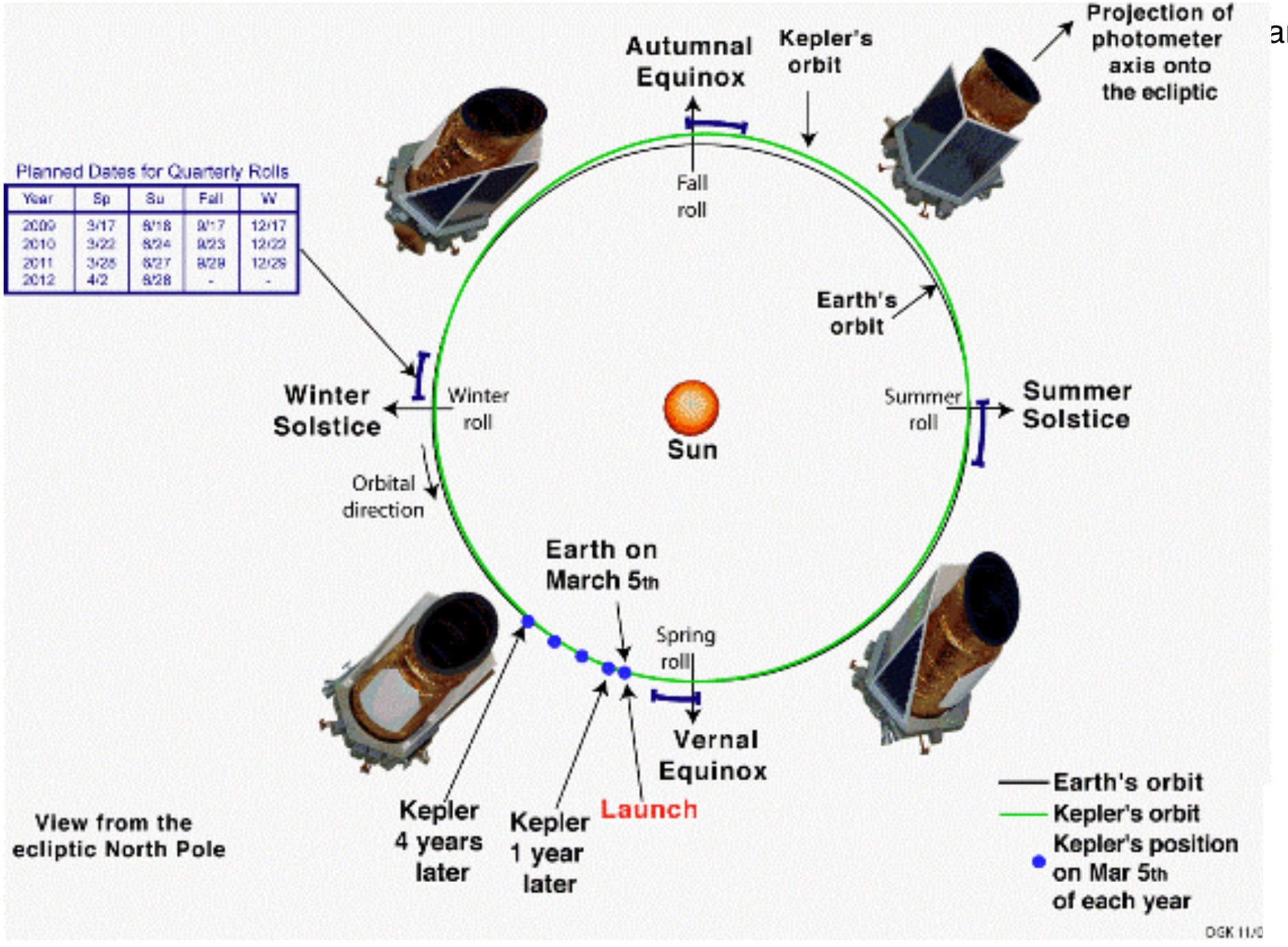
Heliocentrikus pálya, 2009-2013

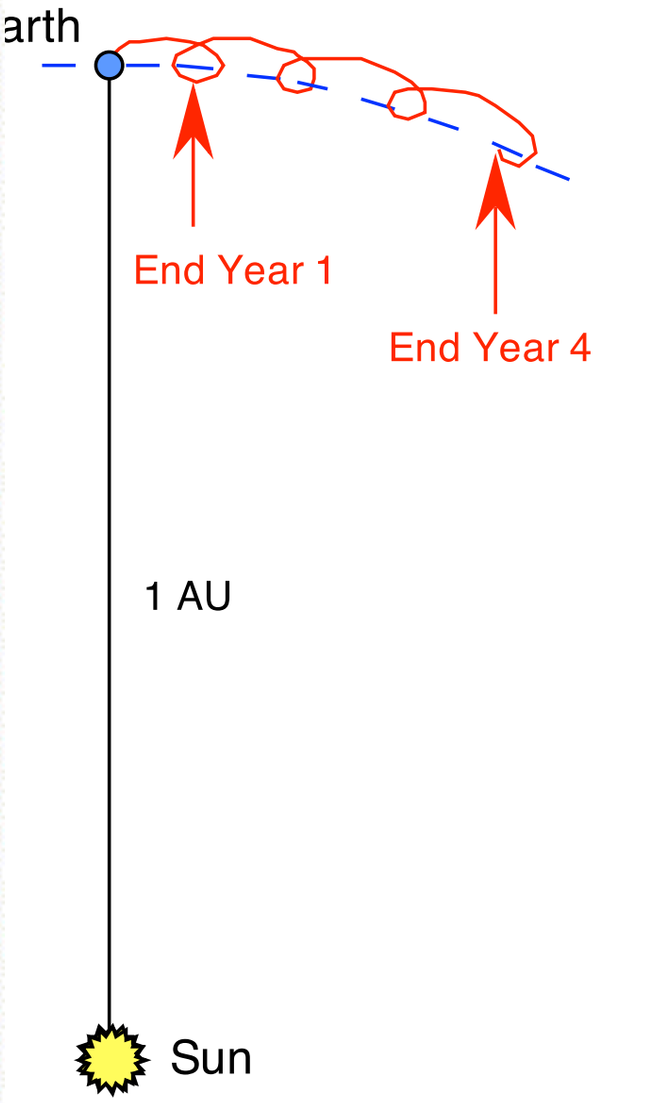



Focal plane electronics
15 minute integrations
Sunshade
42 CCDs
read every
3 seconds
1.4 m diameter
primary mirror
0.95 m diameter
Schmidt corrector
Focus
mechanisms
105 sq deg FOV
Focal plane asse
CCDs, fe d
fie gui anc
Radiator and heat pipe
for cooling focal plane
Graphite cyanate
structure


Ball

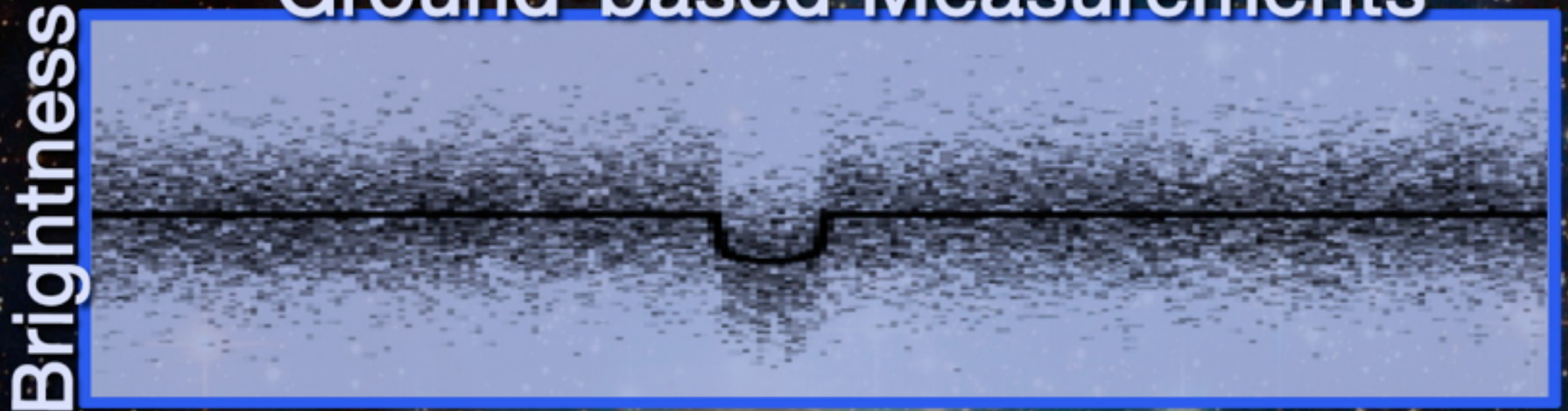
Heliocentric orbit, 1 week/yr lag behind Earth



