


# Exploring the Solar System IV – Exoplanets




Exploring the Solar System IV Exoplanets


Why Look For Exoplanets?  
Finding Exoplanets  
Looking For Life  
What Next?

 UNIVERSITY OF LIVERPOOL 2

**Why Look For Exoplanets?**




Is our solar system typical?  
Are there other planets like the Earth?  
Is there life elsewhere in the galaxy?  
Studying other solar systems will help us understand our own

 UNIVERSITY OF LIVERPOOL 3

**Finding Exoplanets**

Planets orbiting other stars can be found by various methods

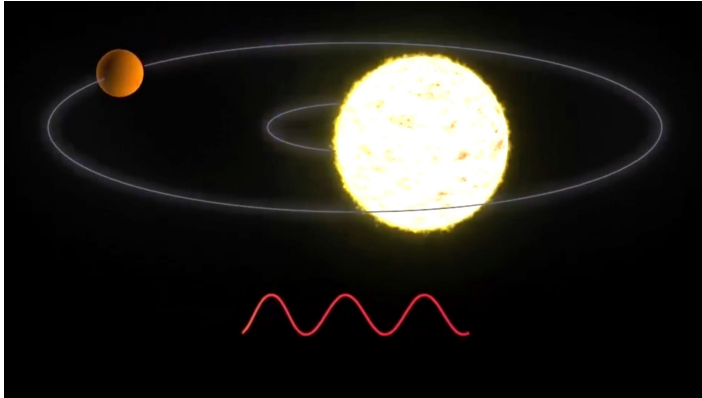
Discovery Method	Method Looks For ...
Radial Velocity	Wobble
Transits	Shadows
Direct Imaging	Dots in images
Microlensing	Bending of light
Astrometry	Motion of stars

 UNIVERSITY OF LIVERPOOL 4

# Exploring the Solar System IV – Exoplanets

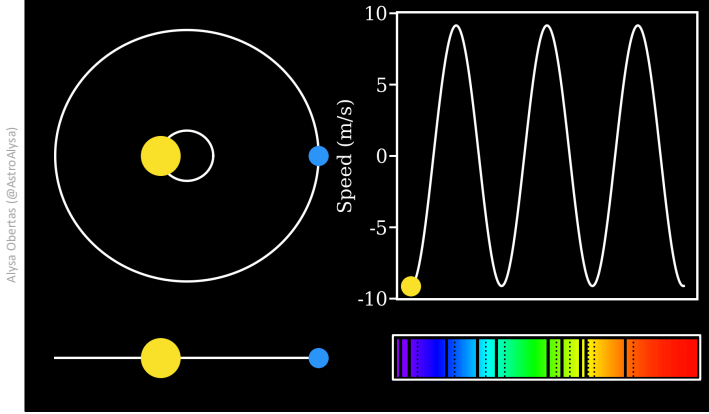
**Method 1 – Radial Velocity**

> 1000 planets found Looking for wobbles



The diagram shows a yellow star and a smaller orange planet orbiting each other. A red wavy line below the star represents the radial velocity wobble. The University of Liverpool logo is at the bottom left, and the number 5 is at the bottom right.

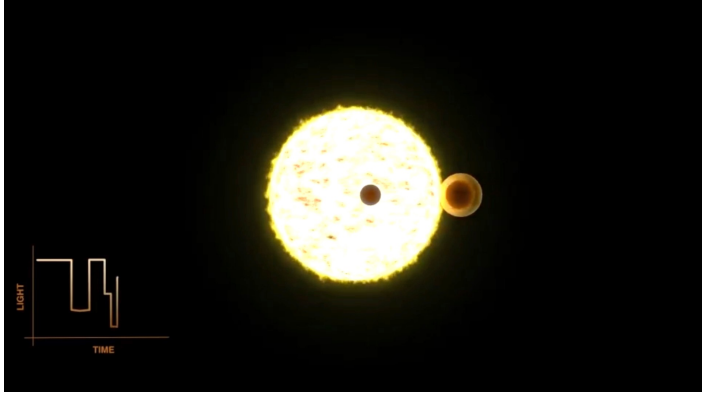
**Changes to Spectrum**



The diagram shows a yellow star and a blue planet orbiting each other. A graph on the right plots Speed (m/s) from -10 to 10, showing a sinusoidal wave. Below the graph is a color spectrum bar. The University of Liverpool logo is at the bottom left, and the number 6 is at the bottom right.

