

THE KEPLER MISSION



<http://kepler.nasa.gov/multimedia/Images/>

What if we saw a star get dimmer
and then brighten up again?

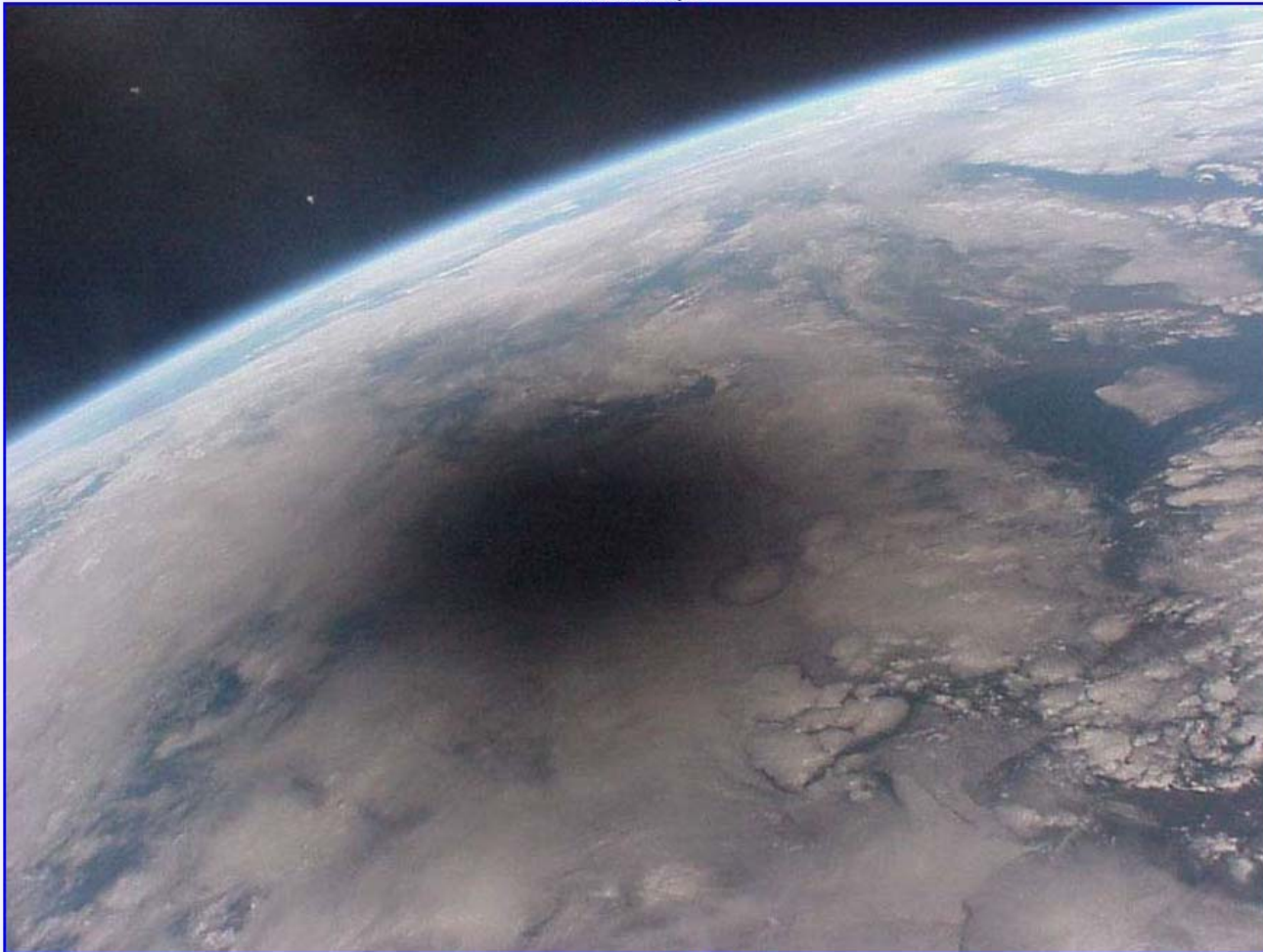


What if that star
is the sun?

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2011 January 2



Looking Back at an Eclipsed Earth
Credit: [Mir 27 Crew](#); Copyright: [CNES](#)

<http://apod.nasa.gov/apod/ap110102.html>

Some explanations for dimming stars



Eclipsing binaries like Algol: orbits seen edge-on, one star periodically blocking the other

Variable stars: some are stars running out of fuel and getting unstable

Sunspots or starspots

Transits

Galileo 1609

How I became interested in the Kepler Mission

Astronomy seems to be a continuing story of what we learn and the surprises we get when we find a new way to look at the sky more closely

Observing some exoplanet transits is now possible for amateur astronomers

IYA 365 Days of Astronomy podcast on the Kepler mission by Davin Flateau



Kepler Mission Description

[NASA Discovery Mission # 10](#) “Are there other planets, orbiting other stars, with characteristics similar to Earth?”

Launched March 6, 2009, into orbit around the Sun trailing Earth

Continuously measuring the brightness of 100,000 stars and sending the data back to Earth for analysis

Capable of detecting extrasolar planets much smaller than Jupiter—other methods are mostly finding giant planets like Saturn or Jupiter (current information on [extrasolar](#) planet discoveries)



Image credit: NASA/Jack Pfaller

Liftoff of the Delta II rocket carrying NASA's Kepler spacecraft

Distance to Kepler:

2009 April 24 14:00 UTC

4,661,000 km

2,896,000 mi

0.031 AU

12.13 times the distance to
the Moon

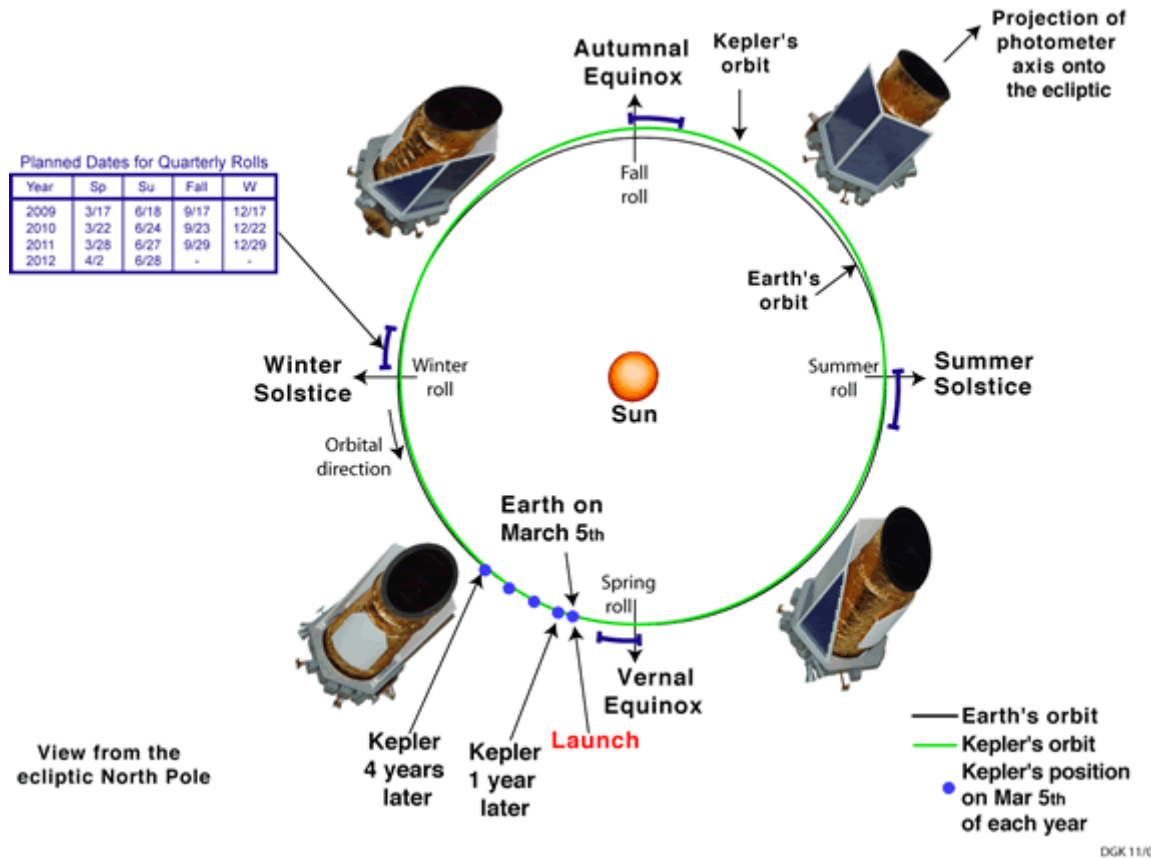
2009 May 01 14:00 UTC

5,382,000 km

3,344,000 mi

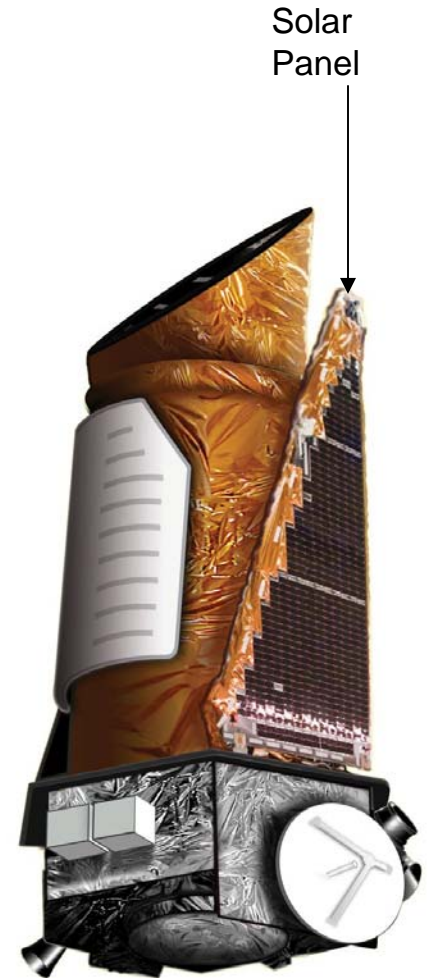
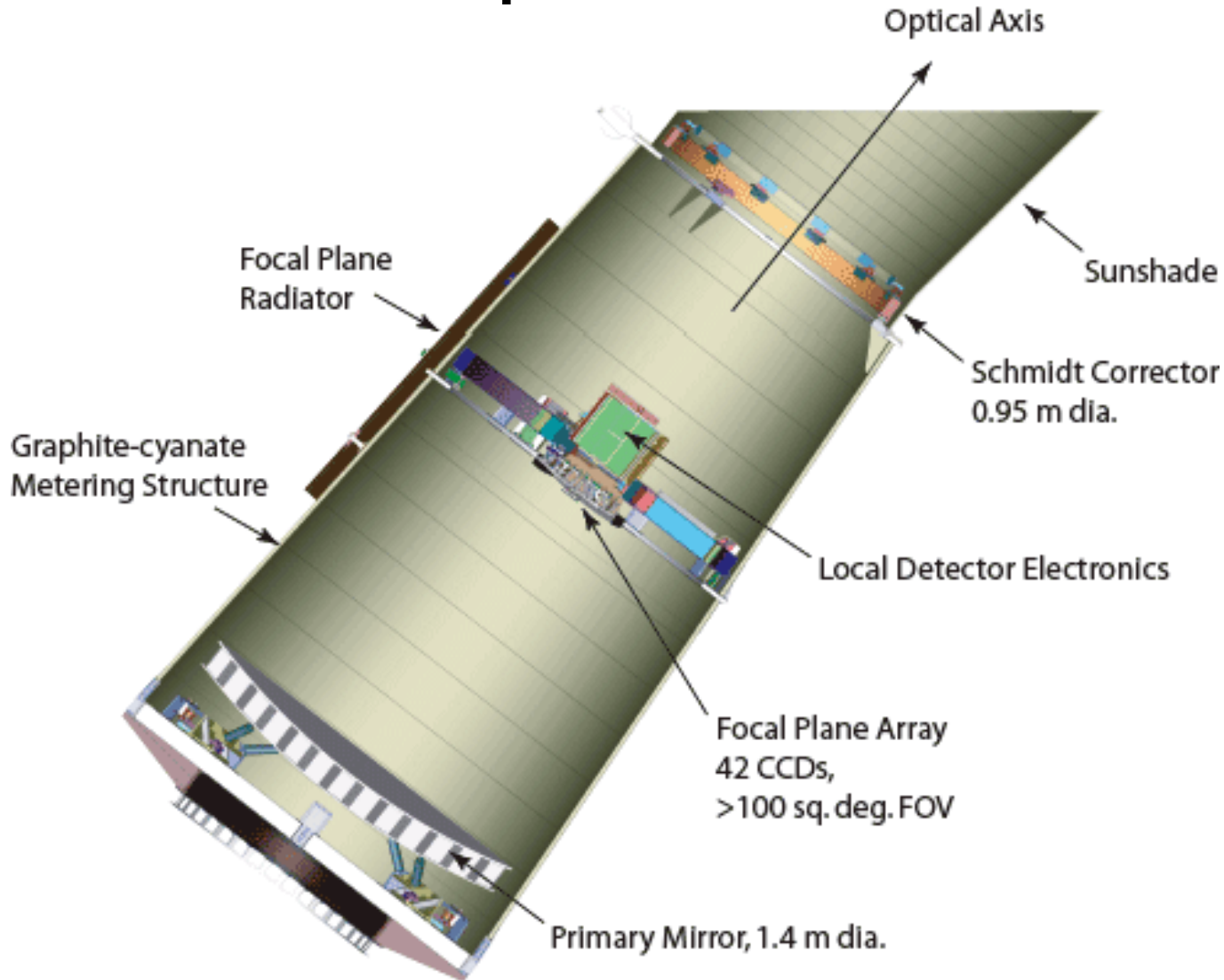
0.036 AU