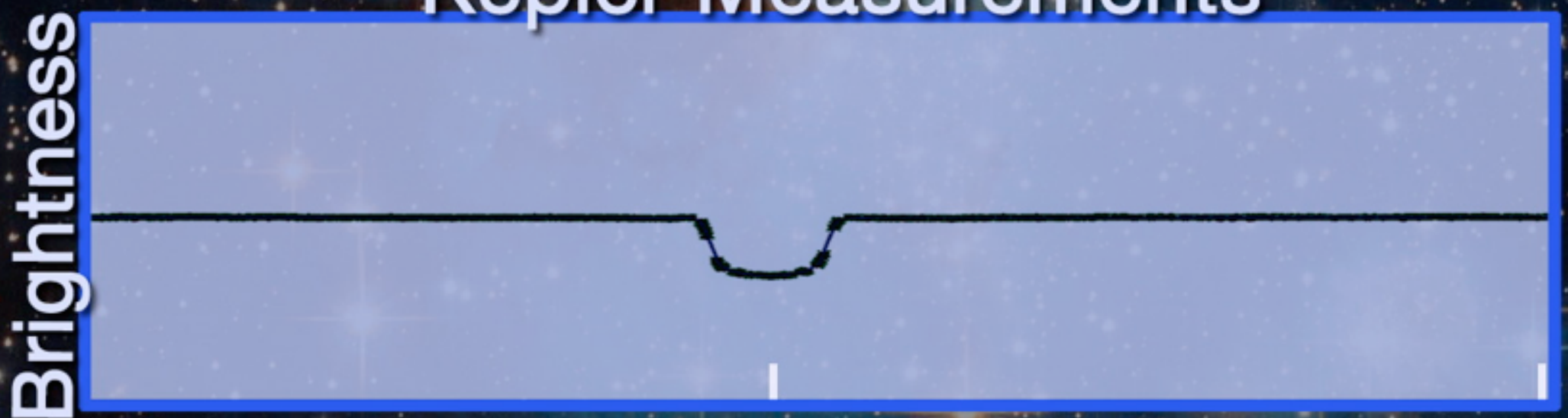


HAT-P-7 Light Curves

Ground-based Measurements



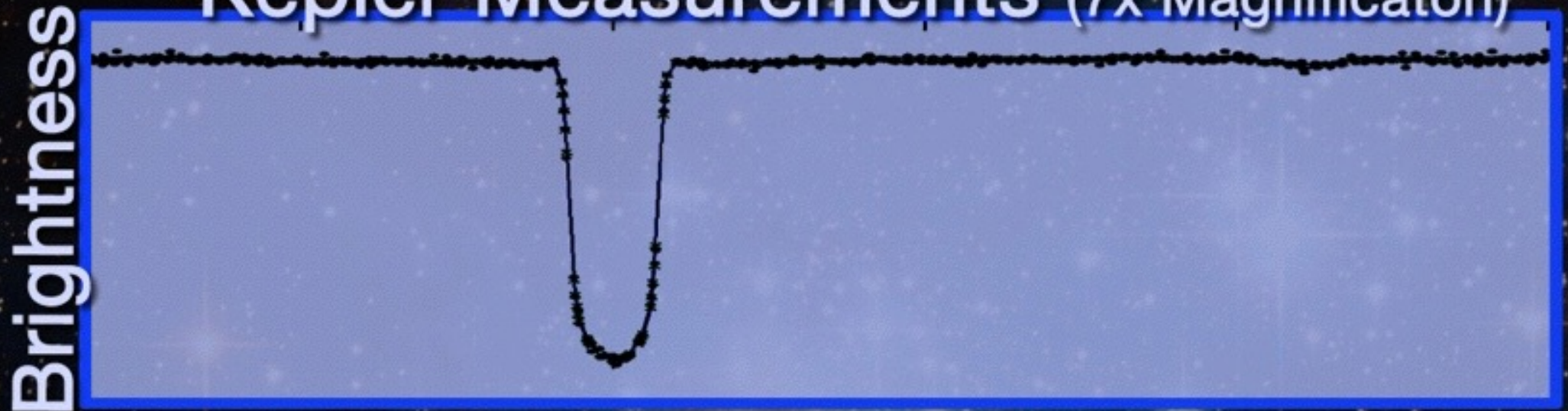
Kepler Measurements



Borucki et al. (2009)

HAT-P-7 Light Curves

Kepler Measurements (7x Magnificaton)



Kepler Measurements (100x Magnification)

Borucki et al. (2009)

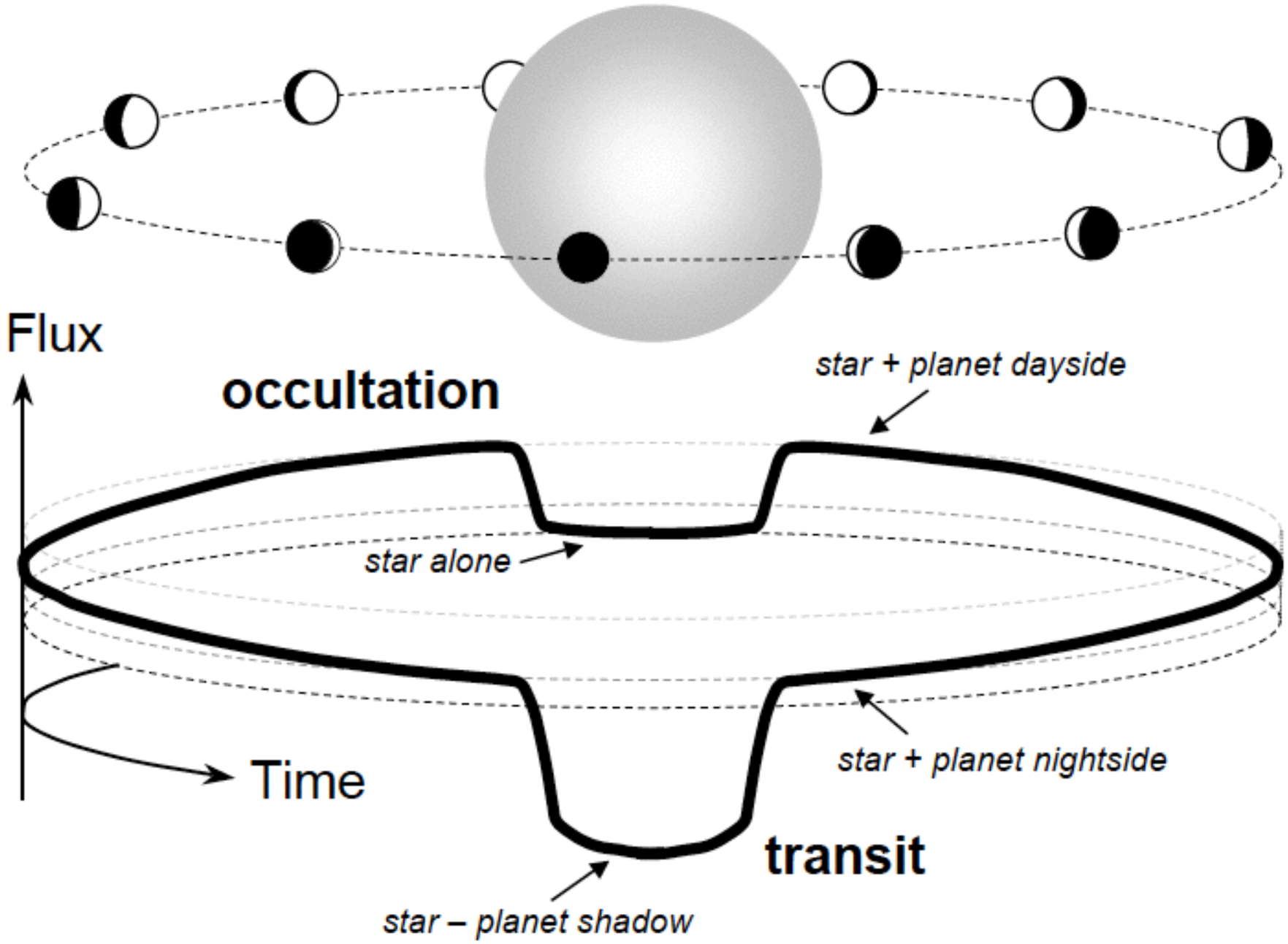
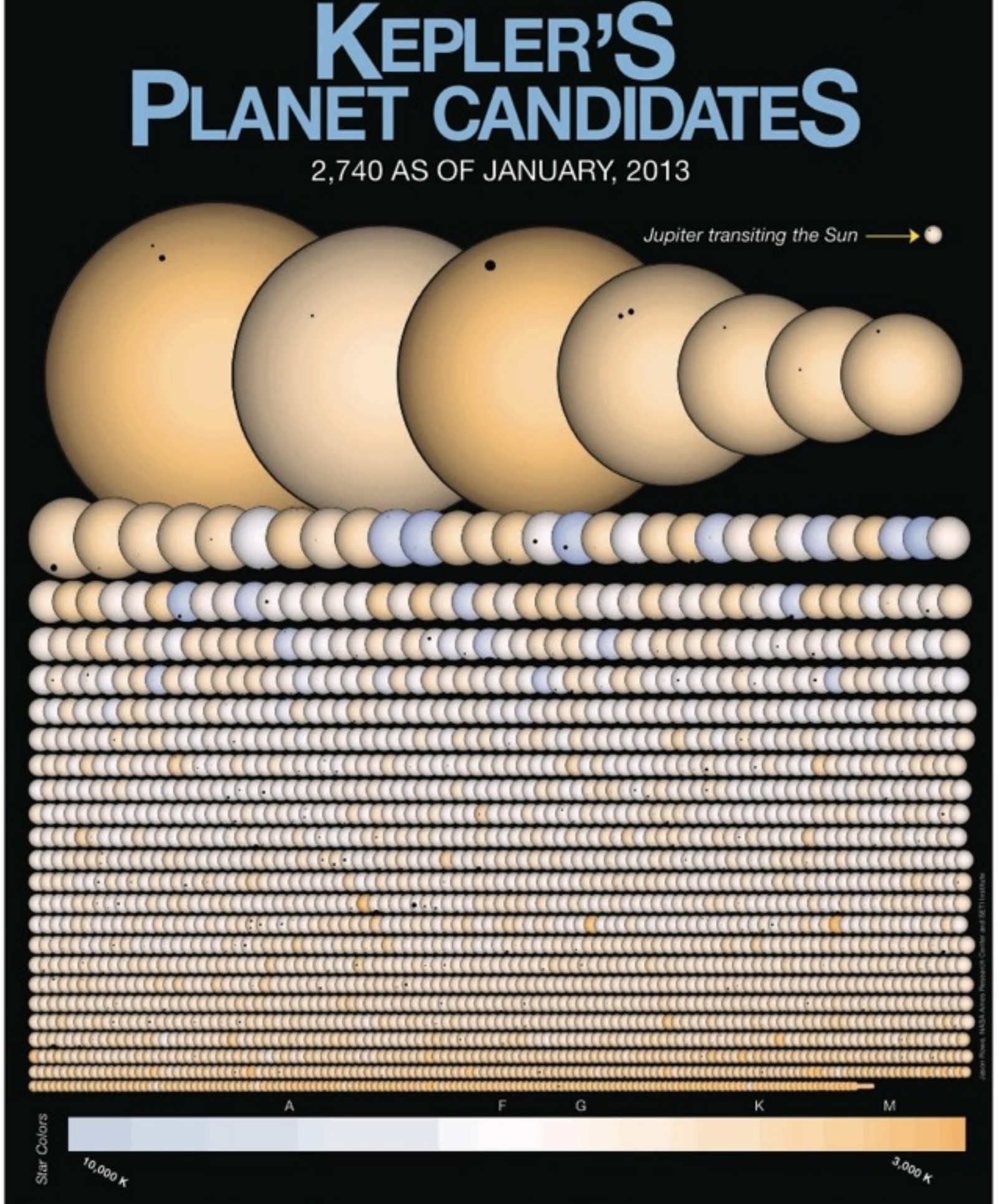


