The Detection and Properties of (Exo)Planetary Systems

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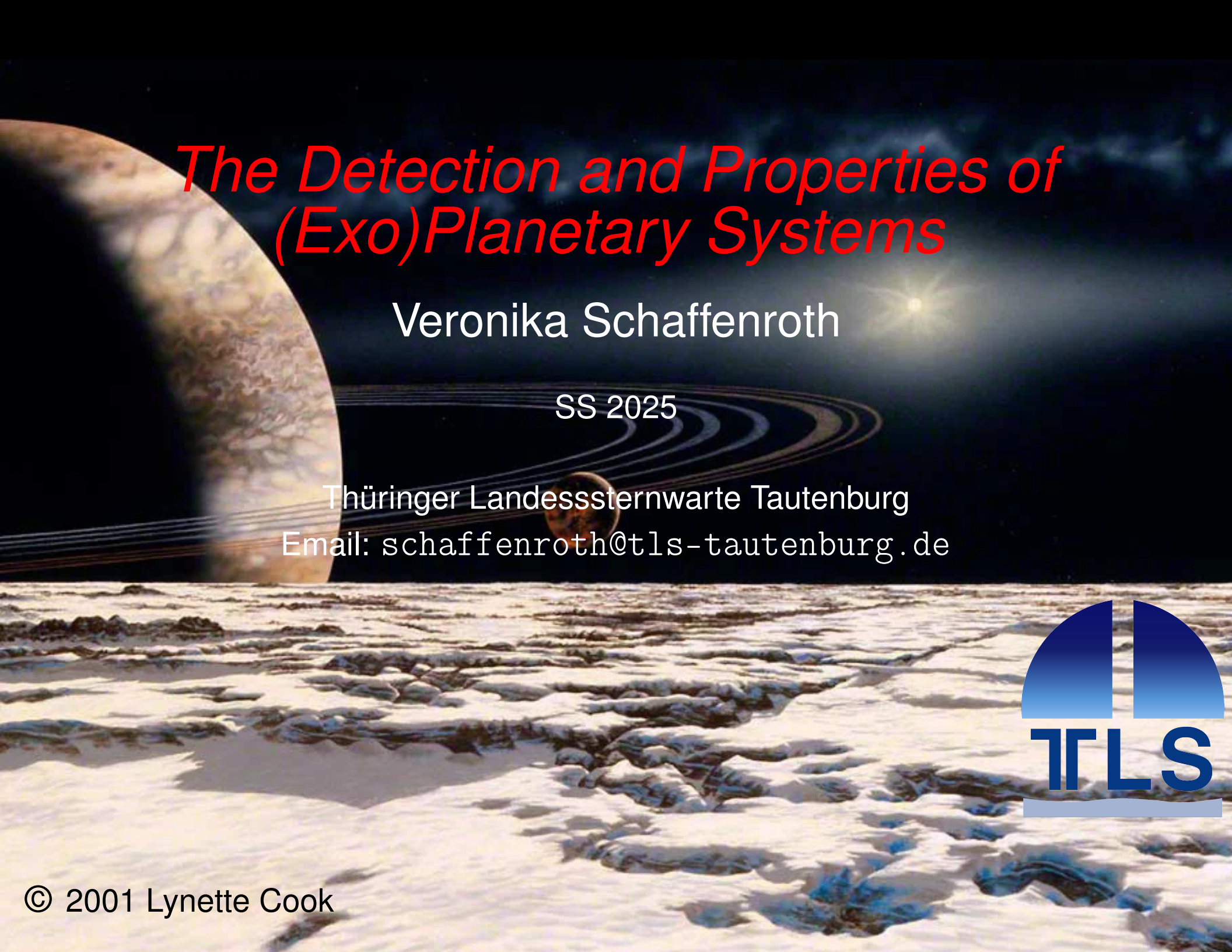


Part I: Detection and properties ($\sim$observations)
lectures by Dr. Veronika Schaffenroth

