Diversity of Exoplanets

A Branching-Diagram Framework for Understanding Planetary Populations

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Abstract & Objectives

The discovery of over 5,500 exoplanets reveals a surprising diversity, with sub-Neptunes and super-Earths being the most common types orbiting FGKM stars.

I introduce a branching-diagram model to:

- Visually map complex formation and evolution pathways
- Connect planetary demographics to protoplanetary disk processes

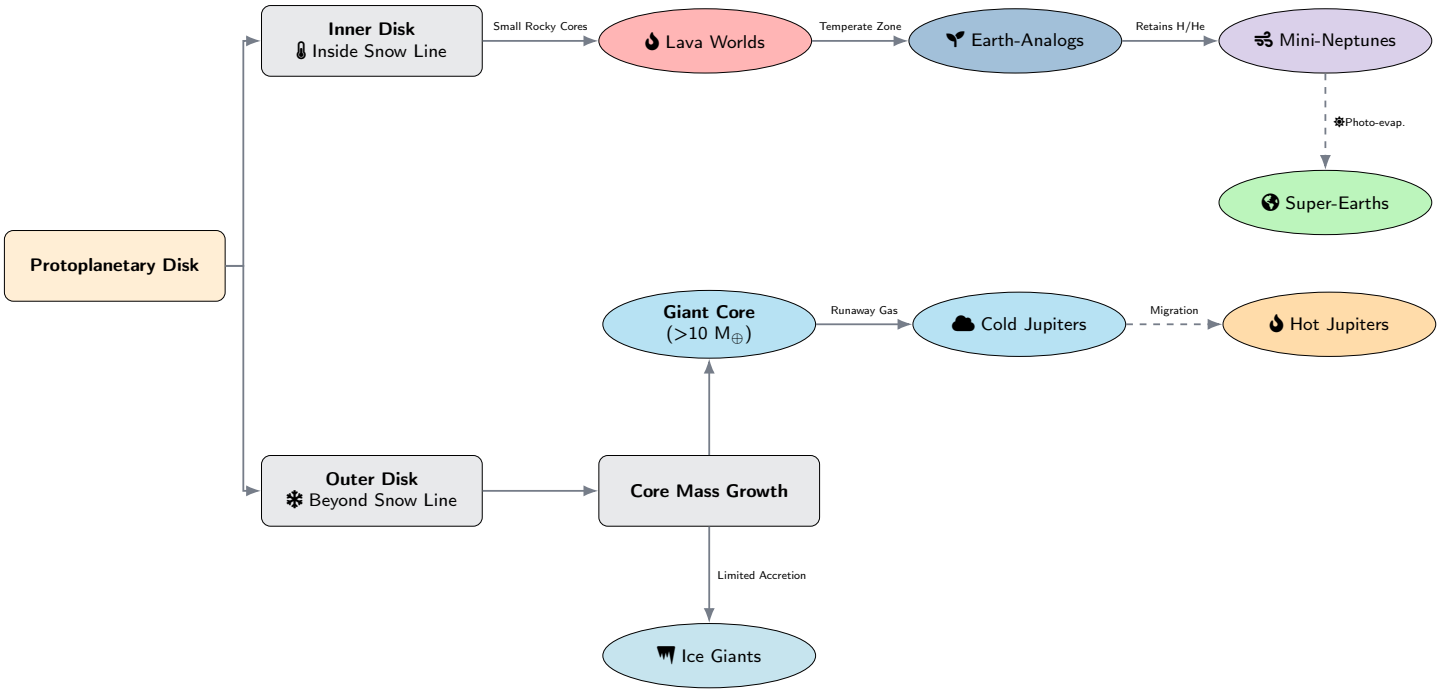
This framework provides a systematic way to understand planetary origins.