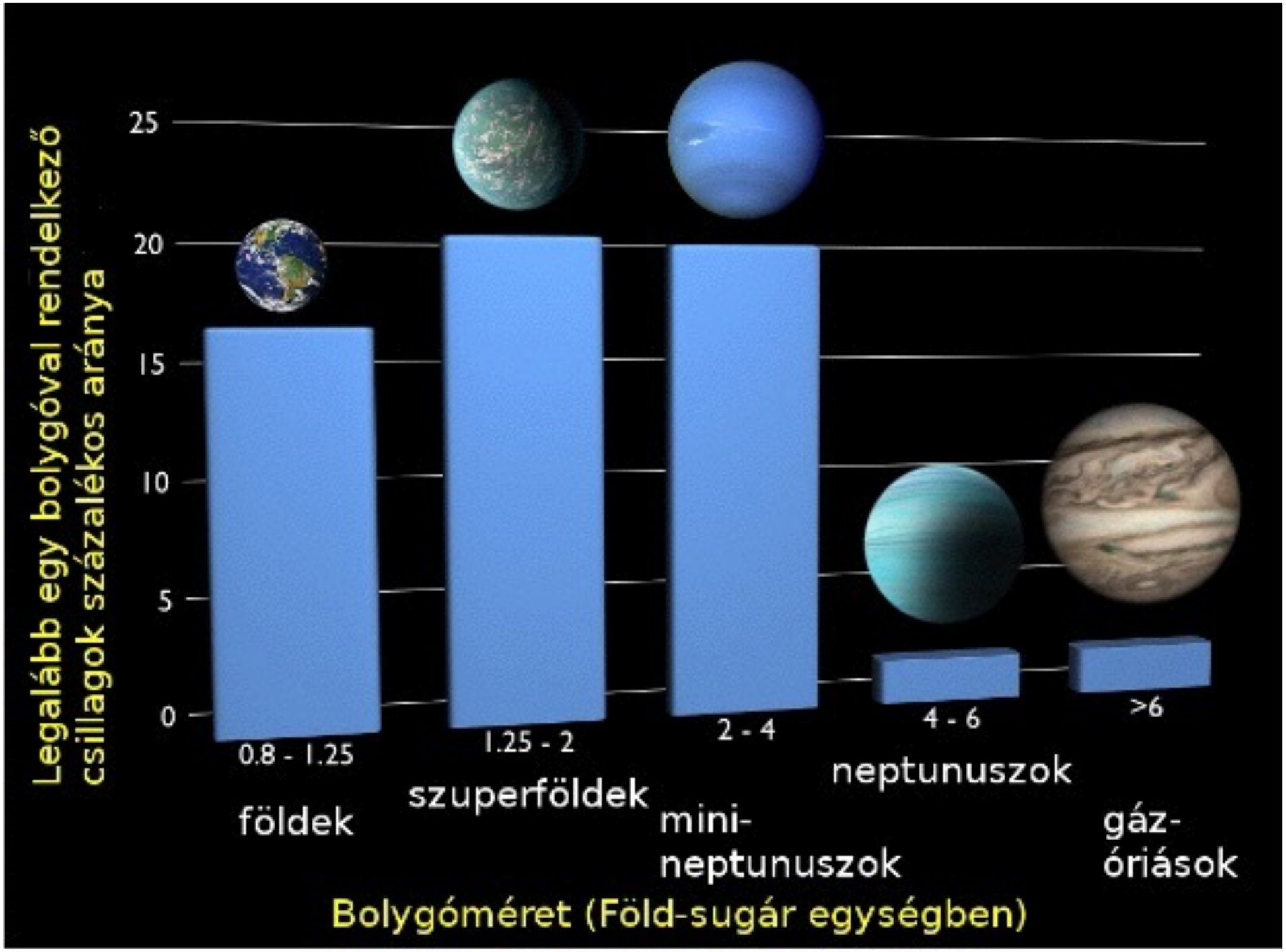
Fig. 1.— Illustration of transits and occultations. Only the combined flux of the star and planet is observed. During a transit, the flux drops because the planet blocks a fraction of the starlight. Then the flux rises as the planet's dayside comes into view. The flux drops again when the planet is occulted by the star.