14.00 times the distance to
the Moon

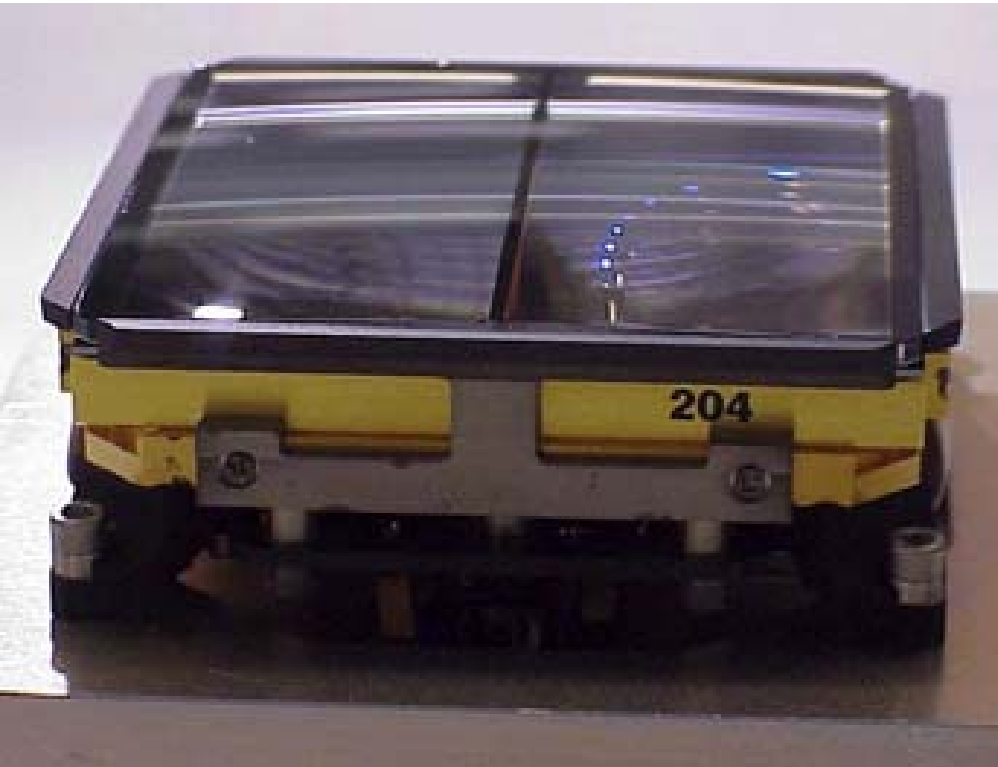


Source: <http://kepler.nasa.gov/Mission/mmupdates/missionManagerArchive/>

Kepler Photometer



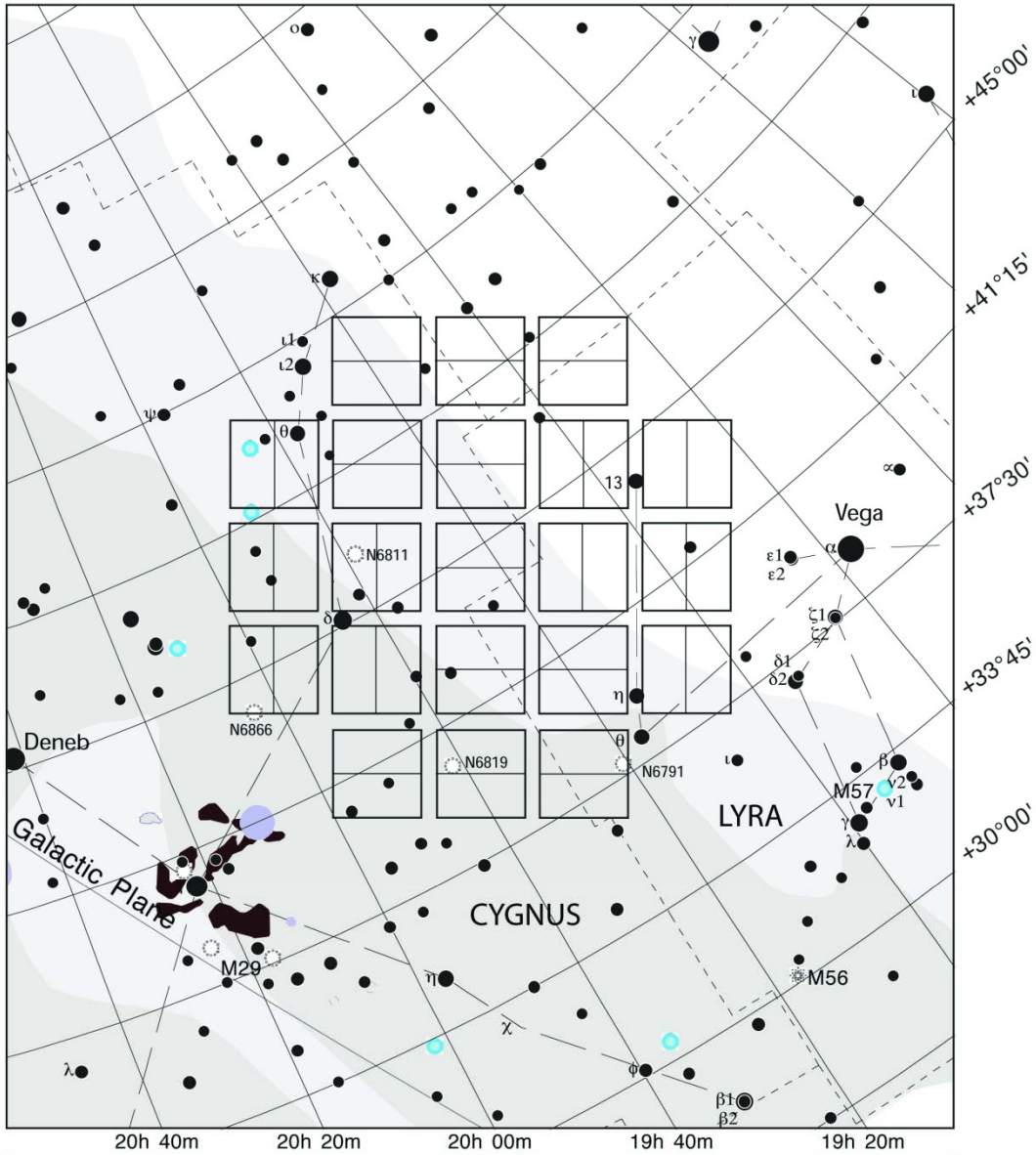
Kepler CCD Array



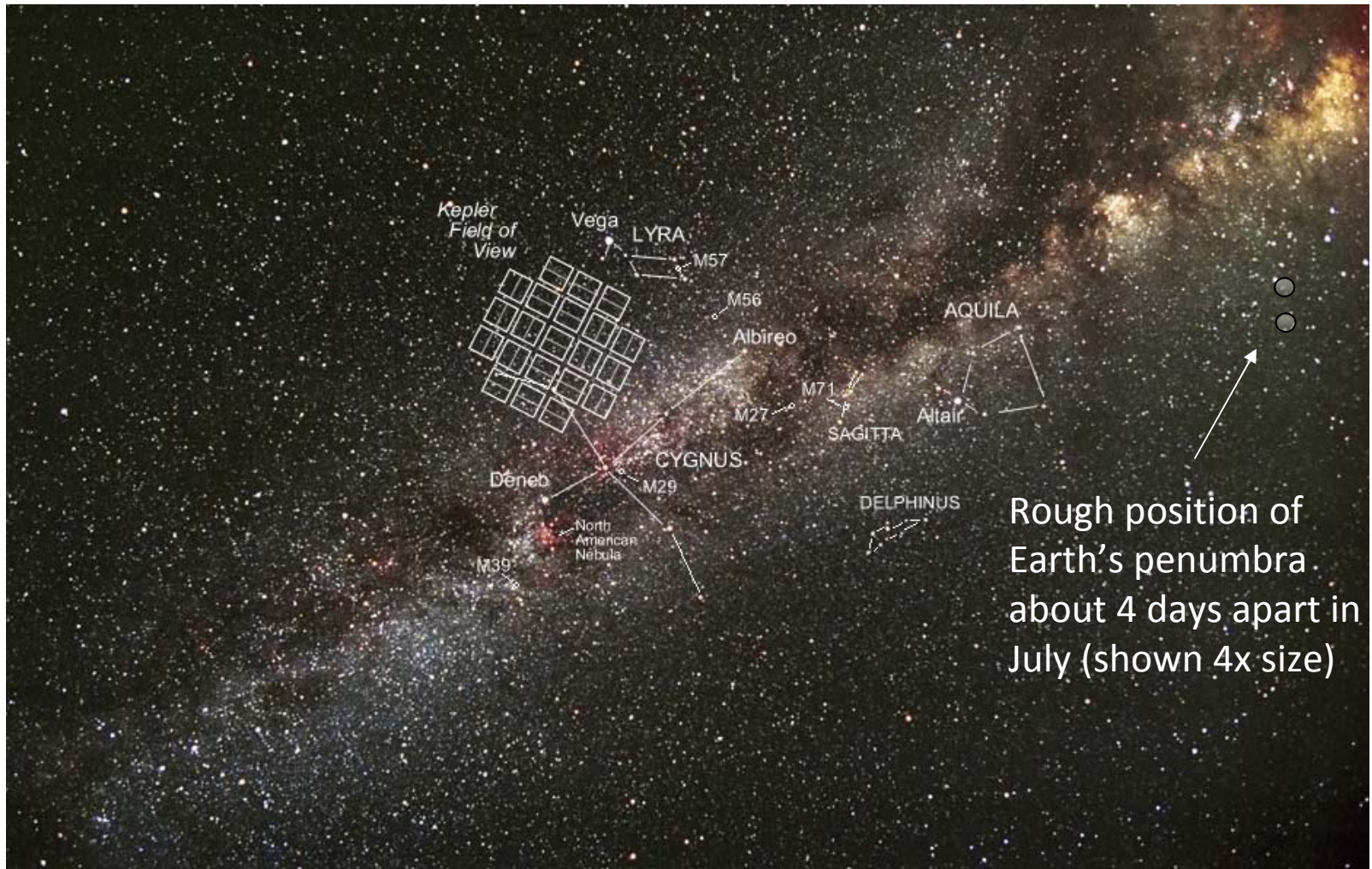
24 pairs of CCD elements, each 2,200 By 1,024 pixels, for 95 megapixels total—30 pixels for each target star

