

How the observations of CoRoT and Kepler satellites have contributed to our understanding of exoplanets?

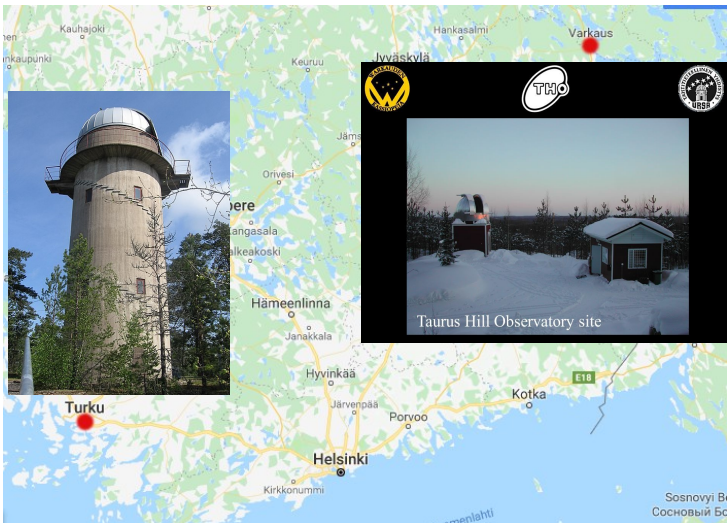
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Background



Introduction - myself

- ▶ Pro-am background in Taurus Hill Observatory.
- ▶ Now a PhD student in Tuorla Observatory, University of Turku.
- ▶ Currently modeling the x-ray observations of neutron stars.
- ▶ My Bachelor Thesis from 2014: How the observations of CoRoT and Kepler satellites have contributed to our understanding of exoplanets?

Introduction - Exoplanets

- ▶ How many found? Over 4000 validated and many still to be confirmed (<http://exoplanet.eu/>).
- ▶ How are they found?
 - ▶ Photometric: Transits (Kepler and CoRoT)
 - ▶ Spectroscopic: Doppler
- ▶ Most new planets found by Kepler but amateurs participation by confirming the candidates.



The screenshot shows the homepage of Exoplanet.eu. At the top, there is a navigation bar with links for Home, All Catalogs, Diagrams, Bibliography, Research, Meetings, Other Sites, and VO. The main content area features the title "The Extrasolar Planets Encyclopaedia" and a sub-header "Established in February 1995". Below this, there are two columns of links: "All Catalogs" (with a spreadsheet icon) and "Diagrams" (with a 3D pie chart icon). A "News" section is located below, containing several articles with dates and brief descriptions. At the bottom of the page, there are navigation icons for back, forward, and search.

Exoplanet.eu Home All Catalogs Diagrams Bibliography Research Meetings Other Sites VO

The Extrasolar Planets Encyclopaedia

Established in February 1995
Developed and maintained by the **exoplanet TEAM**
update : April 26, 2019 (4057 planets)
Please report any problems to vo.exoplanet@obspm.fr

All Catalogs
Filter, sort, export — arbitrary data manipulations with the Extrasolar Planets Encyclopaedia

Diagrams
Analyze the Extrasolar Planets Encyclopaedia data online. Simple plotting tool right in the browser

News

2019-04-26 All of our database is accessible in python via our API. We have added a tutorial to use the API to query our database and collect/handle the data you want in an easy way.

2019-04-26 Today is a celebration day as we are now over 4000 planets validated in our database and this number will grow very quickly thanks to intensive on-going work!

2019-04-26 Warning : Announcements of K2 planets can be duplicated. -The planet of the star EPIC 201498078 has