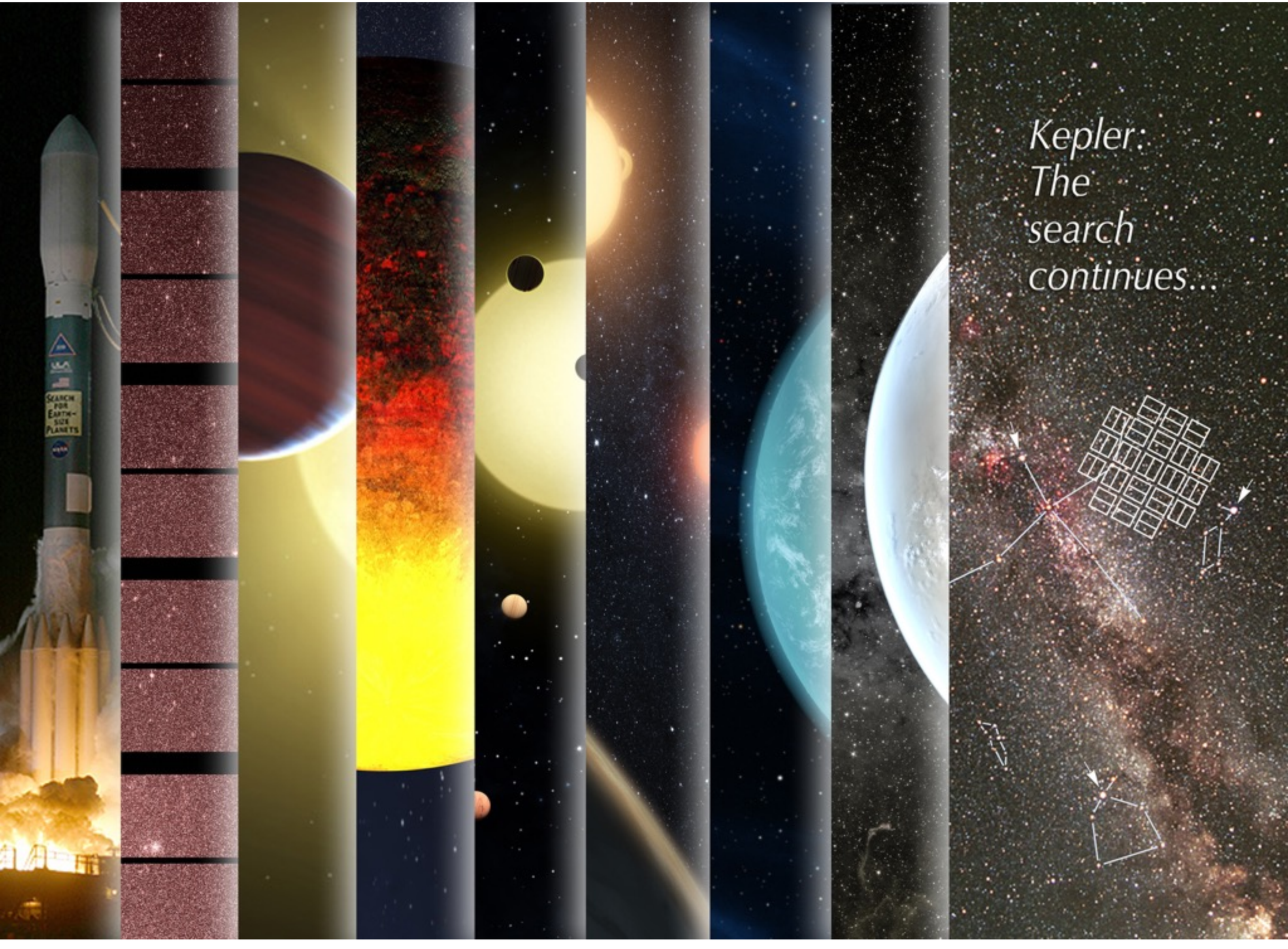
KEPLER'S PLANET CANDIDATES

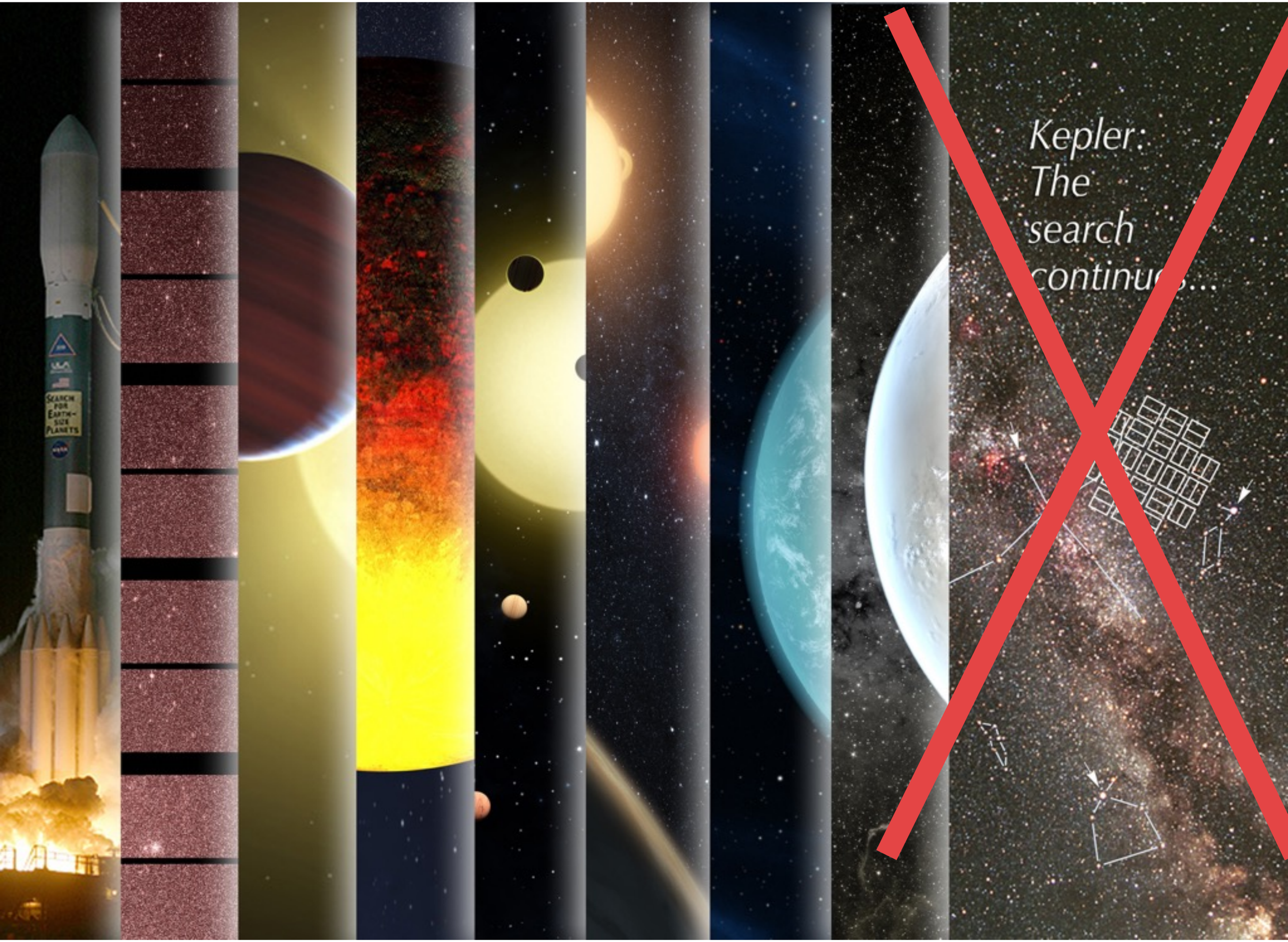
2,740 AS OF JANUARY, 2013

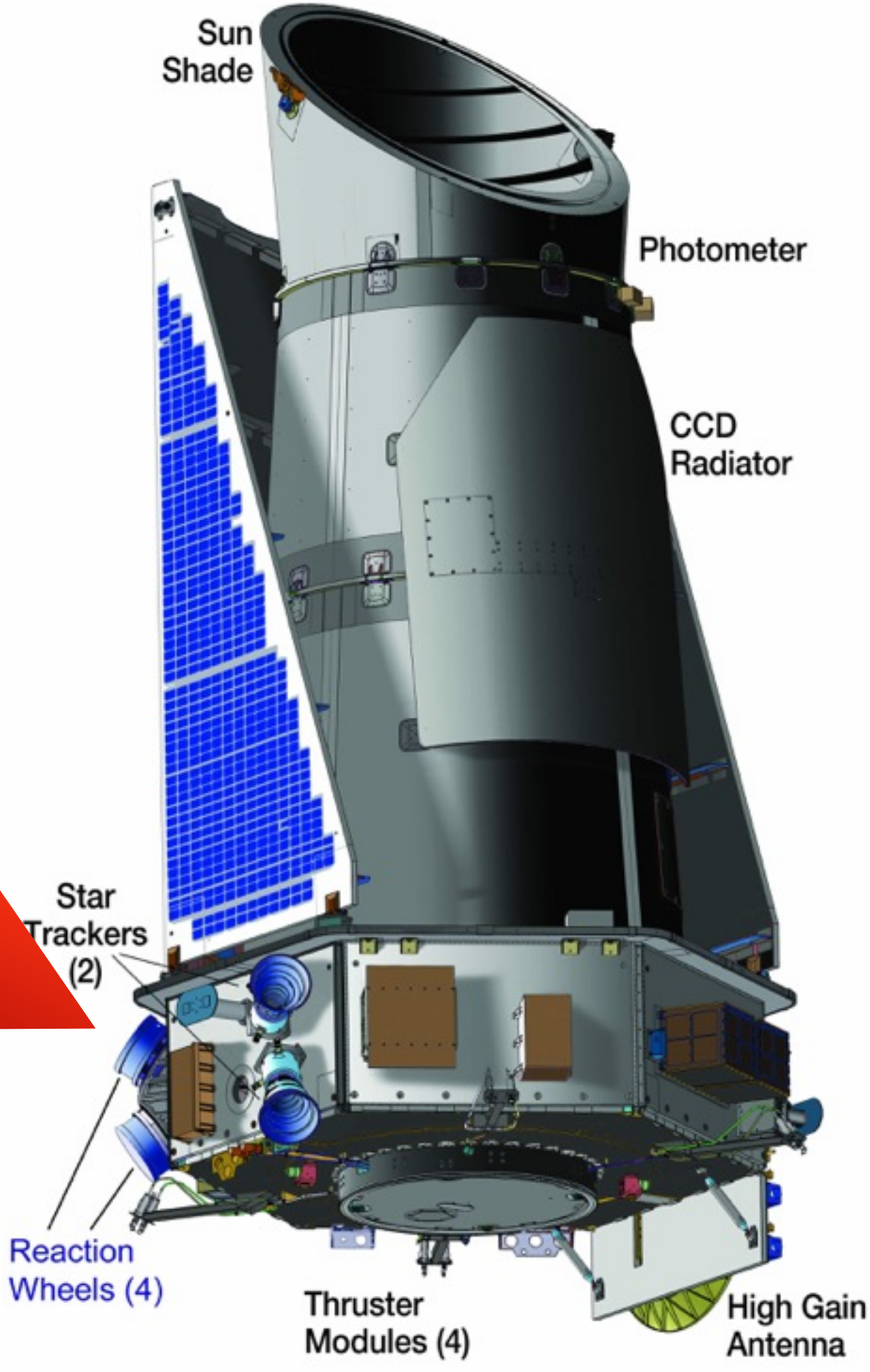


Rövidperiódusú bolygók gyakorisága



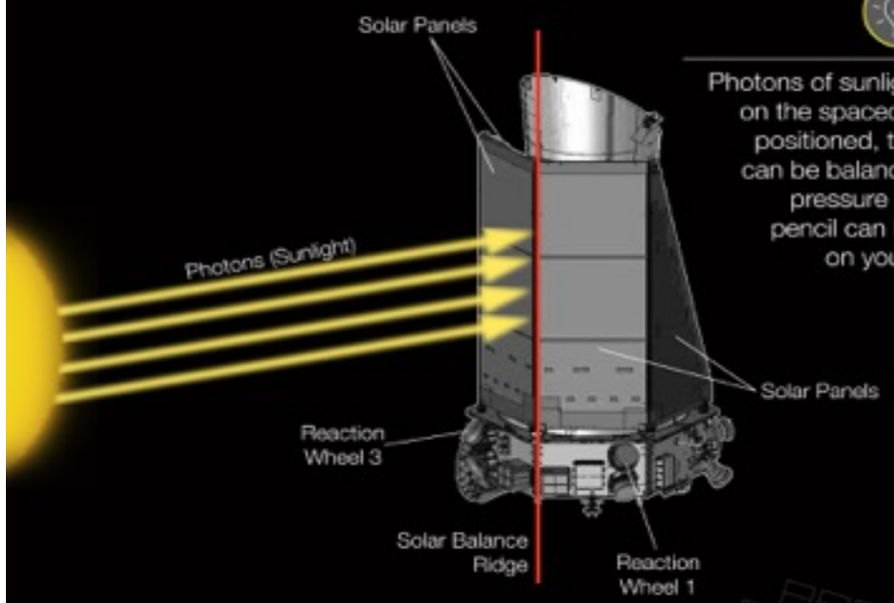

SEARCH FOR EARTH-SIZE PLANETS
Kepler:
The
search
continues...