**Method 2 – Transits**

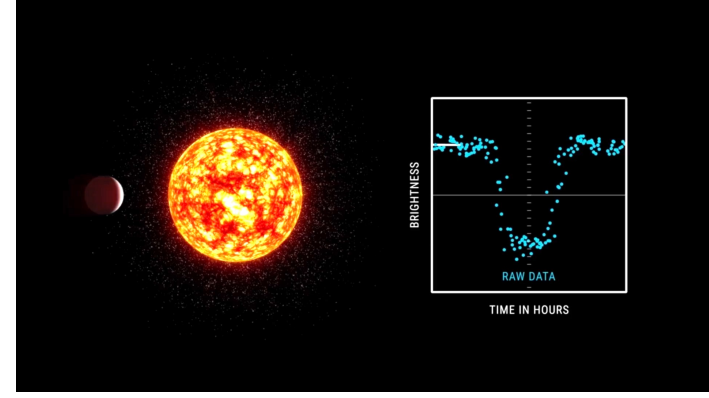
> 4000 planets found Looking for shadows



The diagram shows a yellow star and a smaller orange planet. A graph on the left plots LIGHT vs TIME, showing a series of rectangular dips representing transits. The University of Liverpool logo is at the bottom left, and the number 7 is at the bottom right.

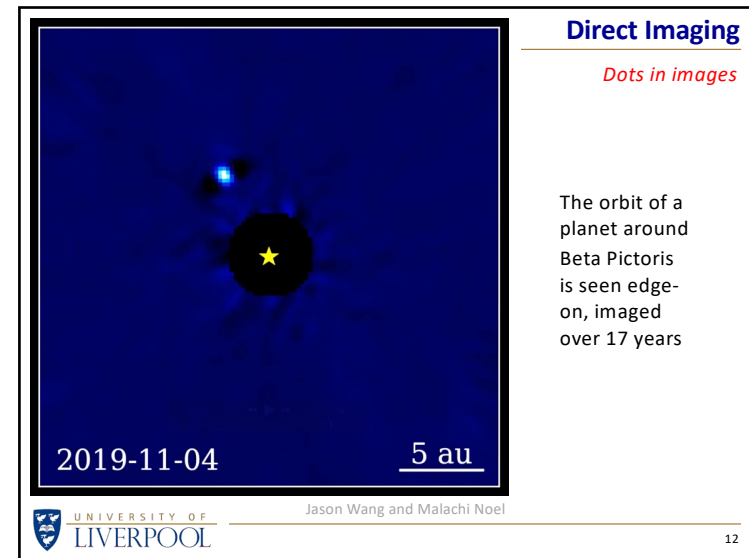
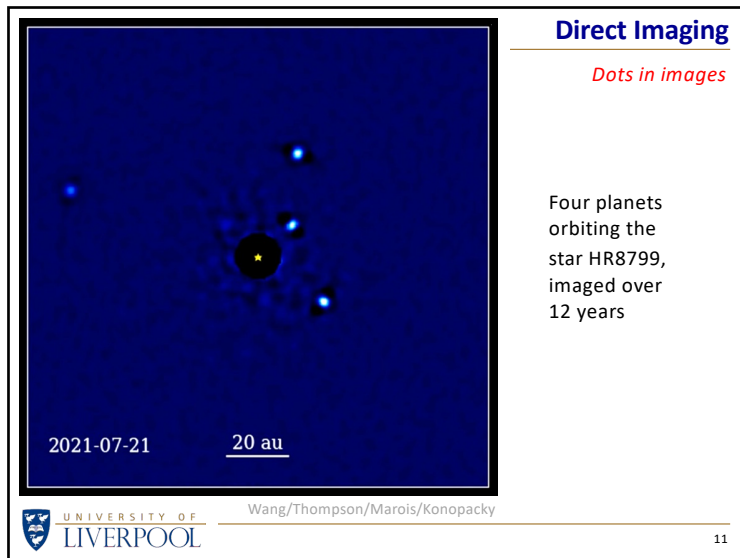
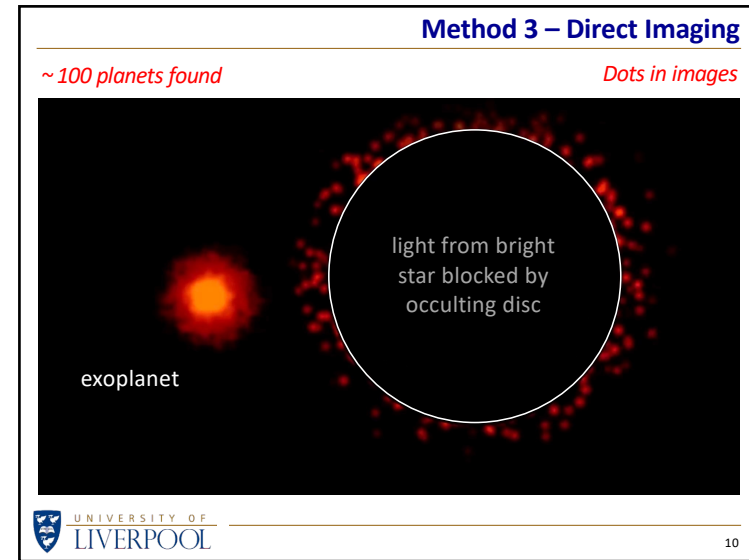
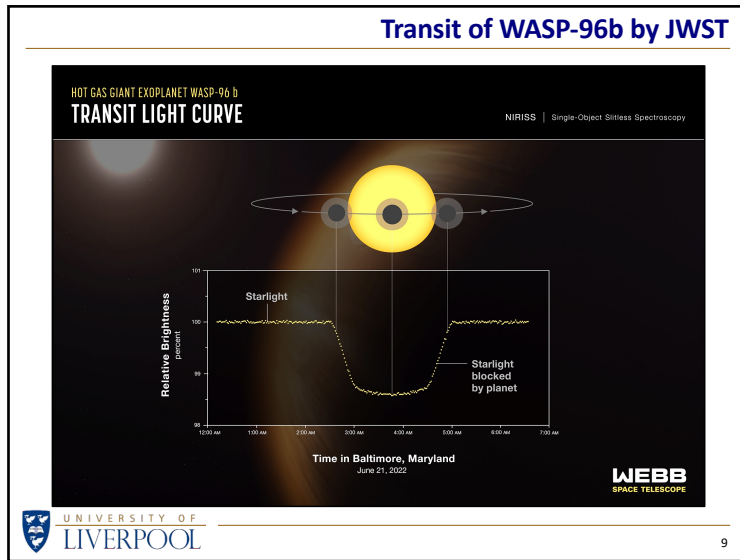
**Method 2 – Transits**