Covers 15-degree wide field of view in Cygnus and Lyra

Square arrangement can turn 90 degrees each quarter

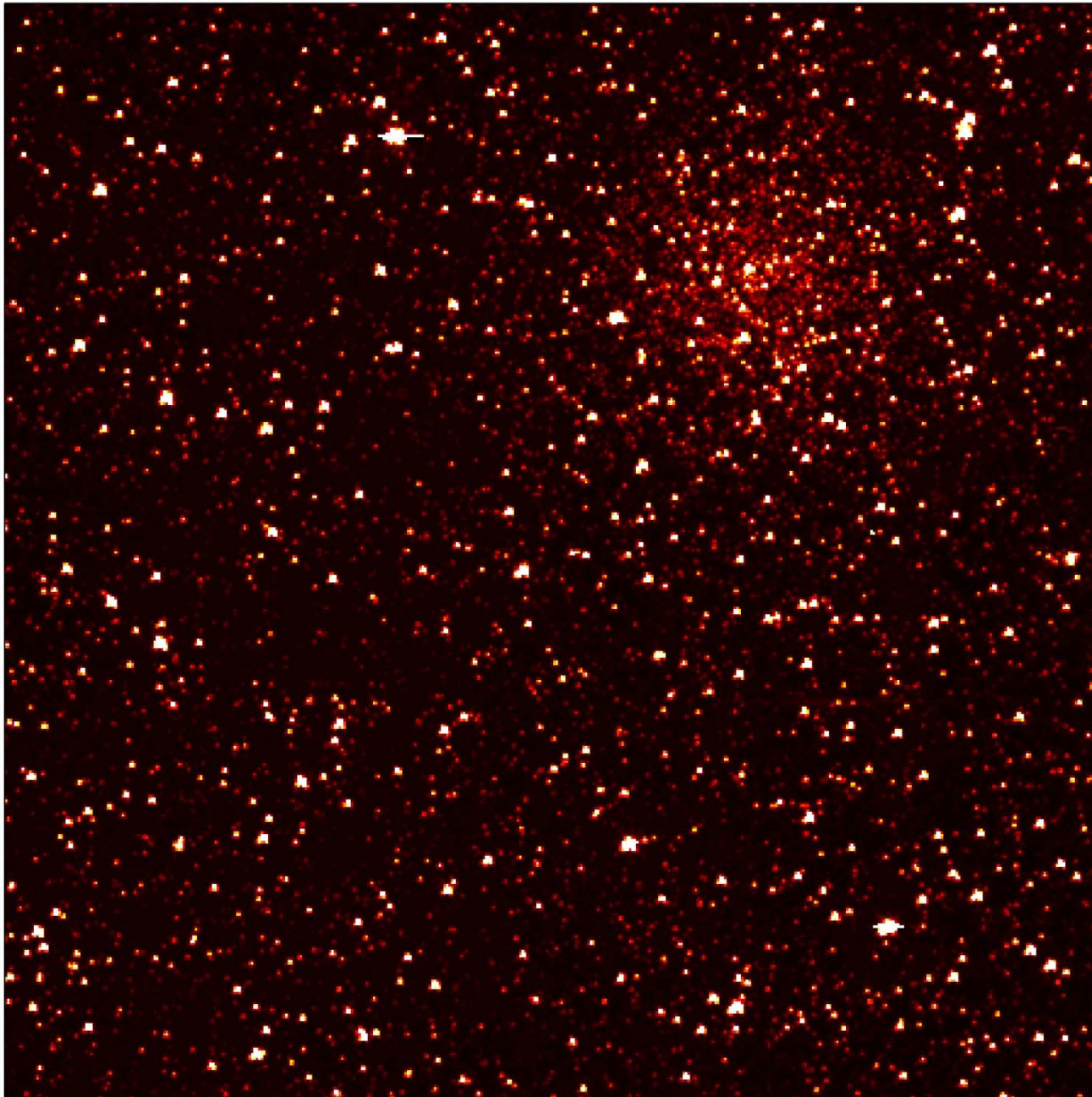


<p>Star Magnitudes</p> <p>0 1 2 3 4 5 6</p> <p><i>Kepler FOV</i></p>	<ul style="list-style-type: none"> Open Cluster Globular Cluster Nebula Planetary Nebula <p>FOV Center RA: 19h 22m 40s Dec: +44 30' 00" 9/10/04</p>	
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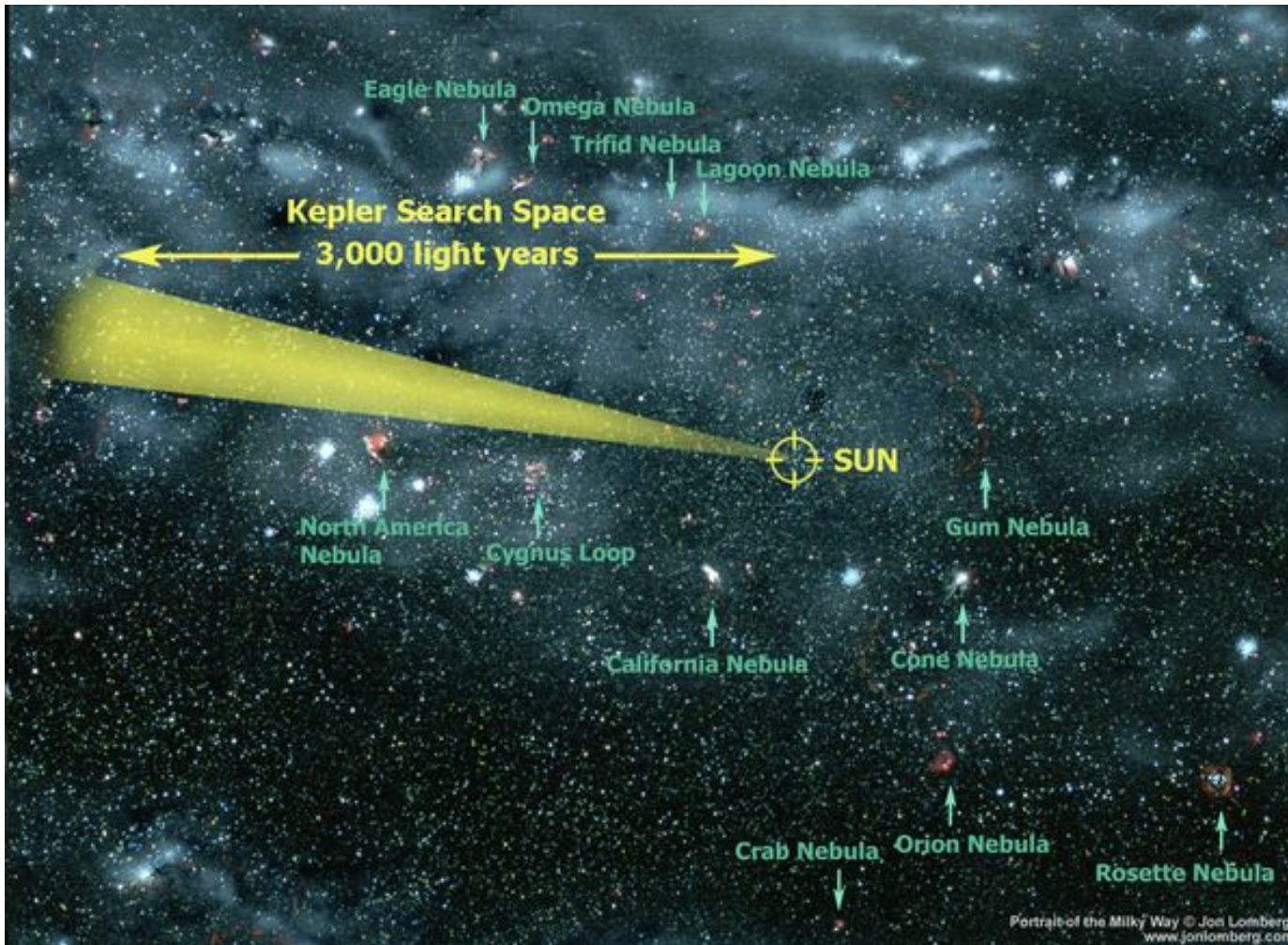
Rough position of Earth's penumbra about 4 days apart in July (shown 4x size)