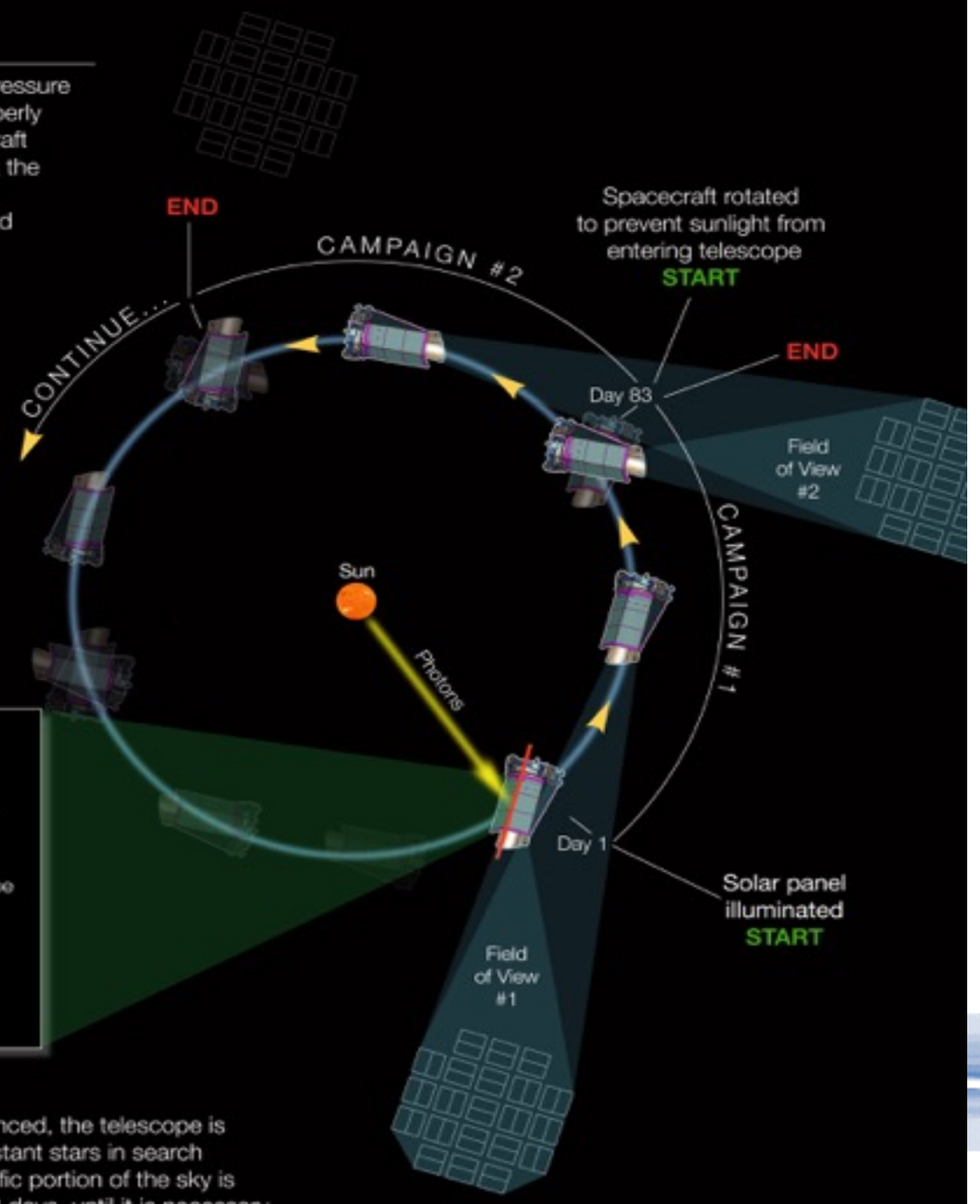

SEARCH FOR EARTH-SIZE PLANETS
Kepler:
The
search
continues...


Sun
Shade
Photometer
CCD
Radiator
Star
Trackers
(2)
Reaction
Wheels (4)
Thruster
Modules (4)
High Gain
Antenna

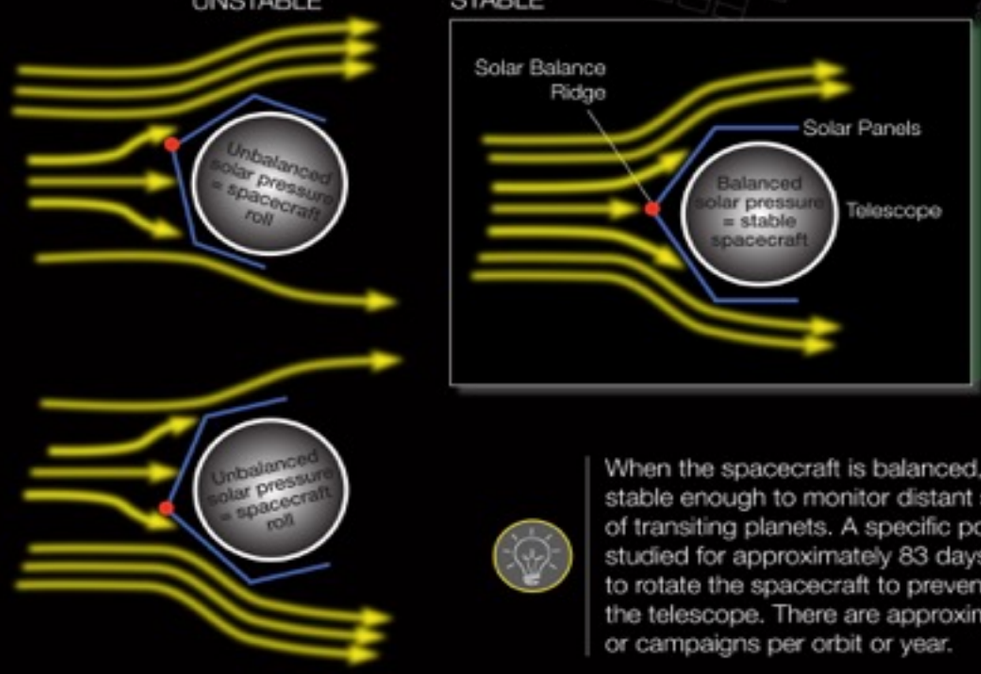
Kepler's Second Light: How K2 Will Work

Photons of sunlight exert pressure on the spacecraft. If properly positioned, the spacecraft can be balanced against the pressure much as a pencil can be balanced on your finger.





TOP-DOWN VIEWS OF SPACECRAFT



When the spacecraft is balanced, the telescope is stable enough to monitor distant stars in search of transiting planets. A specific portion of the sky is studied for approximately 83 days, until it is necessary to rotate the spacecraft to prevent sunlight from entering the telescope. There are approximately 4.5 viewing periods or campaigns per orbit or year.

CONCEPTUAL ILLUSTRATION OF SPACECRAFT SOLAR DISTURBANCE. THE ACTUAL DISTURBANCE IS DUE TO PHOTON PRESSURE, NOT SOLAR WIND.

pencil can be balanced
on your finger.

Solar Panels

Reaction
Wheel 1

RAFT
E

CONTINUE...