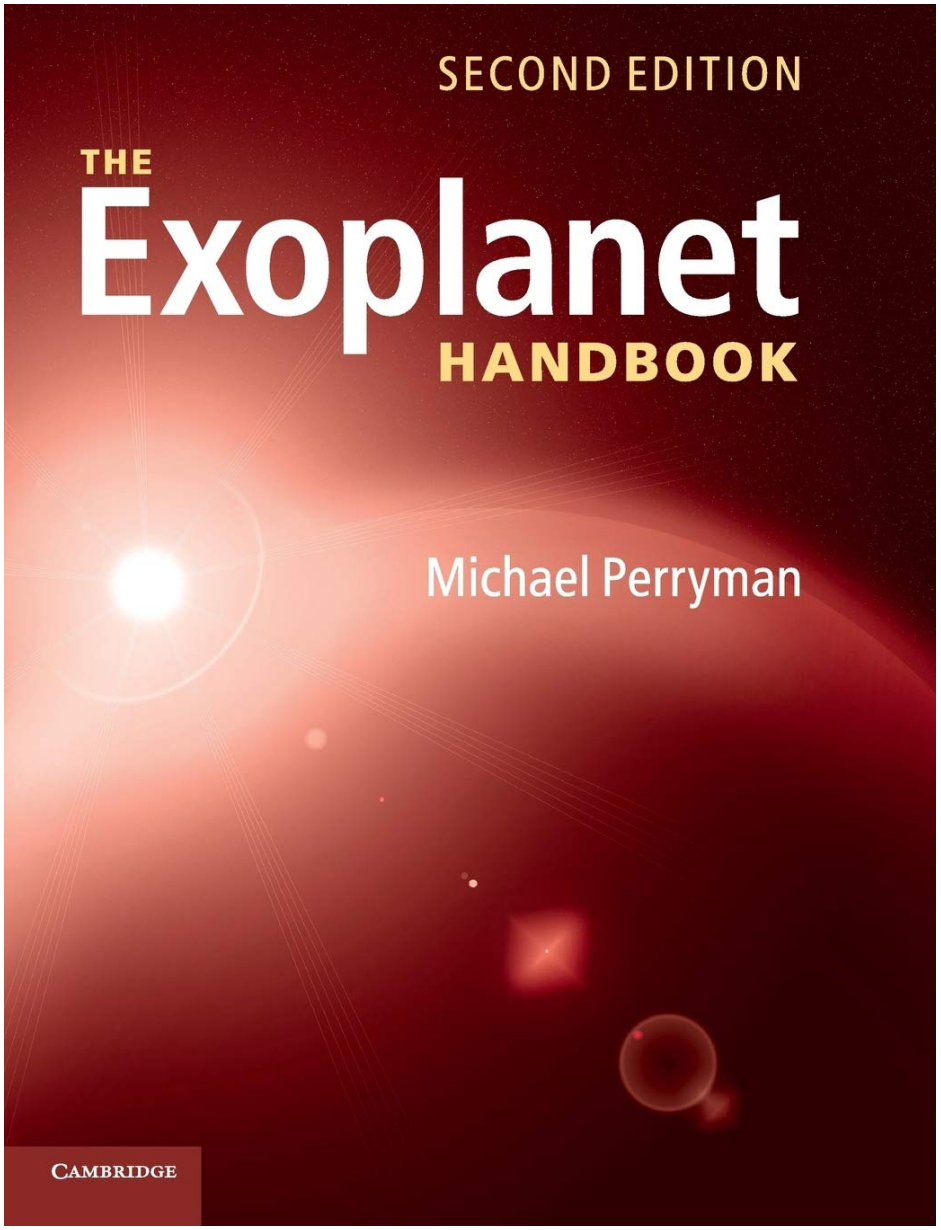
Part II: Formation and evolution ($\sim$theory)
lectures by Prof. Dr. Alexander Krivov