<http://kepler.nasa.gov/multimedia/Images/>



Close-up of one
corner of Kepler
field with NGC
6791

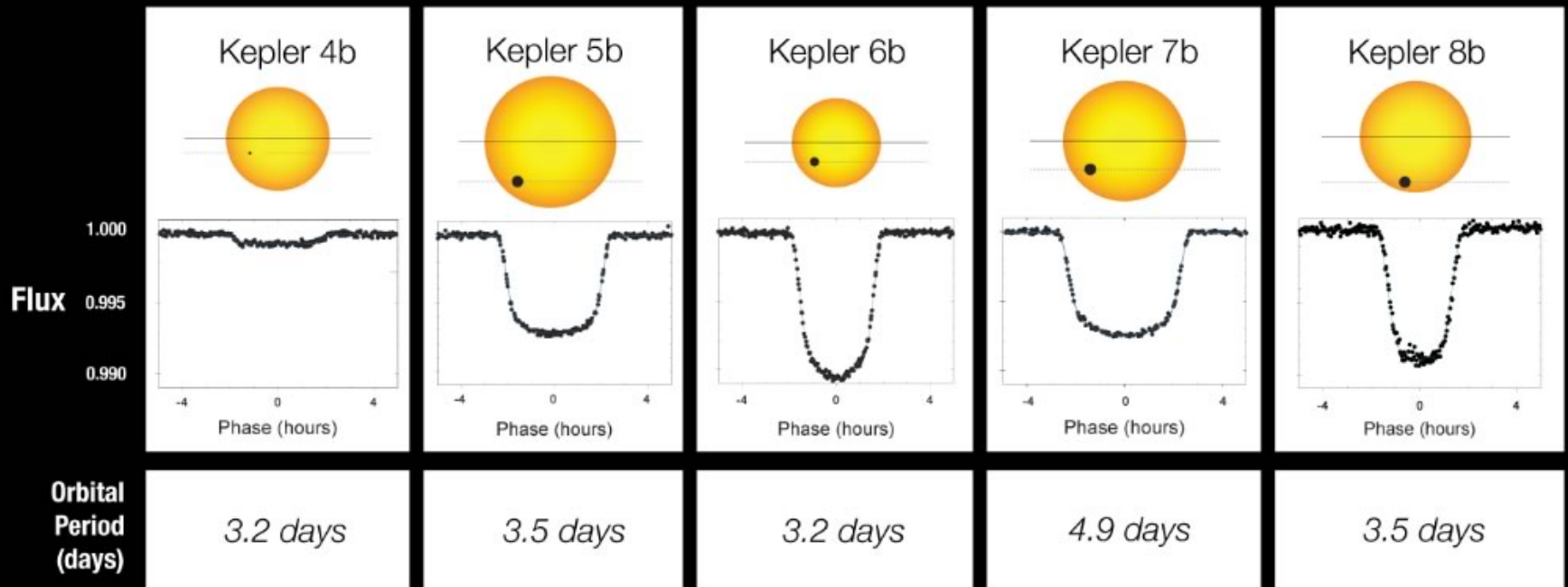
It would take
about a 150-
megapixel
resolution screen
to display the
whole field of
view