Methods

A Multi-Stage Branching Model

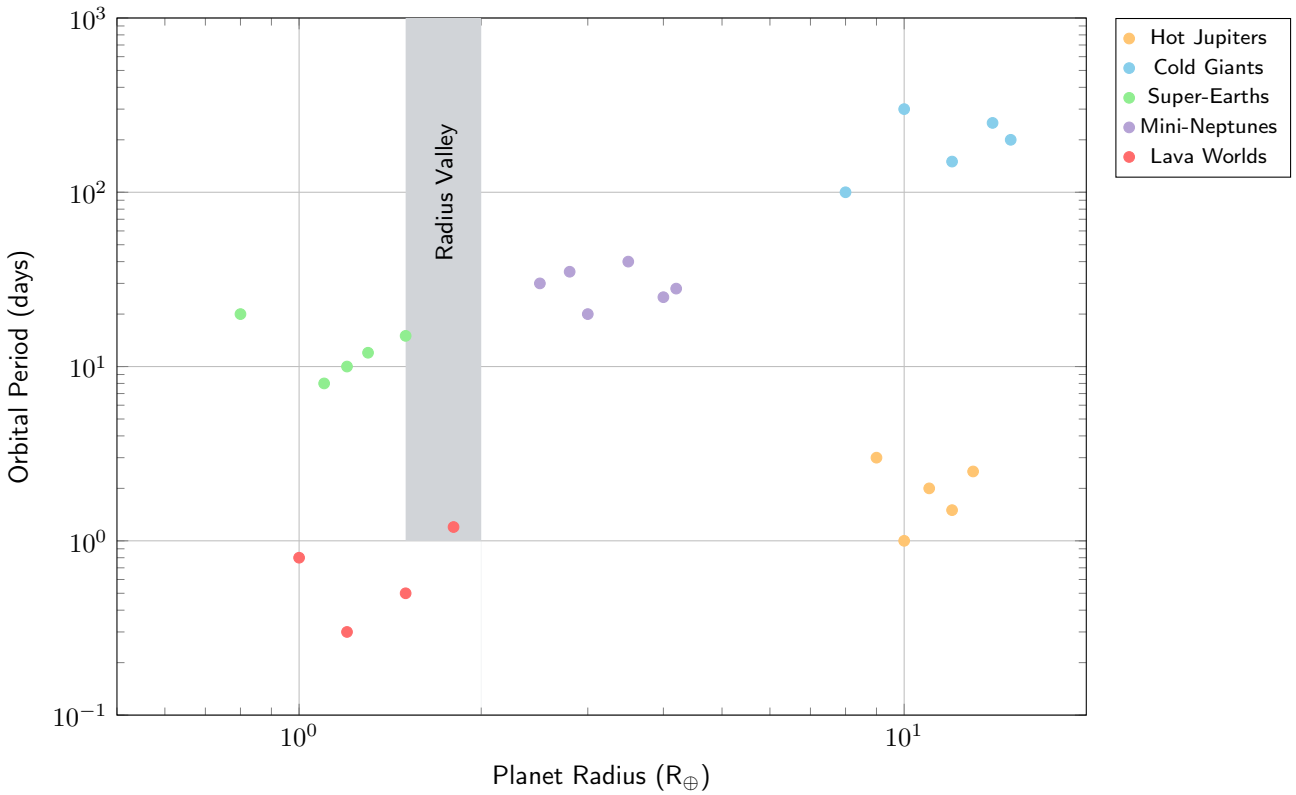
This diagram models exoplanet formation starting from a protoplanetary disk. Key branching points:

- **Snow line**: Separates rocky/icy formation zones
- **Core mass**: Determines gas accretion potential
- **Migration & Photoevaporation**: Further diversifies outcomes



Results

Exoplanet Population Analysis



Key Findings:

- **Radius Valley**: Explained by photoevaporation stripping atmospheres
- **Giant Bimodality**: Hot/Cold Jupiter separation via migration
- **Small Planet Dominance**: Multiple pathways for super-Earths/mini-Neptunes

Discussion & Implications

This framework synthesizes data from Kepler, TESS, and RV surveys:

- Unifies "Radius Valley" and planetary architectures
- Predicts metallicity effects on gas giant formation
- Guides future research on critical parameters

Conclusion

The branching model successfully maps exoplanet diversity to physical pathways, explaining current demographics and providing a predictive framework for future discoveries, particularly regarding habitable worlds.

References & Acknowledgments

References:

- Fulton, B. J., et al. (2017). AJ, 154, 109
- Parc, L., et al. (2014). A&A, 688, A59

Acknowledgments: ASK Astronomy Squad of Koshi and Sagan Workshop organizers.