Exercises to both parts: by M.Sc. Tobias Stein

Schedule of Lectures

10. April:	Introduction and Solar System
17. April:	The Radial Velocity Method: Instruments and Techniques
24. April:	The Radial Velocity Method
1. May:	**holiday**
8. May:	The Transit Method
15. May	The Transit Method, Ground-based and space-based results
22. May:	no lecture (instead Excursion to Observatory in Tautenburg in July)
29. May:	**holiday**
5. June:	The Astrometric Detection of Exoplanets
12. June:	Direct Imaging
19. June:	Microlensing and Pulsar Planets
26. June:	Properties of Exoplanets
3. July:	Atmospheres and Interiors
10. July:	Host Stars and The Search for Habitable Planets
x. July:	Excursion to Observatory in Tautenburg

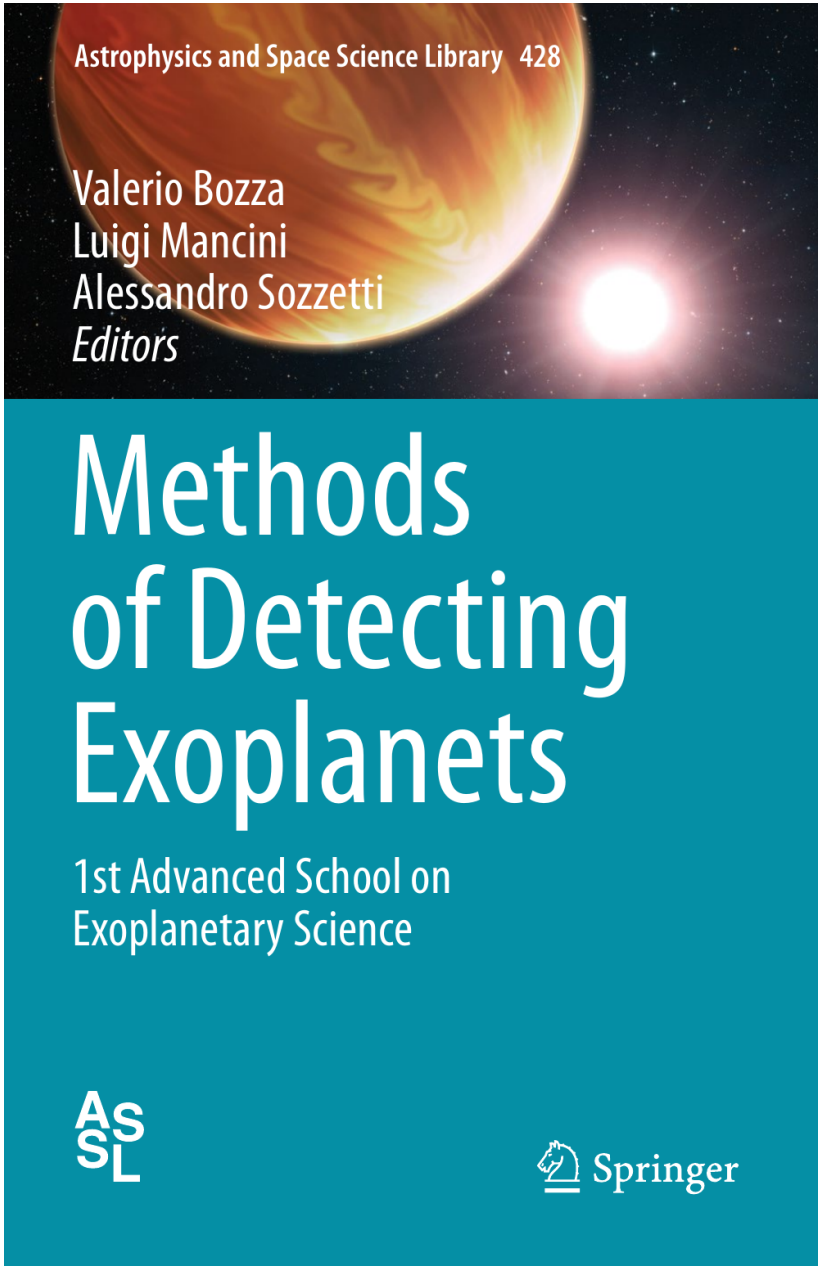
Literature



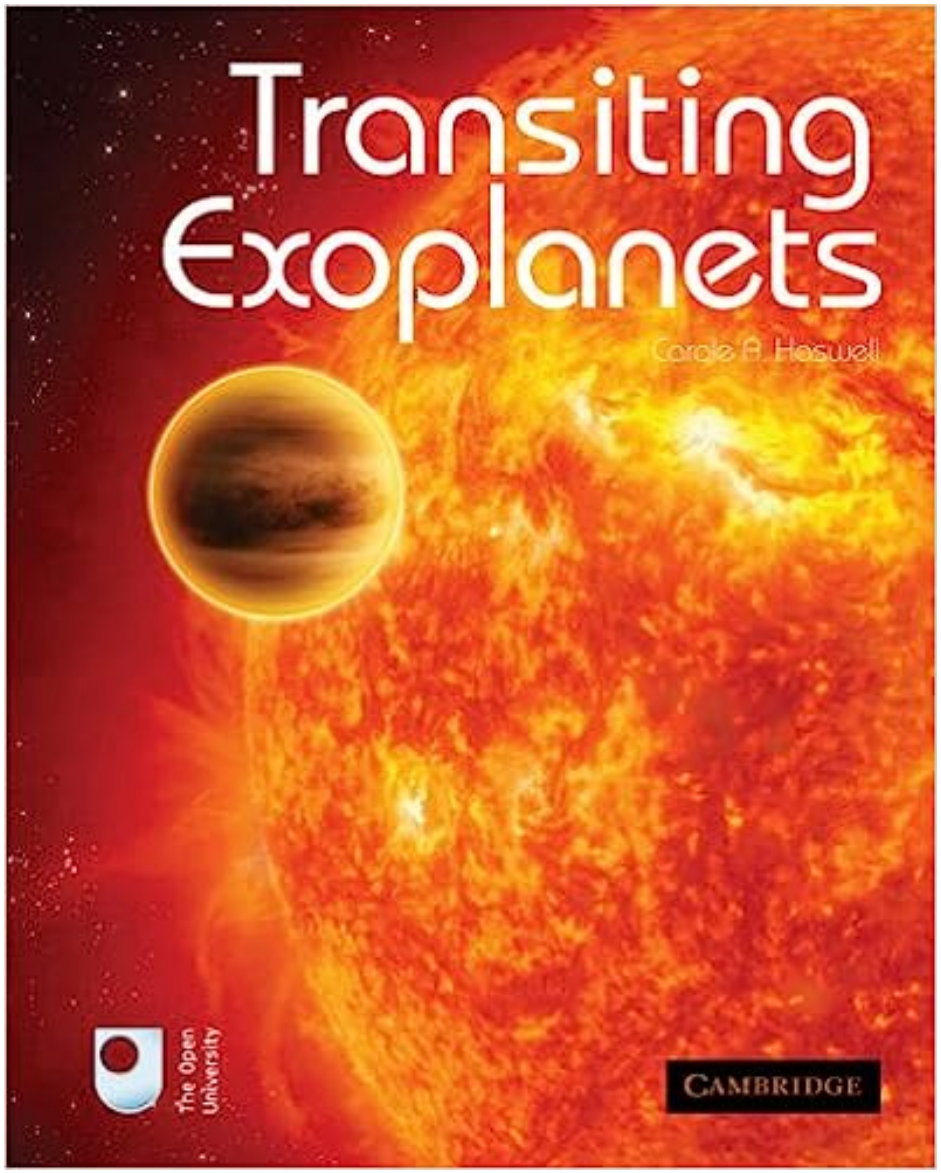
Contents:

- Radial Velocities
- Astrometry
- Microlensing
- Transits
- Imaging
- Host Stars
- Brown Dwarfs and Free floating Planets
- Formation and Evolution
- Interiors and Atmospheres
- The Solar System

Literature



Literature



by Carole Haswell

Contents:

- Our Solar System from Afar (overview of detection methods)
- Exoplanet discoveries by the transit method
- What the transit light curve tells us
- The Exoplanet population
- Transmission spectroscopy and the Rossiter-McLaughlin effect
- Host Stars
- Secondary Eclipses and phase variations
- Transit timing variations and orbital dynamics
- Brave new worlds