> 4000 planets found Looking for shadows



The diagram shows a yellow star and a smaller orange planet. A graph on the right plots BRIGHTNESS vs TIME IN HOURS, showing a series of dips in brightness labeled 'RAW DATA'. The University of Liverpool logo is at the bottom left, and the number 8 is at the bottom right.

# Exploring the Solar System IV – Exoplanets



# Exploring the Solar System IV – Exoplanets

### Dusty Debris Disk

JAMES WEBB SPACE TELESCOPE  
**FOMALHAUT**

inner disk  
inner gap  
intermediate belt  
outer gap  
outer ring  
halo  
great dust cloud

800μm  
MIRI Filters: F2300C, F2550W

UNIVERSITY OF LIVERPOOL  
APOD 11 May 2023

### Method 4 – Microlensing

~ 200 planets found

Bending of light

UNIVERSITY OF LIVERPOOL

### Method 5 – Astrometry

~ 10 planets found

Motion of stars

Gaia

UNIVERSITY OF LIVERPOOL

### Mass–Size–Density

Radial velocity (wobble) → Mass

Transits (shadows) → Size

Spectroscopy → Atmos

Temperature →

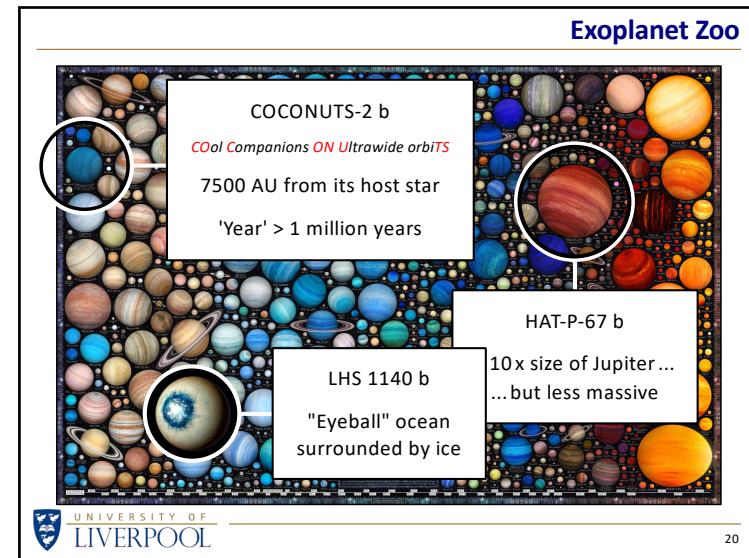
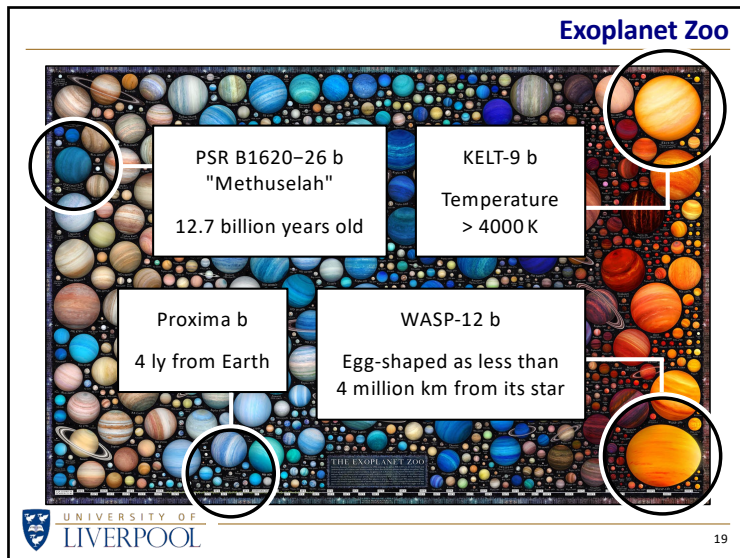
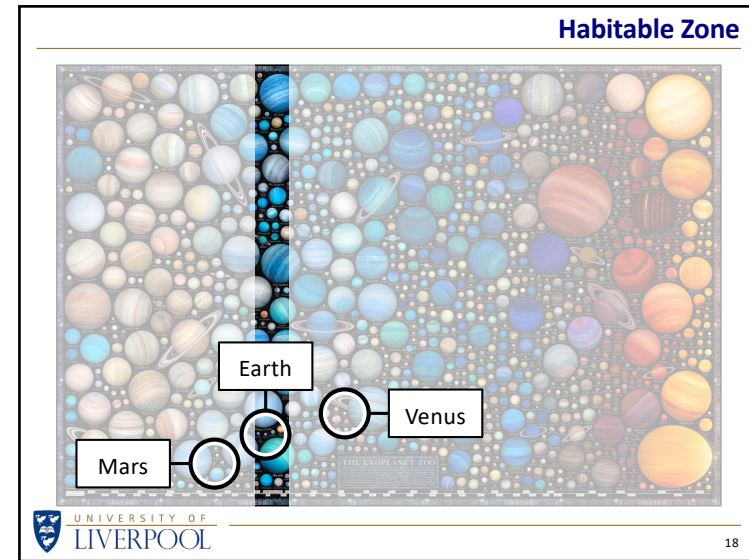
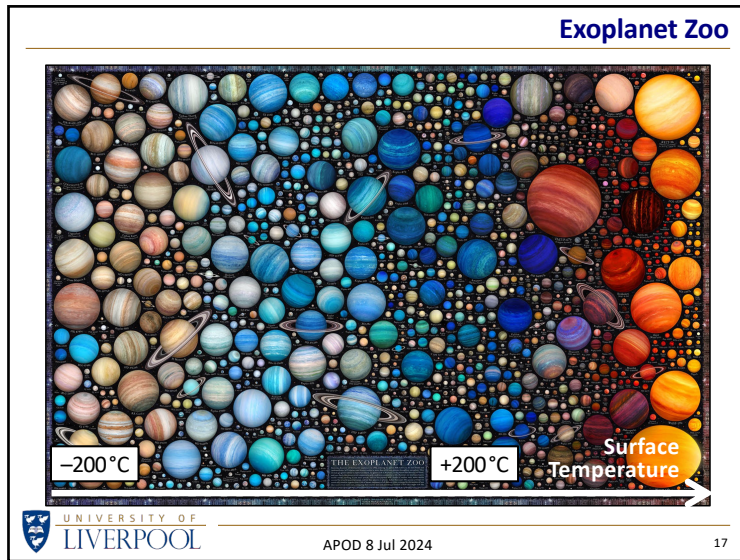
Density