CAMPAIGN #2

to prevent sunlight from
entering telescope

START

END

Day 83

Field
of View
#2

CAMPAIGN #1

Sun

Photons

Balance
Ridge

Solar Panels

Balanced
solar pressure
= stable
spacecraft

Telescope

Day 1

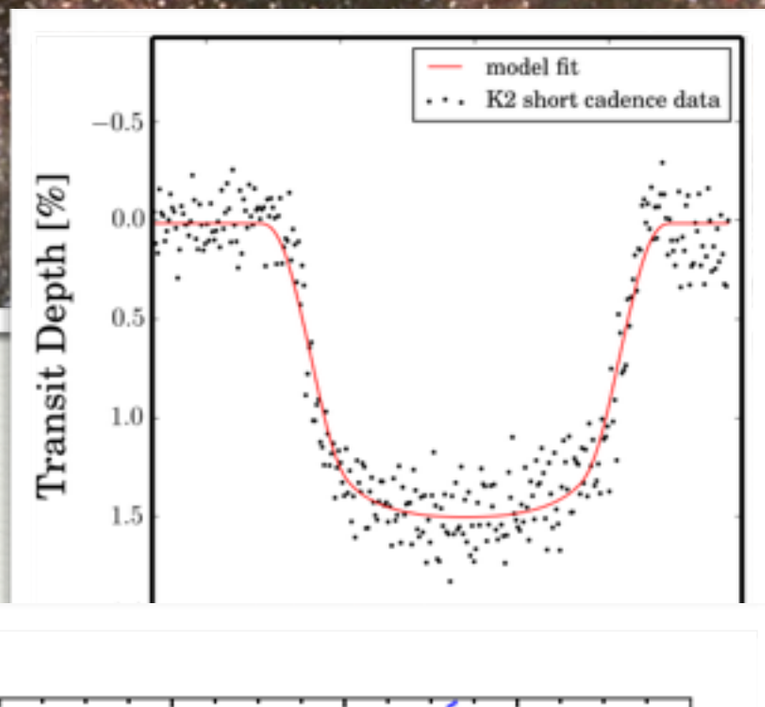
Solar panel
illuminated

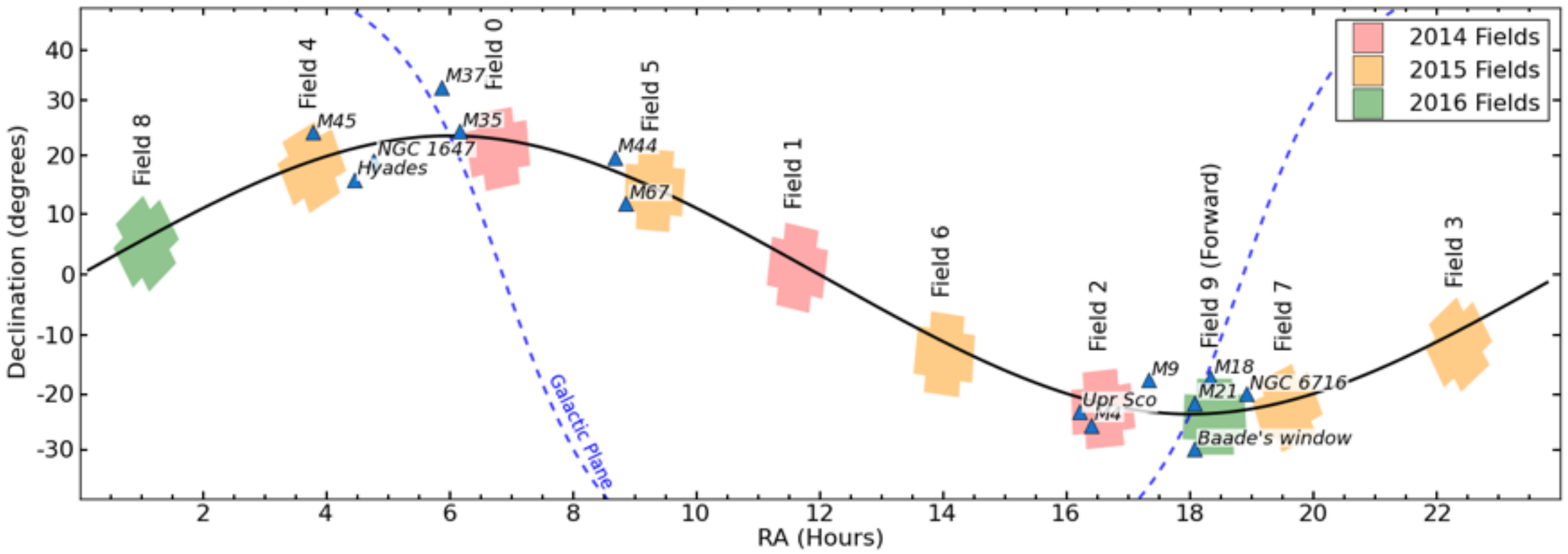
START

Field
of View
#1

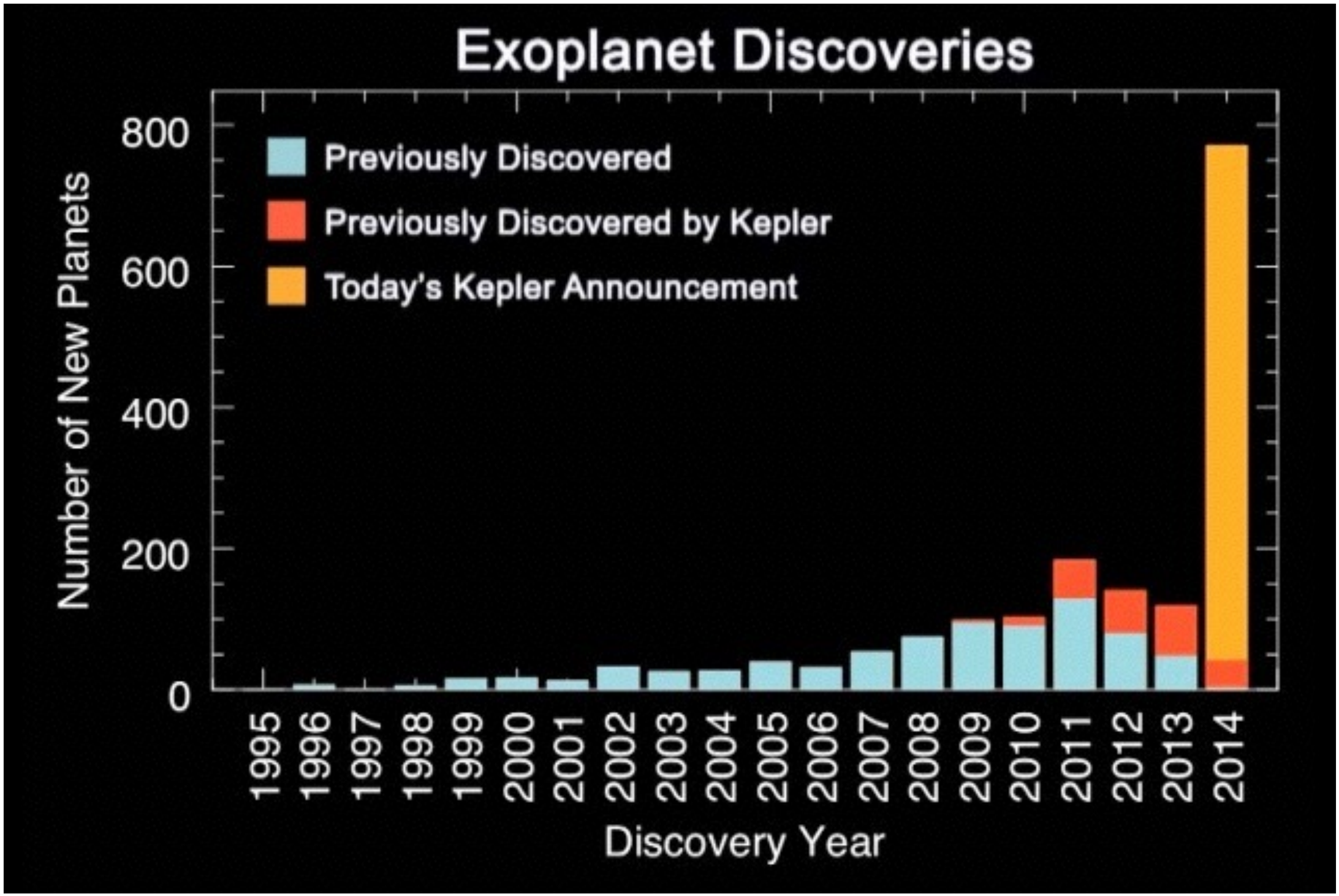
When the spacecraft is balanced, the telescope is stable enough to monitor distant stars in search of transiting planets. A specific portion of the sky is studied for approximately 83 days, until it is necessary


K2
Extending Kepler's Power to the Ecliptic


model fit
K2 short cadence data
Transit Depth [%]
−0.5
0.0
0.5
1.0
1.5


2014 Fields
2015 Fields
2016 Fields
Field 8
Field 4
Field 0
Field 5
Field 1
Field 6
Field 2
Field 9 (Forward)
Field 7
Field 3
M37
M45
M35
NGC 1647
Hyades
M44
M67
M9
M18
NGC 6716
M21
Upr Sco
M4
Baade's window
Galactic Plane
Declination (degrees)
RA (Hours)
40
30
20
10
0
-10
-20
-30
2
4
6
8
10
12
14
16
18
20
22