<http://kepler.nasa.gov/multimedia/Images/>

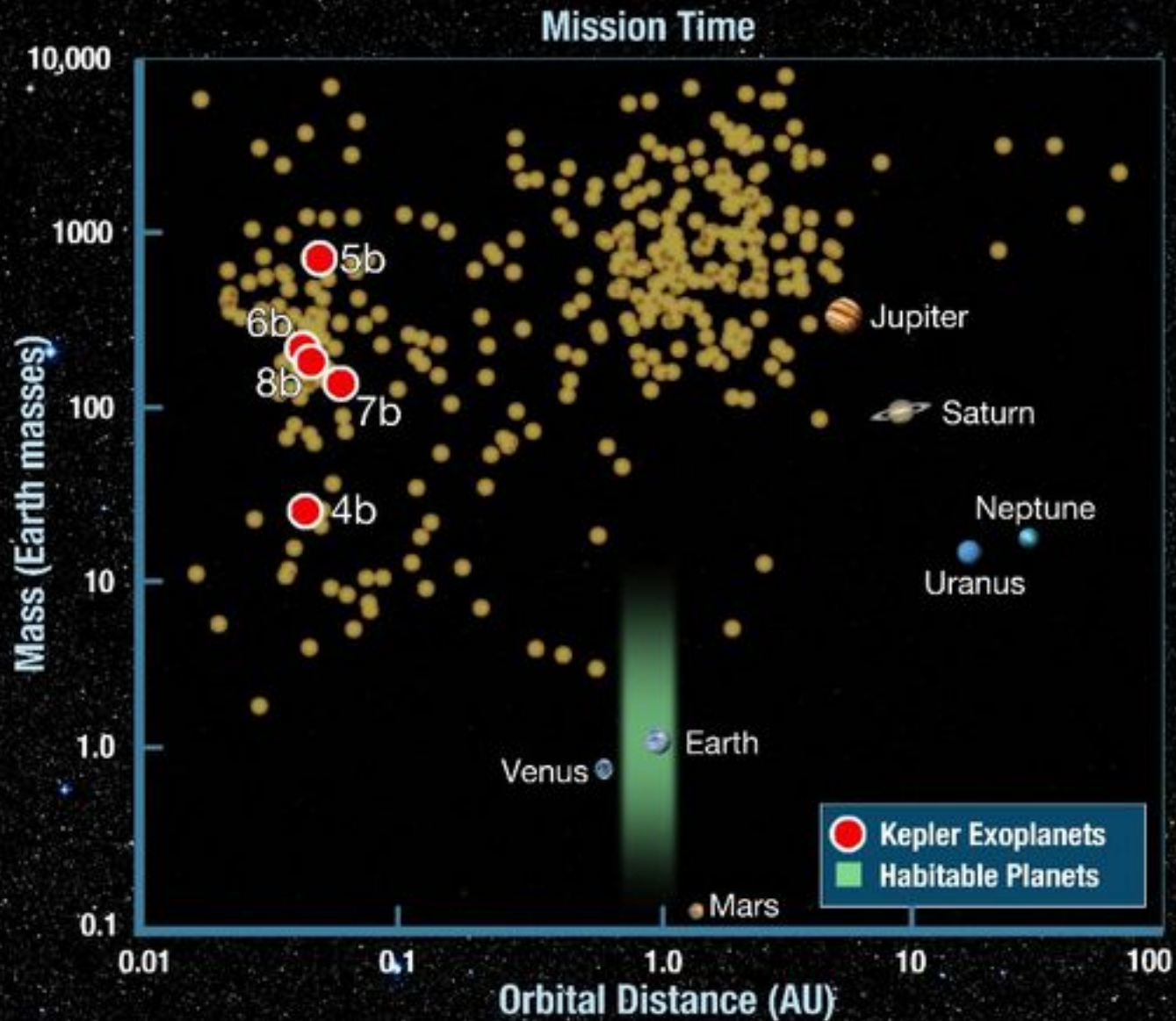
How Kepler Detects Transits

Transit Light Curves



First Five Planet Discoveries

Made with First 43 Days of Data



Kepler Results

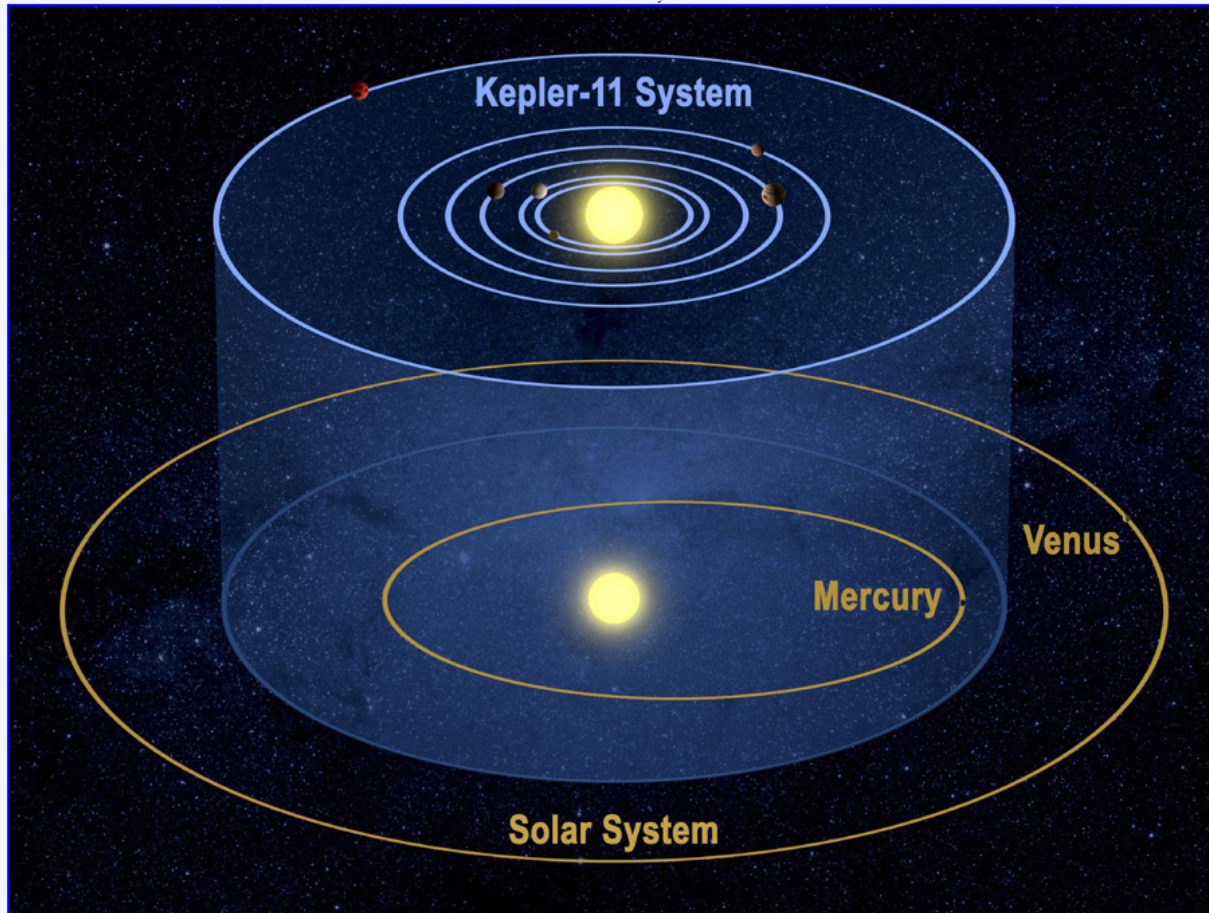
The screenshot displays the NASA Kepler website interface. At the top left is the NASA logo and 'Ames Research Center'. The main heading is 'Kepler A Search for Habitable Planets'. A navigation bar includes links for Home, Mission, News, Science, Discoveries, Multimedia, and Education. A 'Kepler Planet Count' box in the top right corner provides the following statistics:

Kepler Planet Count	
Planet Candidates:	1235
Eclipsing Binary Stars:	1879
Confirmed Planets:	015

Below the navigation bar, the 'Notable Discoveries' section features a 'Kepler Field of View' diagram showing the positions of stars Deneb, CYGNUS, and Albireo. A grid of planet candidates is overlaid on the field. To the right, two portraits of scientists are shown above a news snippet titled 'AAS gives award ... to Kepler PI Bill Borucki & Deputy PI Dave Koch'. The bottom of the page contains three smaller images: a planet with a light curve graph, the Kepler spacecraft, and a close-up of a planet's surface.

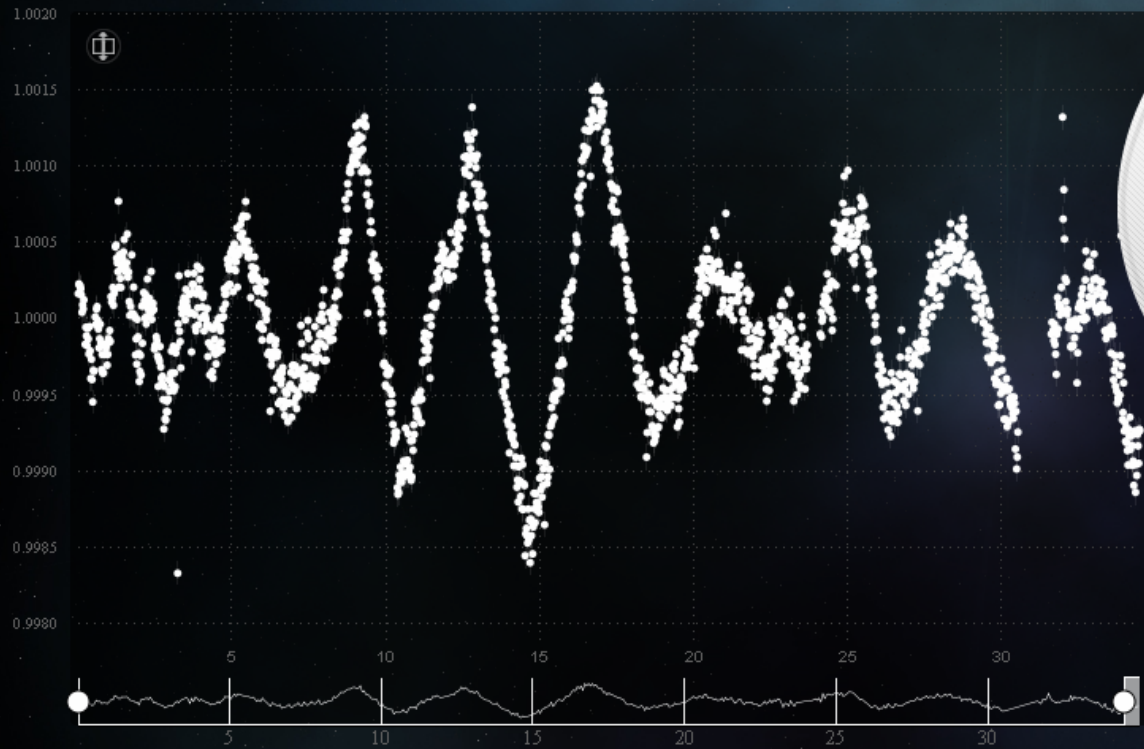
<http://kepler.nasa.gov/>

Six-Planet System Discovered by Kepler



Six Worlds for Kepler-11
Illustration Credit: Tim Pyle, [NASA](http://www.nasa.gov)

<http://apod.nasa.gov/apod/ap110203.html>



HELP RESTART

Is the star

VARIABLE

Type of star: Dwarf
 Apparent visual magnitude: 12.6
 Temperature: 5714 (K)
 Radius: 1.2x Sol

★ MARK AS FAVORITE

Planet Hunters - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.planethunters.org/classify

Planet Hunters

Planet Hunters is part of the ZOO NIVERSE ...just like MOON ZOO

planethunters.org CLASSIFY BDB ABOUT CANDIDATES TALK TUTORIAL

Is the variability...

REGULAR

Type of star:	Dwarf
Apparent visual magnitude:	12.6
Temperature:	5714 (K)
Radius:	1.2x Sol