Tutorials
update : April 1, 2019

Bibliography
update : April 26, 2019

Research
update : Feb. 22, 2019

Planets in binaries

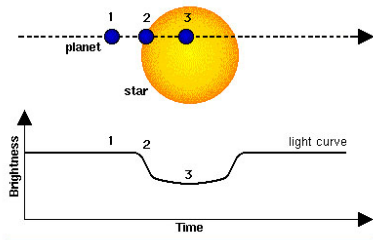
Meetings
update : April 26, 2019

Theory Work
update : Nov. 22, 2017

Other sites
update : Feb. 27, 2019

View of planets around

Transit Photometry

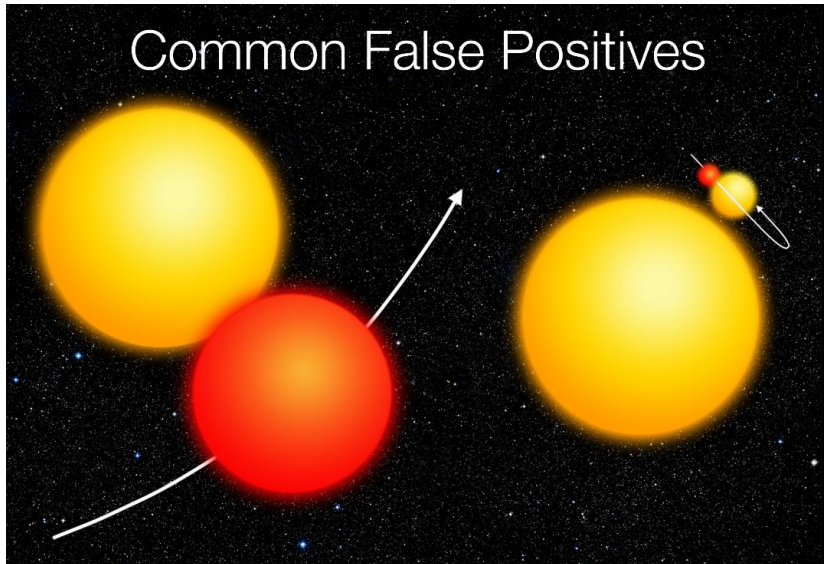


- ▶ The radius of the planet obtained from the amount of dimming of the primary star, if radius of the star known.
- ▶ Period of the orbit of the planet from observations of many transits.
- ▶ Distance between planet and the star from Kepler's 3. law.
- ▶ Mass of the planet only with spectroscopy (Doppler effect).

CoRoT

- ▶ Convection, Rotation and planetary Transits.
- ▶ Space telescope mission which operated from 2006 to 2013.
- ▶ Astroseismology and exoplanet studies.
- ▶ V-magnitude range from 11 to 16.
- ▶ ~ 530 planet candidates, from which ~ 30 finally found to be true planets.
- ▶ 2 parabolic mirrors and aperture of 27 cm, 4 CCD cameras.

False positives



CoRoT -achievements

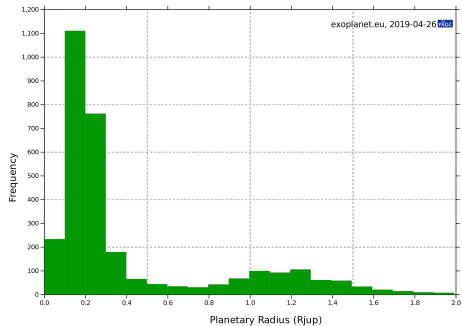
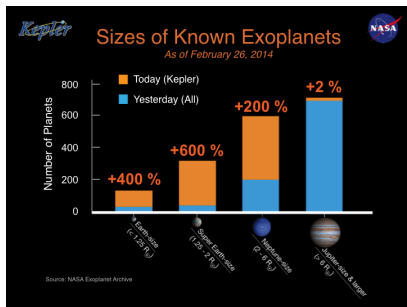
- ▶ Discovered planets with masses down to about $4.8 M_{\text{earth}}$ (CoRoT-7b) and up to $21 M_{\text{jup}}$ (CoRoT-3b).
- ▶ Radius of CoRoT-3b still around $1 R_{\text{jup}}$: Likely to be an object at the boundaries of planets and brown dwarf stars.
- ▶ Radius of CoRoT-7b below $2 M_{\text{earth}}$: First known transiting rocky, Earth-like planet.
- ▶ The variety of internal structures in close-in giant planets.
- ▶ Multiple constraints on the formation, evolution, role of tides in planetary systems.
- ▶ Phase curves of CoRoT-1b revealed a large temperature contrast between the dayside and the nightside.
- ▶ Secondary transits also observed.