2014. február 26.: 715 új bolygó többes rendszerben

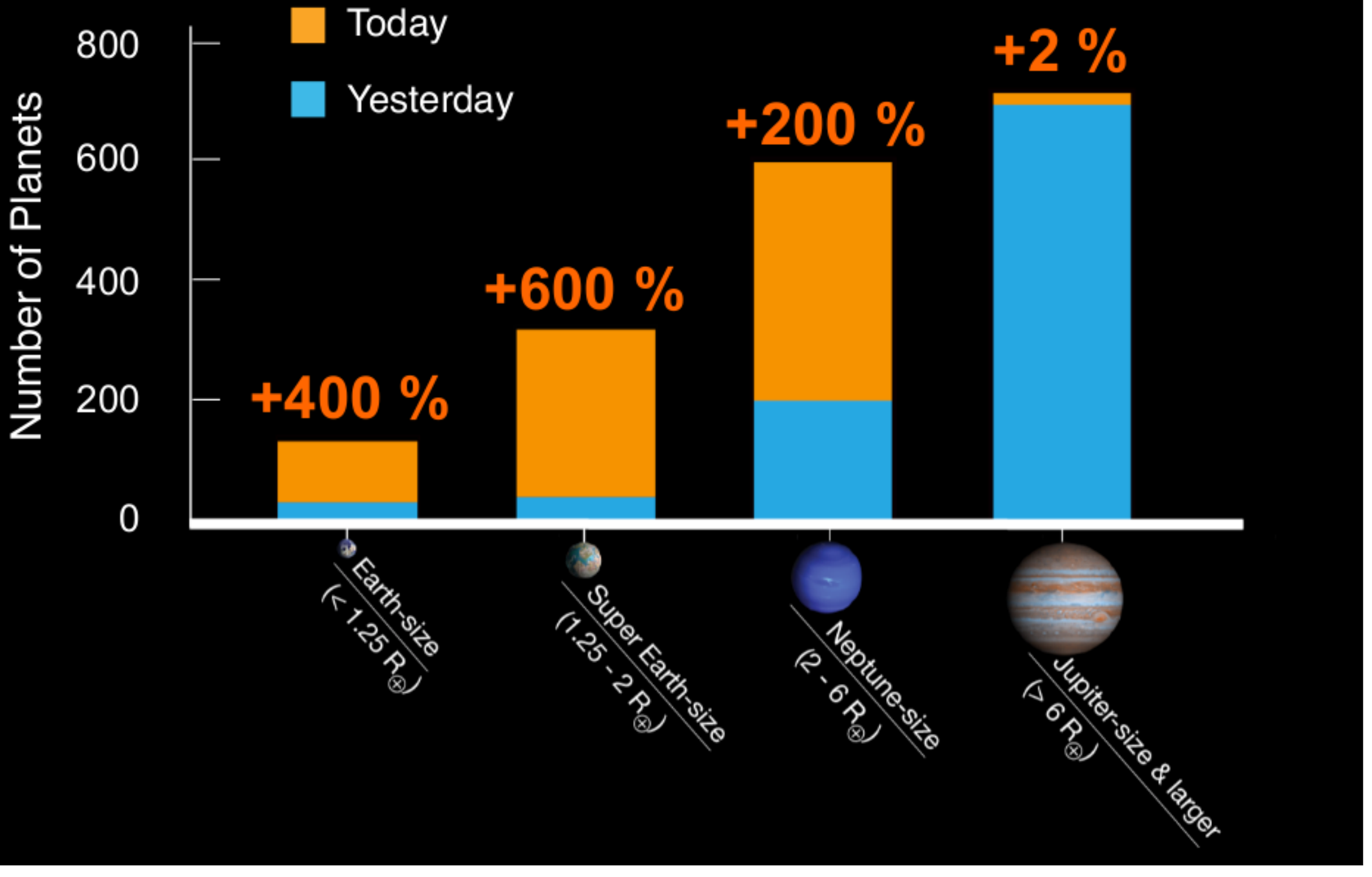


Kepler

Sizes of Verified Planets

As of February 26, 2014

NASA



KISMŰHOLDAS LEHETŐSÉGEK

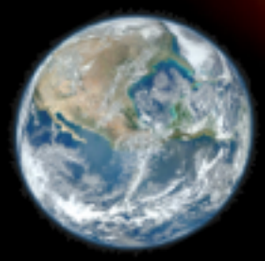
- Űrbéli mérések célja
  - földi légkör zavaró hatásaitól mentes adatgyűjtés
  - nappalok és éjszakák váltakozásaitól mentes mérések
  - fotonzaj-limitált adatok (0,1% - 1 millió foton)
  - kis távcső - fényes csillag!

MOST

Canada's first space telescope

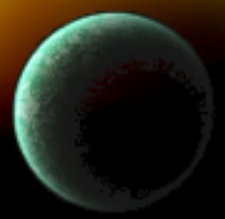
Microvariability & Oscillations of Stars Microvariabilité et Oscillations

Peering into the hidden hearts of stars
Finding and exploring exoplanets
Reading stellar life stories

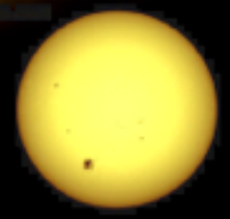


HOME

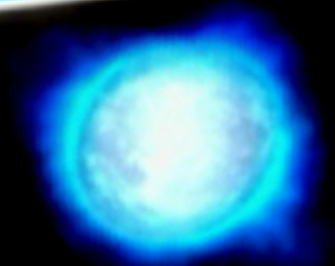
MISSION AT A GLANCE



NEWS



SCIENCE



GALLERY

LINKS

Scientific Goals (in astro-jargon)

- Asteroseismology of acoustic and gravity-mode oscillations in Sun-like stars, magnetic (rapidly oscillating Ap or roAp) stars, cool giants, pre-main-sequence delta Scuti pulsating stars, massive O and B stars, and other stellar classes, to probe uniquely their internal structures and evolutionary states
- Analyses of the transits and eclipses of exoplanets around Sun-like stars and red dwarf stars, to reveal their sizes, atmospheric compositions, magnetic fields and other properties
- Measurement of the turbulent variations in massive evolved (Wolf-Rayet) stars to understand

MOST: max. 60 napos folyamatos mérés, 15 cm-es távcső, 65 x 65 x 30 cm, 54 kg, 2003 óta

BRITE: max. 180-200 napos folyamatos mérés, 3 cm-es távcső, 20 x 20 x 20 cm, <8 kg, 2013 óta

CHEOPS

CHARACTERIZING EXOPLANET SATELLITE

esa

100% vapor

Mission Status & Summary

Mission Status

CHEOPS has been proposed as an S-class mission in response to the call for Proposals issued by ESA in March 2012.

On 19 October 2012 it was selected for study for the first S-class mission.

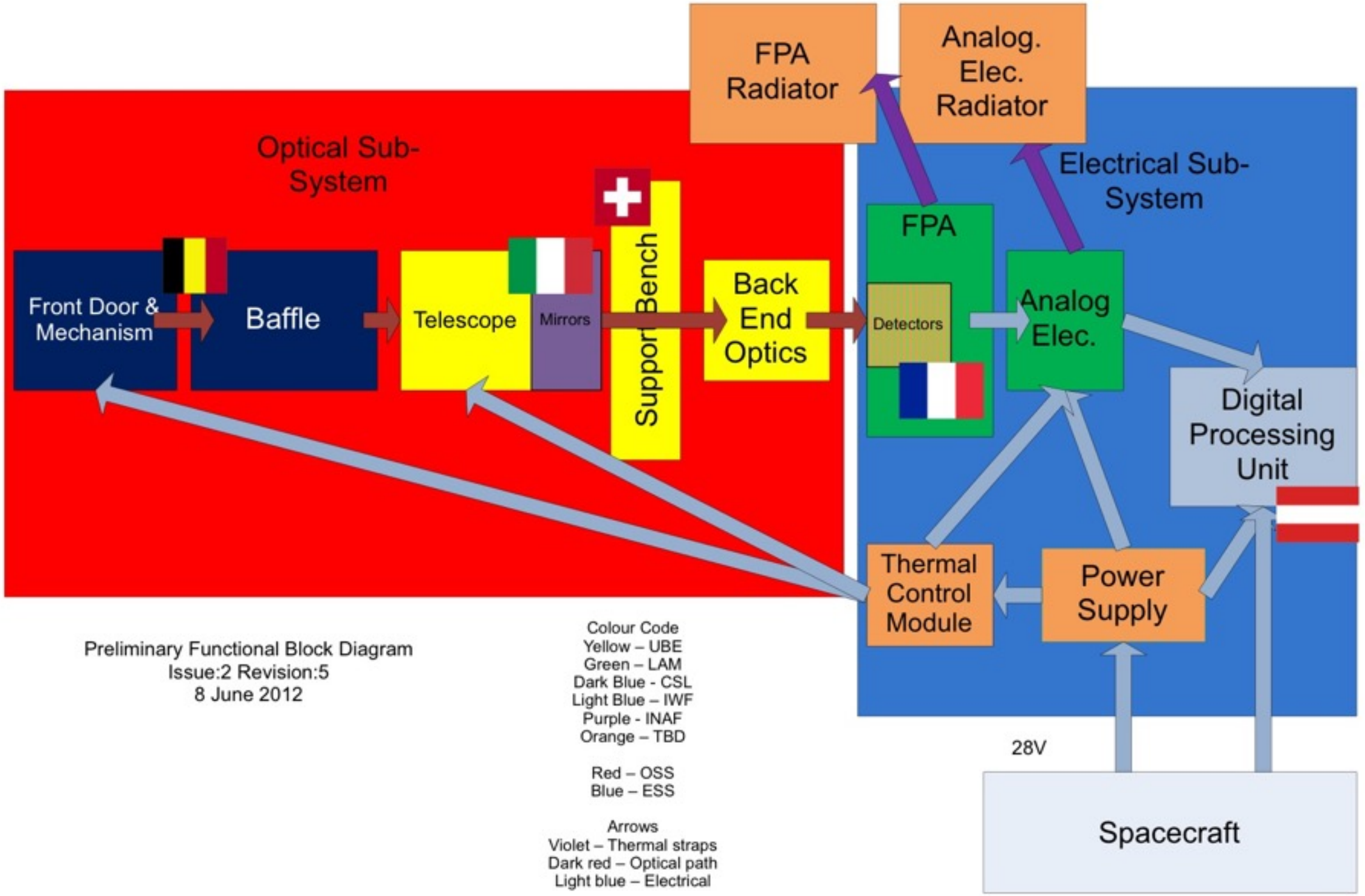
On 19 February 2014 CHEOPS was adopted by SPC.

Mission Summary:

The following table summarizes the mission.

Name	CHEOPS, CHaracterizing ExOPlanet Satellite
Primary Goal	Characterize transiting exoplanets on known bright and nearby host stars
Targets	Known exoplanet host stars with a V-magnitude < 12.5 (goal: 13) anywhere on the sky
Wavelength	Visible range : 400 to 1100 nm
Telescope	33 cm reflective an-axis telescope
Orbit	Sun-synchronous Low Earth Orbit, LTAN 6am, altitude 620-800 km
Lifetime	3.5 years
Type	S-class mission

(last update Feb 2014)



