

## Formation of Exoplanets

Understanding the formation of exoplanets is a complex endeavor that involves various models and recent discoveries. The two primary theories of planetary formation are the **Core Accretion Model** and the **Disk Instability Model**. Recent findings have also highlighted the role of stellar nurseries in this process.

### Planetary Formation Theories

#### 1. Core Accretion Model:

- This model posits that planets form from the gradual accumulation of dust and gas in a protoplanetary disk surrounding a young star. Small particles collide and stick together, forming larger bodies called planetesimals, which eventually coalesce into planets.
- Recent research has shown that this model can explain the formation of gas giants like Jupiter, especially in environments rich in heavy elements, which catalyze the process

#### 2. Disk Instability Model:

- In contrast, this model suggests that giant planets can form rapidly through gravitational instabilities in the protoplanetary disk itself, leading to clumps that collapse into planets.
- This model is particularly relevant for understanding the formation of gas giants around low-mass stars, where traditional core accretion may not suffice due to limited material

### Recent Discoveries

Recent discoveries have provided new insights into these models:

- **TOI-4860 b:** An unusual Jupiter-sized planet discovered orbiting a low-mass star (TOI-4860) has challenged existing theories. Traditionally, it was believed that low-mass stars could not host massive planets due to insufficient material in their protoplanetary disks. However, TOI-4860 b appears to be enriched with heavy elements, suggesting that unique conditions may allow for the formation of such planets around low-mass stars
- **Formation Limits Near Metal-Poor Stars:** A study published in September 2024 indicates that planets larger than Earth struggle to form near stars with low metallicity. This finding emphasizes the importance of heavy elements in planetary formation and suggests that stellar composition plays a critical role in determining the types of planets that can form

### Role of Stellar Nurseries

Stellar nurseries are regions where new stars and their accompanying planetary systems are born. These environments are crucial for understanding planet formation because they provide the raw materials—gas and dust—necessary for building planets. Observations from telescopes

like the James Webb Space Telescope have revealed complex interactions within these nurseries, influencing how planets form and evolve.

### **New Models and Insights**

Recent advancements include:

- A new model explaining the rapid formation of giant planets like Jupiter has been developed, providing deeper insights into how these processes work
- Observations from NASA's TESS mission continue to reveal new exoplanets, contributing to our understanding of diverse planetary systems and their formation mechanisms