Kepler

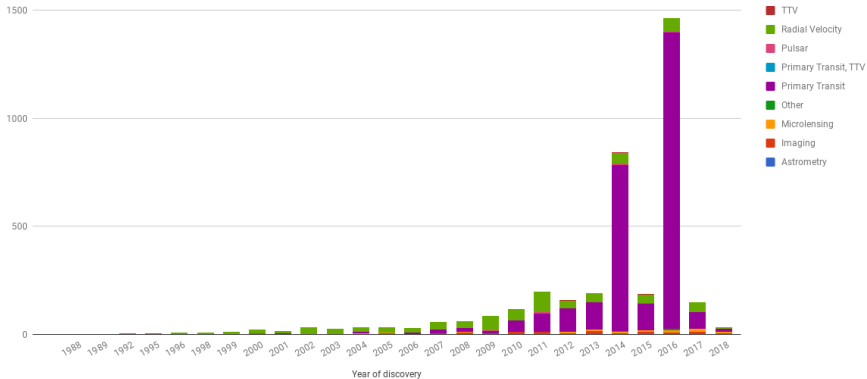
- ▶ Operated from 2009 to 2018.
- ▶ 1.4 meter primary mirror.
- ▶ Observed 530,506 stars and detected 2,662 planets.



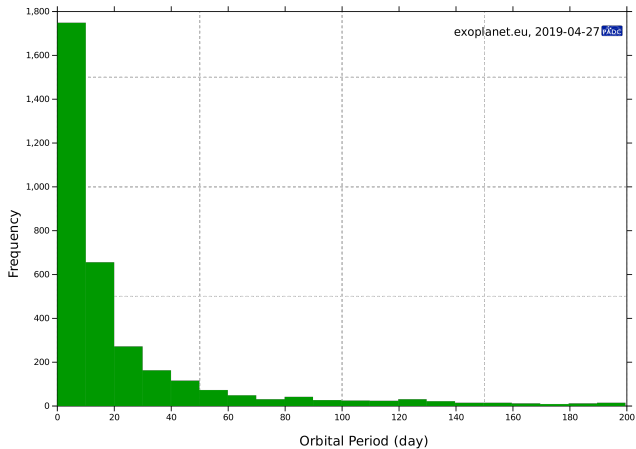
Kepler -statistics



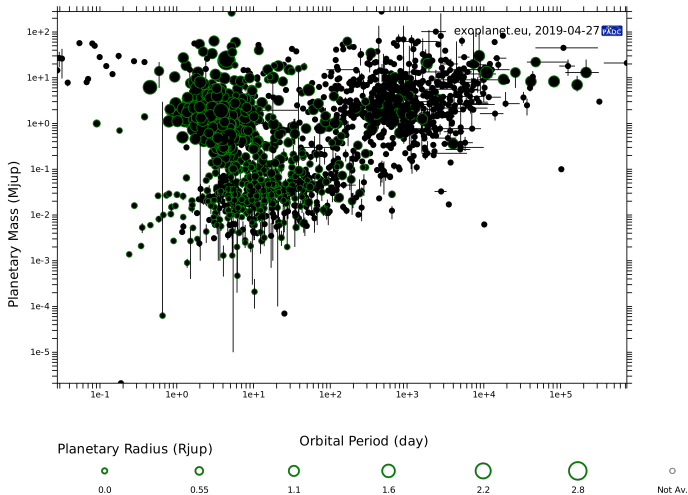
Kepler -statistics



Kepler -statistics

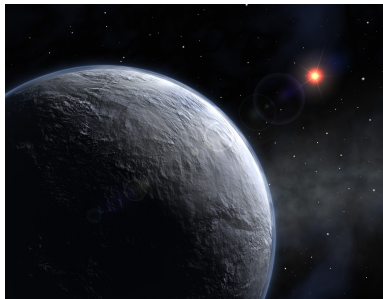


Kepler -statistics



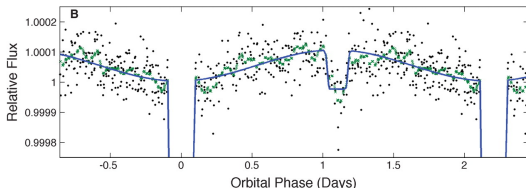
Kepler - habitable planets

- ▶ Many Earth-size planets found from the habitable zone.
- ▶ Petigura 2013: 22% of Sun-like Stars have Earth-sized Planets in the Habitable Zone.



Exoplanetary atmospheres

- ▶ Spectroscopy during transit: Absorption spectrum of the planet.
- ▶ Spectroscopy during secondary eclipse: Emission spectrum of the planet.
- ▶ CoRoT and Kepler did no spectroscopy but measured secondary eclipses phase curves giving information e.g. of the albedo and the cloudiness of the planets.
- ▶ HAT-P-7 b obtained by the Kepler:



Thank you for your attention!