Preliminary Functional Block Diagram
Issue:2 Revision:5
8 June 2012

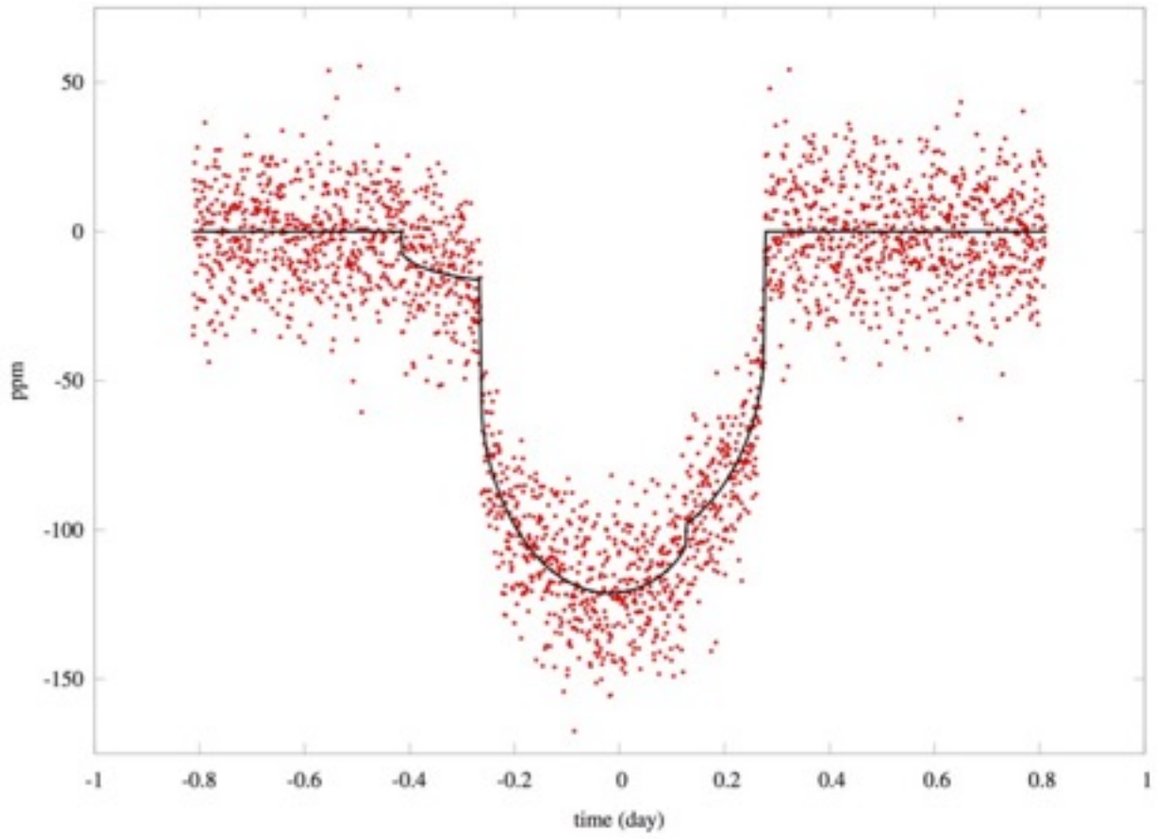
Colour Code
Yellow – UBE
Green – LAM
Dark Blue - CSL
Light Blue – IWF
Purple - INAF
Orange – TBD

Red – OSS
Blue – ESS

Arrows
Violet – Thermal straps
Dark red – Optical path
Light blue – Electrical

Board Members:

Country	Institute	Name
A	Institut für Weltraumforschung, Graz	Baumjohann Wolfgang
A	Institut für Weltraumforschung, Graz	Steller Manfred
B	University of Liège	Gillon Michaël
B	Centre Spatial de Liège	Renotte Etienne
CH	Universität Bern	Benz Willy
CH	Universität Bern	Thomas Nicolas
CH	Observatory of the University of Geneva	Udry Stéphane
F	Laboratoire d'astrophysique de Marseille	Deleuil Magali
F	Institut d'astrophysique de Paris	Lecavelier des Etangs Alain
GER	DLR Institute of Planetary Research	Spohn Tilman
HU	Admatis	Barczy Tamas
HU	Konkoly Observatory	Kiss Laszlo
I	Università di Padova	Piotto Giampaolo
I	Osservatorio Astronomico di Padova - INAF	Ragazzoni Roberto
P	Deimos	Gutierrez Antonio
P	Centro de Astrofisica da Universidade do Porto	Santos Nuno C.
S	Onsala Space Observatory, Chalmers Univ. of Technology	Liseau René
S	Stockholm University, Stockholm	Olofsson Göran
UK	University of Warwick	Pollacco Don



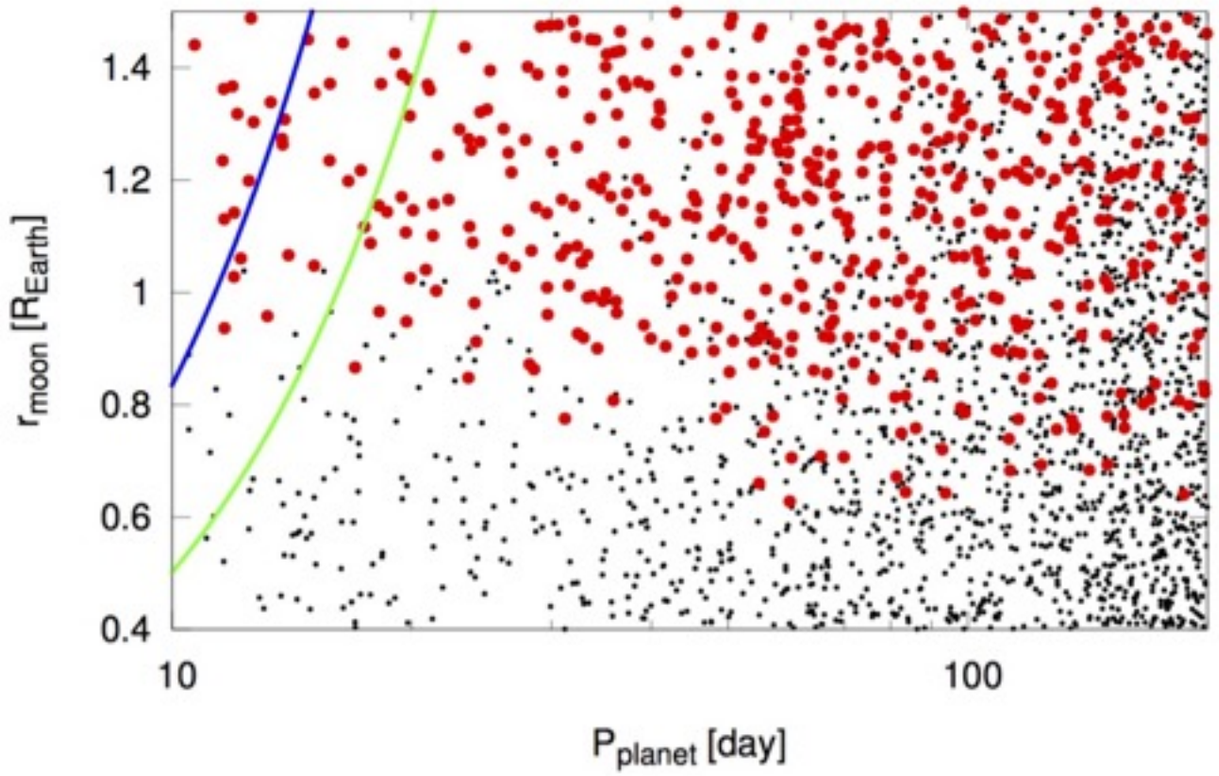


Figure 17 | ***Left panel****— Transit of an Earth-size exoplanet plus a 0.4×smaller moon is simulated when the photometric precision is set to ~20 ppm (the solid curve shows the underlying theoretical model).* ***Right panel****— Planet + moon systems have been generated with random planet periods and moon sizes (black dots). The blue and green curves show the 1- and 4.6-Gyr stability limits, respectively, of these systems (stable systems are on the right of the lines). The red dots are those systems for which the moon could be detected assuming* **CHEOPS** *observes five planetary transits.*

NASA gives planet-hunting TESS space telescope go-ahead for 2017 launch

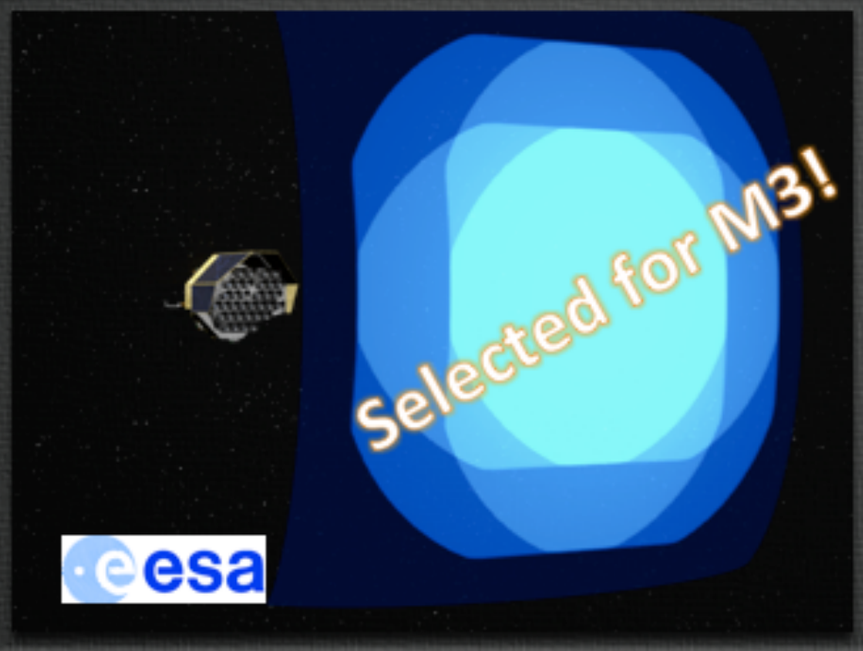
By **Donald Melanson** posted Apr 9th, 2013 at 3:01 PM

17

NASA's Kepler space telescope hasn't exactly been a slouch when it comes to planet

PLATO 2.0

An European Space Agency (ESA) Cosmic Vision 2015-2025 Project



ESA/SRE(2013)5 - The YellowBook

ESRE-F/2013.075 - Preliminary Requirement Review

PLATO 2.0 (PLAnetary Transits and Oscillations of stars) is a medium class (M class) mission studied in the framework of the ESA Cosmic Vision 2015-2025 program.

Project Status

On February 19th 2014 PLATO has been selected by the ESA SPC for the M3 slot, according to the proposal made by he ESA executive that followed the recommendation by the ESA Space Science Advisory Committee.

Tweets Follow

SCORE
0

HIGHSCORE
36580