Exoplanet data bases:

The first: Exoplanet Encyclopaedia
`www.exoplanet.eu` (Jean Schneider)

The best: NASA Exoplanet Archive:
`https://exoplanetarchive.ipac.caltech.edu/`

- Interactive catalog (radial velocity, transits, etc)
- On line histograms and correlation plots
- Download data

ipac

NASA Exoplanet Archive

A service of NASA Exoplanet Science Institute

EXOPLANET EXPLORATION
Planets Beyond Our Solar System

5,470
Confirmed Planets
07/11/2023 →

363
TESS Confirmed Planets
07/11/2023 →

6,687
TESS Project Candidates
07/08/2023 →

View more Planet and Candidate statistics →

Explore the Archive

gamma cep | Search

Optional Radius (arcsec)

Advanced Search →

Transit Surveys

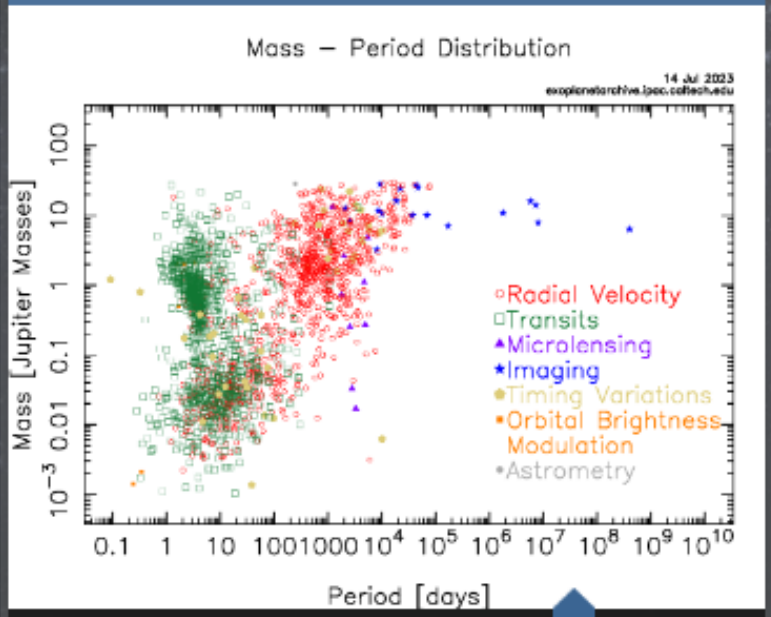
130,041,578 Light Curves

Launched in April 2018, TESS is surveying the sky for two years to find transiting exoplanets around the brightest stars near Earth.

- Confirmed Planets →
- ExoFOP-TESS →
- Project Candidates → | Community Candidates →

TESS | Kepler | K2 | KELT | UKIRT

Exoplanet Mass vs. Period



News → 1 2 3 4 | Plots → 1 2 3 4

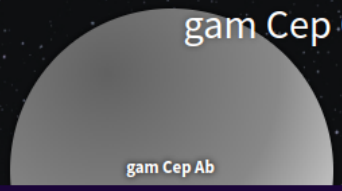
Tools & Services

- Build a Query (TAP) →
- Build a Query (API) →
- Transit and Ephemeris Service → | Periodogram →
- EXOFAST: Transit and RV Fitting → | Predicted Observables for Exoplanets (POE) →

Work with Data

- Planetary Systems → | Planetary Systems Composite Data →
- Atmospheric Spectroscopy (BETA) → | HWO ExEP Precursor Science Stars →
- Pre-generated Plots → | ExoFOP →
- Microlensing Planets → | Direct Imaging →

gam Cep Overview



Overview | Notes | System Parameters | Ancillary | Nearby Data | Legend | Expand All

ARCHITECTURE
- gam Cep
- ★ gam Cep Ab
- ★ gam Cep
  - gam Cep b

OTHER DATA
- Bibliography 25
- Exoplanet Archive Notes 2
- gam Cep Ab Nearby Data 4
- gam Cep Nearby Data 4

