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Project Name:

#### **Exoplanets Discoveries**

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# Exoplanets

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Welcome to our exoplanet study hub! Here, we explore planets beyond our solar system, known as exoplanets. Discover how scientists detect these distant worlds, learn about their diverse characteristics, and delve into their potential for habitability Join us in unraveling the mysteries of these intriguing celestial bodies and their role in our understanding of the universe.

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RADIAL VELOCITY

## Watching for Wobble

1091 planets discovered

Orbiting planets cause stars to wobble in space, changing the color of the light astronomers observe.

+ more info

RADIAL VELOCITY

## Watching for Wobble

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1091 planets discovered

## **Understanding Planetary Motion through Gravity**

Imagine a game of tug-of-war between a massive star and a smaller planet. The star, with its strong gravitational pull, wins, which is why planets orbit stars and not the other way around. However, the smaller planet still exerts a gravitational force that affects the star, causing it to "wobble" slightly. Your browser does not support the video tag.

The Wobble Effect

The size of the planet influences the wobble: smaller planets like Earth cause a tiny wobble, while larger planets like Jupiter create a more noticeable effect. This star wobble can indicate the presence, number, and size of orbiting planets.

Detecting Wobbling Stars: The Doppler Effect

To observe these wobbles, astronomers use the Doppler shift. When a source of energy (like a star) moves, it compresses or stretches light waves. For example, as an ambulance approaches, its sound pitch increases, then decreases as it moves away. Blueshift occurs when waves compress (moving towards us). Redshift occurs when waves stretch (moving away from us). Your browser does not support the video tag.

Observing Exoplanets

As a planet causes its star to wobble, the light waves from the star also compress and stretch, leading to observable color changes. This method, known as the radial velocity method, has been highly successful in discovering exoplanets and is often used alongside other detection methods for confirmation. Major observatories, such as the Keck Telescopes in Hawaii and the La Silla Observatory in Chile, utilize this technique to explore and confirm the existence of exoplanets.

Next Steps: The Transit Method

Close

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TRANSIT

## Searching for Shadow

4291 planets discovered

Orbiting planets cause stars to wobble in space, changing the color of the light astronomers observe.

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TRANSIT

## Searching for Shadow

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1091 planets discovered

## **Transit method**

When a planet passes between its star and an observer, it blocks a small part of the star’s light, causing it to dim slightly. This dimming helps scientists find exoplanets.



Solar Eclipse Comparison:

A solar eclipse is when the Moon blocks the Sun’s light. The transit method works similarly, where a planet passing in front of its star blocks some of its light. Although the dimming is small, it's enough for astronomers to detect an exoplanet.

Light Curve:

A light curve is a graph that shows how much light is coming from a star. When a planet passes in front of the star, the light dims, and the graph shows this drop. Redshift occurs when waves stretch (moving away from us).



What We Learn from Transits :

Bigger planets block more light, creating deeper dips in the light curve. The farther a planet is from its star, the longer it takes to complete an orbit, making the dimming last longer.

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Multiple Planets

If more than one planet orbits a star, their transits make the light curve more complicated. Astronomers can still identify each planet, but it takes more work.

Atmosphere Information

When a planet passes in front of its star, some light passes through its atmosphere. By studying this light, scientists can learn about the planet’s atmosphere, like whether it contains water vapor or methane.

Transit Method Success

The transit method has been very successful. NASA’s Kepler mission used it to discover thousands of possible exoplanets, helping astronomers learn about the galaxy’s planets.

Next Steps: The Transit Method

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DIRECT IMAGING

## Taking Picture

82 planets discovered

Orbiting planets cause stars to wobble in space, changing the color of the light astronomers observe.

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DIRECT IMAGING

## Taking Picture

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82 planets discovered

## **Direct Imaging**

Direct imaging is one of the most exciting ways astronomers find exoplanets—planets outside our solar system. So far, 82 planets have been discovered using this method. But taking pictures of these far-off planets isn’t as easy as taking a photo of planets like Jupiter or Venus. Why? Because exoplanets are very far away and hidden by the bright light of the stars they orbit.