MARK AS FAVORITE

http://www.planethunters.org/classify#

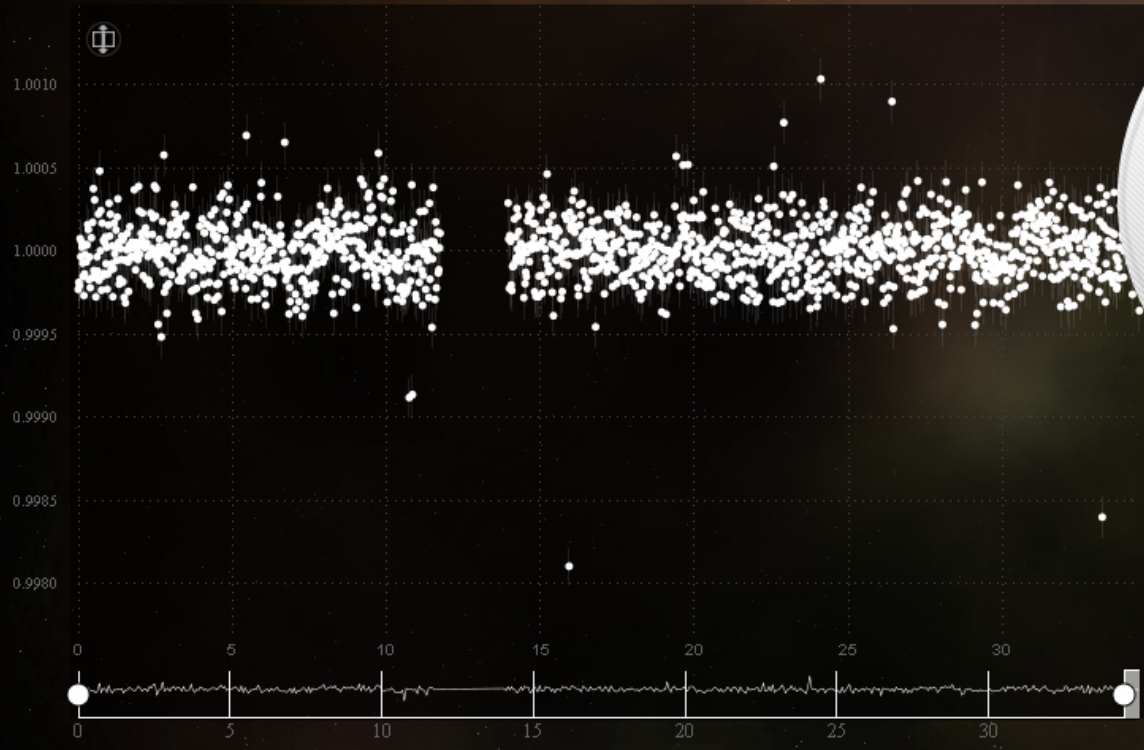
http://www.planethunters.org/classify

Planet Hunters is part of the ZOO NIVERSE

...just like MOON ZOO

planethunters.org

CLASSIFY BDB ABOUT CANDIDATES TALK TUTORIAL



HELP RESTART

Does the star have any transit features?

YES NO

Type of star: Giant
 Apparent visual magnitude: 13.5
 Temperature: 5240 (K)
 Radius: 2.7x Sol

★ MARK AS FAVORITE

Resources for Further Exploration

What is happening:

Kepler Mission website: <http://kepler.nasa.gov/> (links to mission status, news, related science like astroseismology, and more)

Exoplanets in general: <http://planetquest.jpl.nasa.gov/index.cfm> or <http://oklo.org/>

Getting involved:

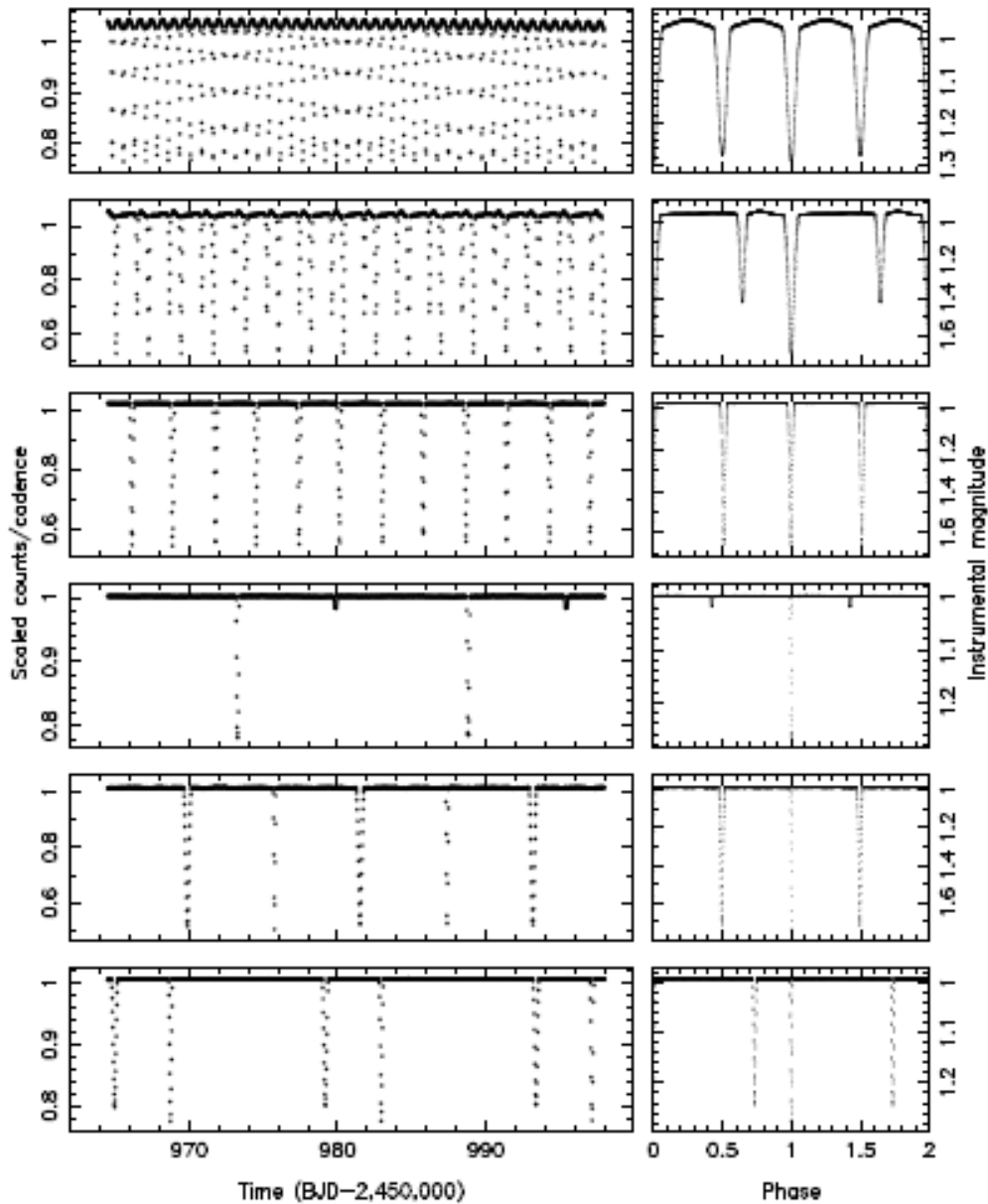
Analyzing Kepler data: <http://www.planethunters.org/> (also do-it-yourself analysis by downloading data from Kepler Mission website)

Looking for your own transits: <http://www.transitsearch.org/>, <http://www.aavso.org/>, and http://brucegary.net/book_EOA/x.htm

A lighter look at follow-up studies for some day hence?...

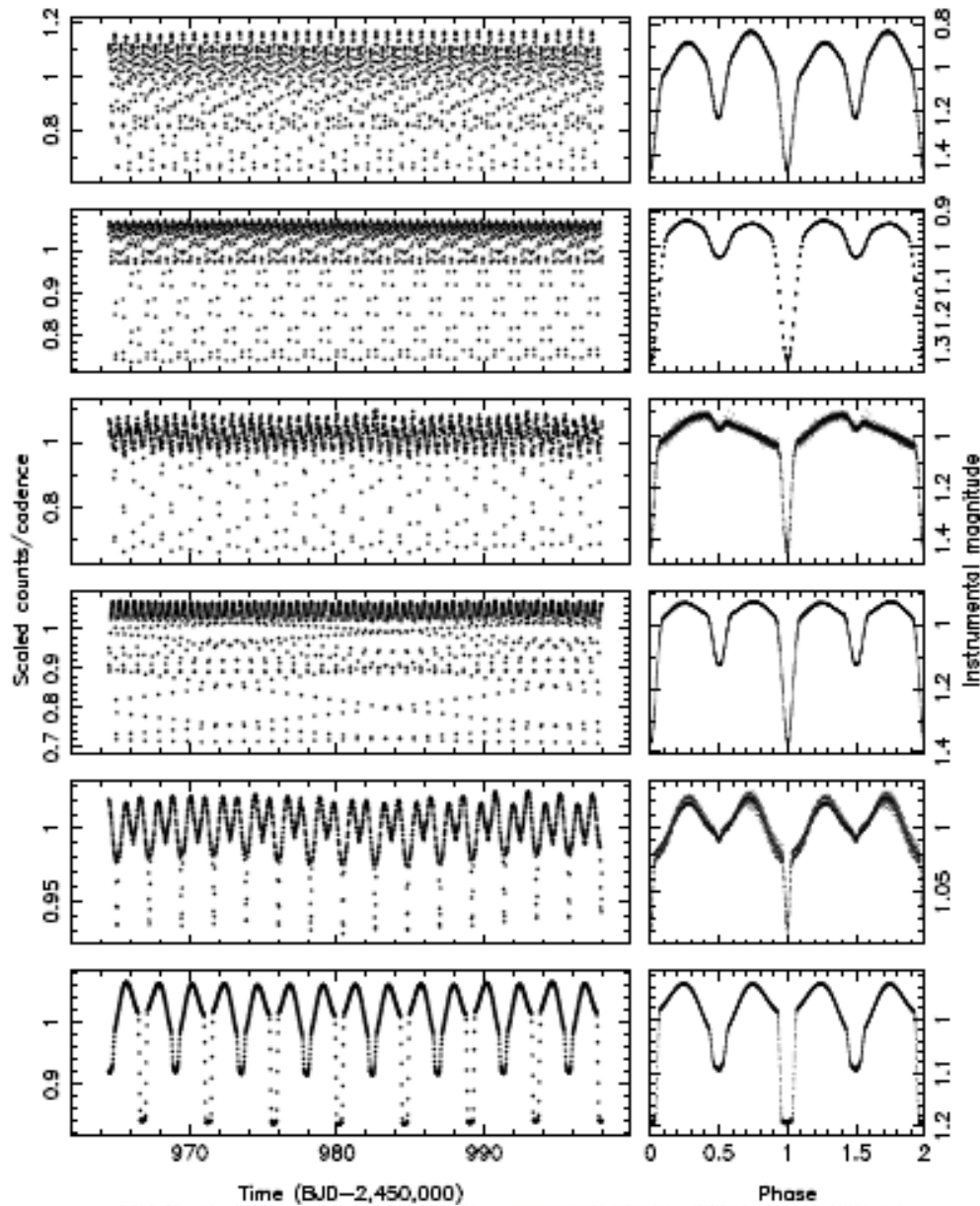
<http://www.creators.com/comics/the-other-coast/69188.html>