Type

Gas << 1  
Water = 1  
Rock ≈ 3  
Metal ≈ 5

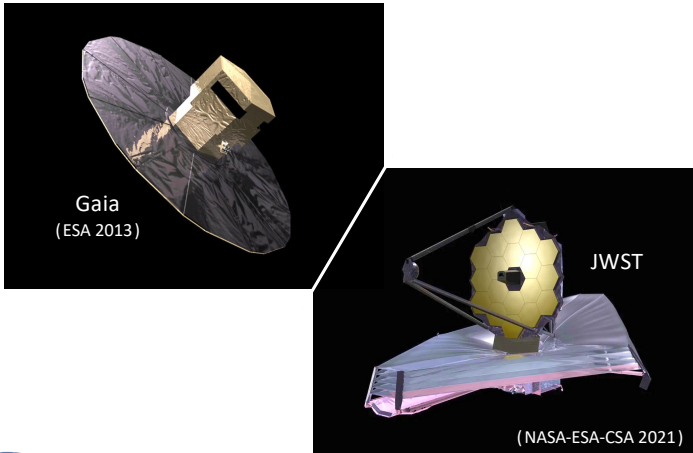
UNIVERSITY OF LIVERPOOL

# Exploring the Solar System IV – Exoplanets



# Exploring the Solar System IV – Exoplanets

### Exoplanet Missions



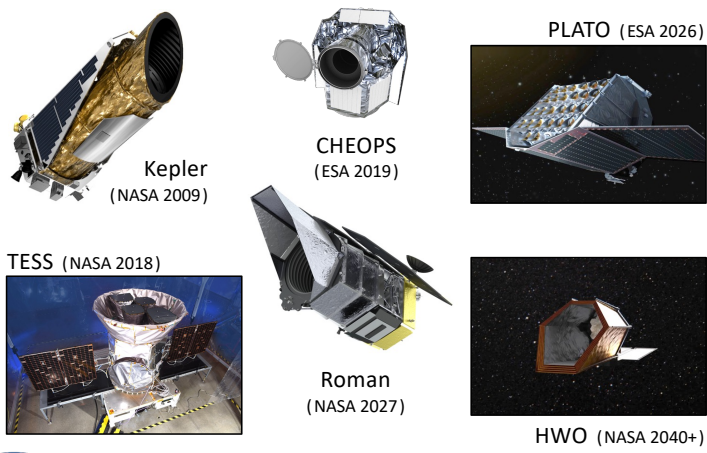
Gaia (ESA 2013)

JWST (NASA-ESA-CSA 2021)

UNIVERSITY OF LIVERPOOL

21

### Exoplanet Missions



Kepler (NASA 2009)

CHEOPS (ESA 2019)

PLATO (ESA 2026)

TESS (NASA 2018)

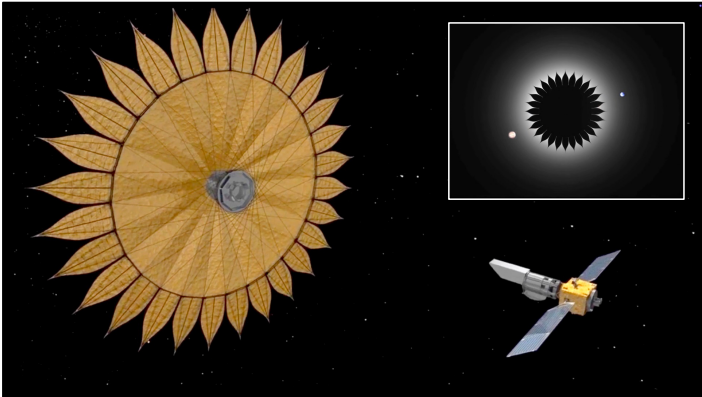
Roman (NASA 2027)

HWO (NASA 2040+)