The Challenge

Exoplanets are much dimmer than their host stars. The star's light is so strong that it drowns out the planet's light, making it almost impossible to see the planet.

It's like"trying to spot a tiny insect next to a bright flashlight"

Blocking the Light

To see exoplanets, astronomers need to block the star's light, just like we use sunglasses to block out sunlight. Special tools have been created to block the star's brightness so we can see the planets near them.

Two Main Techniques

1. Coronography:

This tool is built inside telescopes and blocks a star’s light, helping us see the faint light of nearby planets. It's already being used in telescopes on Earth.

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2. Starshade:

This is a spacecraft that would fly in front of a space telescope. It blocks the light from the star before it reaches the telescope, helping astronomers detect planets more clearly from space.

2.he Future of Direct Imaging

Although it’s still a new method, direct imaging has a lot of promise. In the future, astronomers hope to use it to take pictures so clear they might show details like weather patterns, oceans, or even land on exoplanets. These advancements could help us discover more planets and learn whether they could support life.

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GRAVITATIONAL MICROLENSING

## Light in a Gravitational Lens

225 planets discovered

New methods of detecting exoplanets open up exciting possibilities for discovery.

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GRAVITATIONAL MICROLENSING

## Light in a Gravitational Lens

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225 planets discovered

Gravitational Microlensing

A Cosmic Magnifying Glass

Gravitational microlensing is a fascinating phenomenon that allows astronomers to discover distant planets and stars by using the gravitational pull of objects in space as a lens. Here’s how it works:

The Bending of Light

Albert Einstein's theory of relativity showed us that gravity doesn’t just pull objects together—it also bends the fabric of space. This bending can affect how light moves. When a planet or star passes between a distant star and Earth, the gravity of that object can bend the light of the distant star, making it appear brighter to observers on Earth.





How Microlensing Works

Think of it like using a magnifying glass: the gravity of a planet or star acts like a lens, focusing the light from a distant star and making it temporarily brighter. As the object moves, the light bends in different ways, causing the brightness of the distant star to increase and then fade.



In some cases, when a planet is involved, a brief spike in brightness occurs, which tells astronomers that a planet may be orbiting the star. This spike appears as a blip of light in the otherwise smooth brightening and dimming process of the star.

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What Astronomers See

When astronomers observe a lensing event, it looks like a distant star is getting gradually brighter over several weeks before fading away. If a planet is involved, the light will briefly brighten even more before continuing to dim. This data gives scientists clues about the size and presence of the star and planet involved.

Discovering Rogue Planets

Gravitational microlensing also helps astronomers find "rogue planets," which are planets that don't orbit a star. These planets cause quick microlensing events, offering insight into how common these free-floating planets are in the galaxy.



In this way, gravitational microlensing has helped discover over **225 exoplanets** , revealing the hidden wonders of our universe.

Close

Caption Four

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Astrometry

## Mapping the the star & measuring the universe

3 planets discovered

New methods of detecting exoplanets open up exciting possibilities for discovery.

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Astrometry

## Light in a Gravitational Lens

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3 planets discovered

The orbit of a planet can make its star wobble slightly in space. This happens because the planet’s gravity pulls on the star, causing it to move just a bit in relation to nearby stars. One method scientists use to detect this wobble is called astrometry.

Astrometry involves tracking the position of a star in the sky over time. Scientists take multiple pictures of a star and the nearby stars and then compare them. If the star they’re observing changes position compared to the nearby stars, it might be due to an orbiting planet.

However, this method is extremely challenging. The wobble is so tiny that it’s hard to spot, especially for small planets like Earth. Plus, the Earth's atmosphere distorts the light, making it even harder to get accurate measurements.

In summary, astrometry is a powerful but difficult method for finding planets by observing the small wobbles of stars caused by their planets' gravity.

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