Detached eclipsing binary light curves



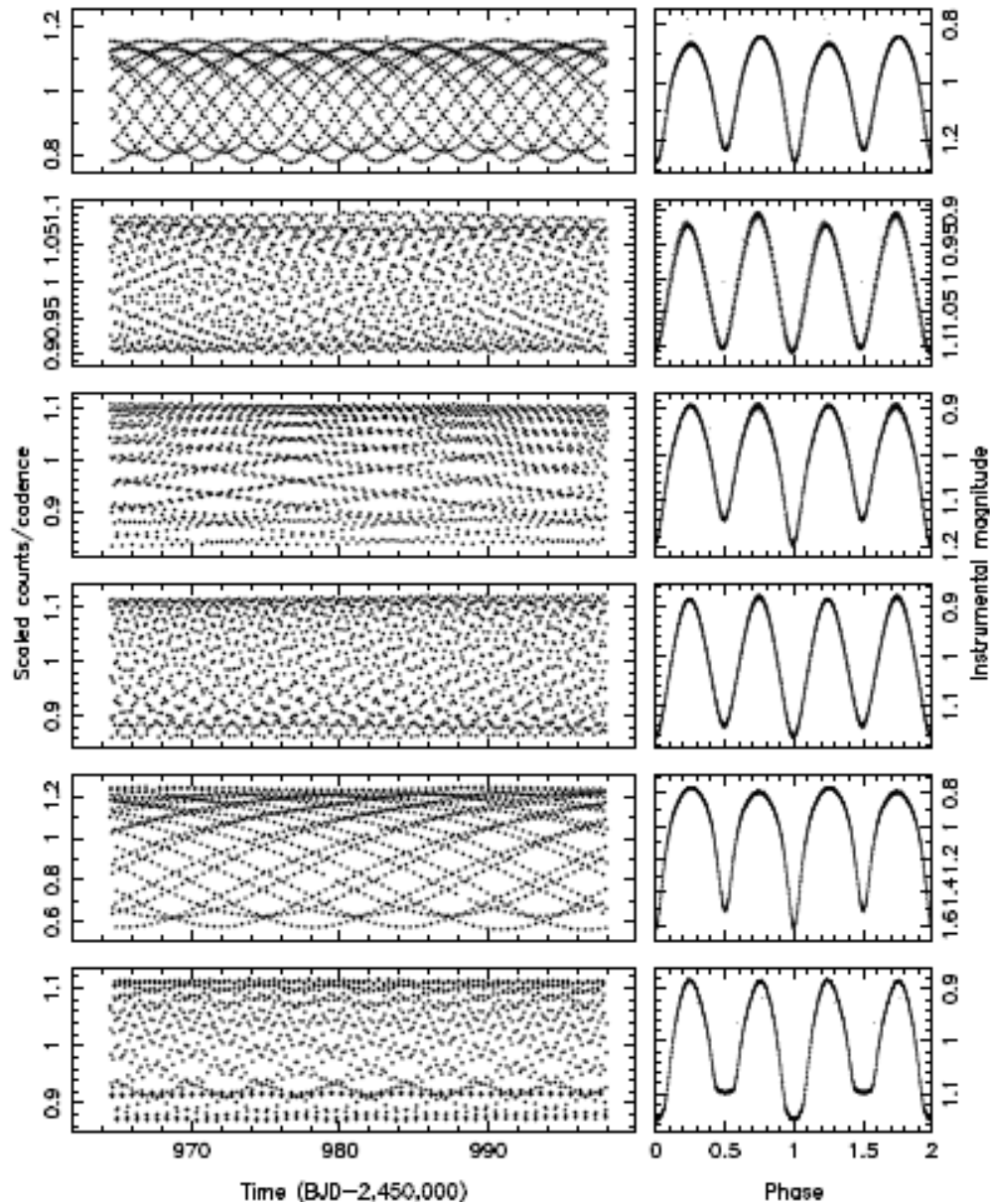
<http://arxiv.org/abs/1006.2815v1>

Semi-detached eclipsing binary light curves

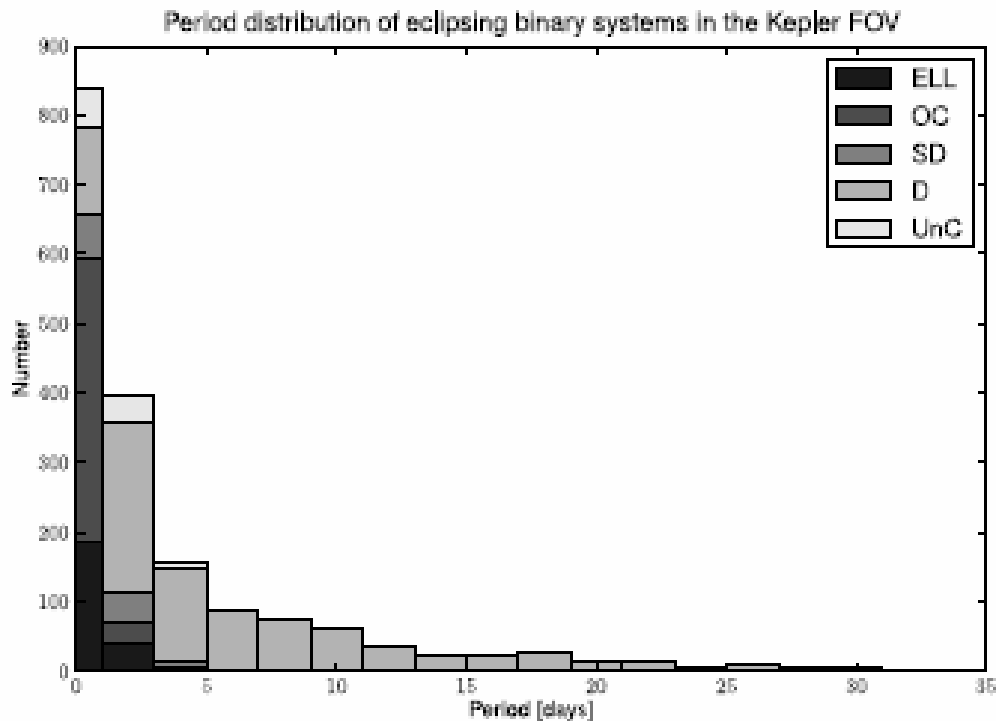


<http://arxiv.org/abs/1006.2815v1>

Contact eclipsing binary light curves



<http://arxiv.org/abs/1006.2815v1>



The distribution of periods for all the stars identified as eclipsing binaries in the *Kepler* Q1 data set. The baseline was 34 days (44 with Q0). Systems have been classified as ellipsoidal ('ELL'), over-contact ('OC'), semi-detached ('SD'), detached ('D'), and unclassified ('UnC').

<http://arxiv.org/abs/1006.2815v1>



Milky Way Galaxy