UNIVERSITY OF LIVERPOOL

22

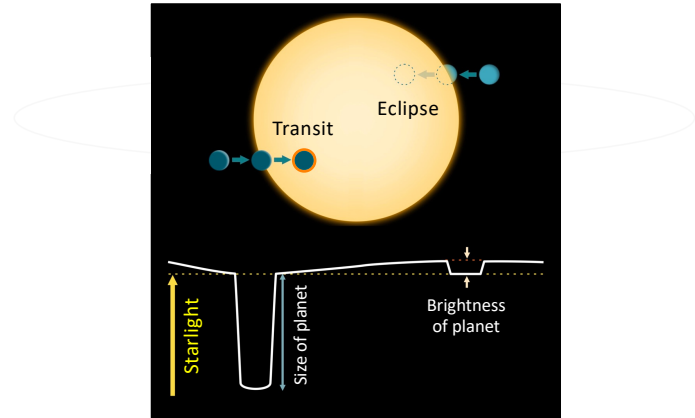
### Star Shade Concept



UNIVERSITY OF LIVERPOOL

23

### Looking For Life



Transit

Eclipse

Starlight

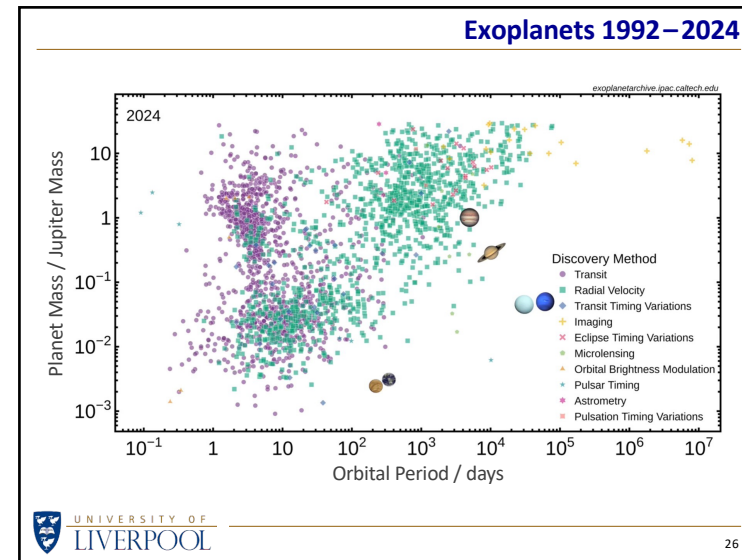
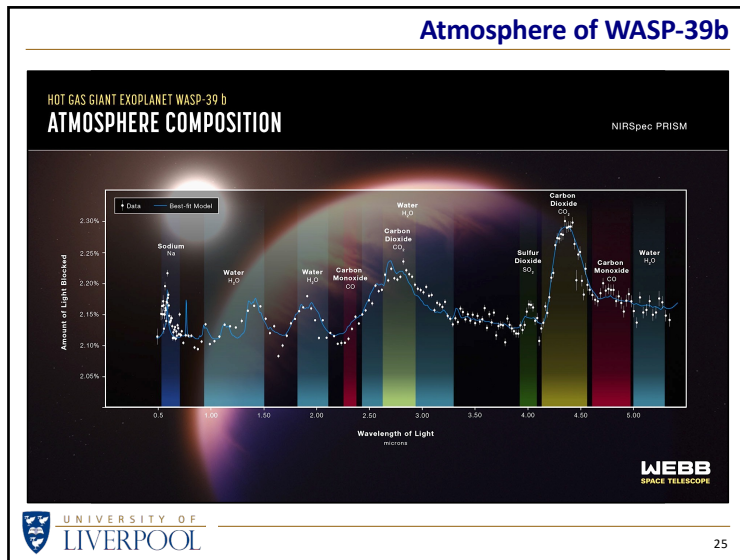
Size of planet

Brightness of planet

UNIVERSITY OF LIVERPOOL

24

# Exploring the Solar System IV – Exoplanets



### Want To Know More?

NASA Discovery Dashboard:  
[science.nasa.gov/exoplanets/discoveries-dashboard](https://science.nasa.gov/exoplanets/discoveries-dashboard)

NASA Exoplanet Archive:  
[exoplanetarchive.ipac.caltech.edu](https://exoplanetarchive.ipac.caltech.edu)



PLATO 2026  
[sci.esa.int/web/plato](https://sci.esa.int/web/plato)



Roman 2027  
[roman.gsfc.nasa.gov](https://roman.gsfc.nasa.gov)



HWO 2040+  
[habitableworldsobservatory.org](https://habitableworldsobservatory.org)

UNIVERSITY OF LIVERPOOL

27

## Exploring the Solar System – IV

# EXOPLANETS

[www.liverpool.ac.uk/~sdb/Talks](http://www.liverpool.ac.uk/~sdb/Talks)

Dr Steve Barrett  
UoL 29 Jan 2025