DISCOVERY DATA

Host	Planet	Method	Year	Reference	Disposition
gam Cep	gam Cep b	Radial Velocity	2003	Hatzes et al. 2003	Confirmed Planet

Exoplanet Archive Notes (2) +

★ gam Cep Ab Stellar Parameters (0 Solutions)

★ gam Cep Stellar Parameters (13 Solutions) +

gam Cep b Planetary Parameters (3 Solutions) –

STATUS
Confirmed Planet
DETECTED BY
Imaging, Radial Velocity

TOOLS

Source	Endl et al. 2011	Benedict et al. 2018	Hatzes et al. 2003
T_p (days)	2453227±87	2453248.1	2453121.925±66.900
ω (deg)	94.6±34.6	86	49.6±25.6
$M_p \sin i$ ($M_\oplus$)	587.96±50.85	---	540.3±127.1
$M_p \sin i$ (M_{Jup})	1.85±0.16	---	1.7±0.4
e	0.049±0.034	0.08	0.12±0.05
P (days)	903.3±1.5	905.0	905.574±3.08
K (m/s)	31.1±0.97	32.4	27.50±1.5
a (au)	2.05±0.06	---	2.13±0.05
M_p ($M_\oplus$)	---	2988^{+222}_{-350}	---
M_p (M_{Jup})	---	$9.40^{+0.70}_{-1.10}$	---

The Nebraska Astronomy Applet:
An Online Laboratory for Astronomy

`http://astro.unl.edu/naap/`

`http://astro.unl.edu/animationsLinks.html`

The Nebraska Astronomy Applet Project

Online Labs for Introductory Level Astronomy

The Nebraska Astronomy Applet Project provides online laboratories targeting the undergraduate introductory astronomy audience. Each lab consists of background materials and one or more simulators that students use as they work through a student guide. Pretests and posttests can be used to gauge student learning.

NAAP materials are designed to be flexible to accommodate a variety of needs. Student guides are provided in MS Word format (in addition to PDF format) so that they can be edited if necessary. Demonstration guides and in-class worksheets are provided for some labs, helping instructors make use of NAAP simulations even if they don't assign the accompanying lab.

Please visit the instructor information page for more details on using the NAAP labs, or the lab descriptions page for a summary of the NAAP labs. You may also want to visit the simulations list page, which includes animations from the ClassAction project as well.

The NAAP Labs

Stellar Properties

- Distance Modulus Explorer
- Stellar Velocity Calculator
- Parallax Calculator
- Spectroscopic Parallax Simulator
- Stellar Luminosity Calculator
- Flux Simulator
- HR Explorer (NAAP)

Binary and Variable Stars

- Eclipsing Binary Simulator
- Aliasing in Wagon Wheels
- Center of Mass Simulator
- Lightcurve Simulator

Milky Way Galaxy

- Milky Way Rotational Velocity
- Traffic Density Analogy

Cosmology

- Balloon Universe
- Galactic Redshift Simulator

Solar System Characteristics

- Planet Formation Temperatures Plot
- Solar System Properties Explorer

ExtraSolar Planets

- Influence of Planets on the Sun
- Radial Velocity Graph
- Transit Simulator (NAAP)
- Extrasolar Planet Radial Velocity Demonstrator
- Radial Velocity Simulator (NAAP)
- Doppler Shift Demonstrator
- Pulsar Period Simulator
- Hammer Thrower Comparison

Solar System Debris

- Driving Through Snow
- Planetary Configurations Simulator (NAAP)
- Planetary Orbit Simulator (NAAP)

Pre-requisite for the class

You have some background in Astronomy from an introductory course

I assume that you:

1. Know what a star is
2. Know what a planet is
3. Know about Kepler's three laws
4. Know what a Hertzsprung-Russell Diagram is
5. Know what the Main Sequence is
6. Know what a Spectral Type is
7. Know what the magnitude scale is

If you don't, The Nebraska Astronomy Applet Project is a good place to learn