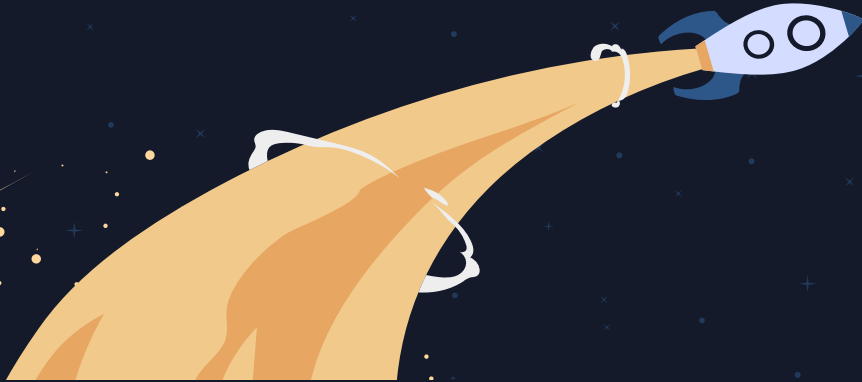


Study of Exoplanets

A Journey Through Data & Space



Team Members

Anand Kumar | Atharva Yeola | Colin Zhong | Rohan Sreedhar | Wang Liu

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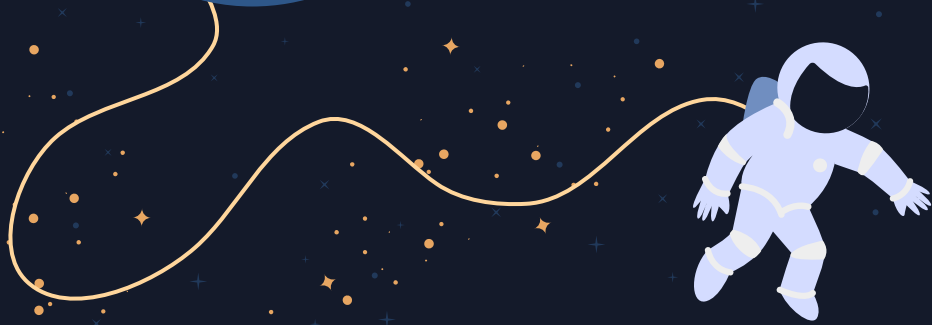
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01

INTRODUCTION

Dataset Details
& Overview

NASA Dataset on Discovered Planets, 1992-2023

Planet Info

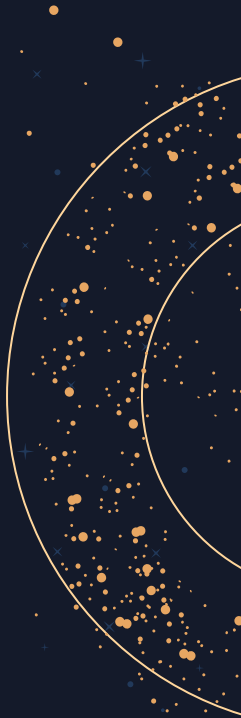
- Name
- Density (g/cm^3)
- Orbital period (days)
- SemiMajor axis (au)
- Eccentricity
- Radial Velocity (m/s)
- Transit depth (%)

System Position

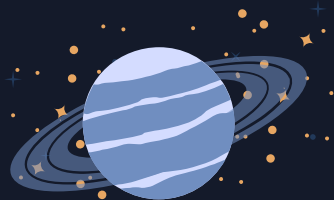
- Distance from Earth (parsec)
- Right Ascension (dec)
- Declination (dec)
- System Rotational Velocity (km/s)

Discovery

- Methods
- Year
- Telescope
- Locale
- Facility



Overview of our Work



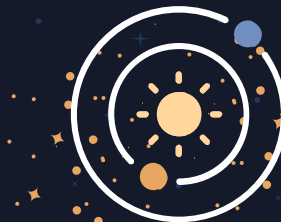
01 | Planet Viz.

Visualizing and drawing inference from the planet info



02 | Discovery Viz.

Using discovery data, to obtain interesting insights



03 | Prediction

Predicting important exoplanet features using ML models.



02

PLANET VISUALIZATION

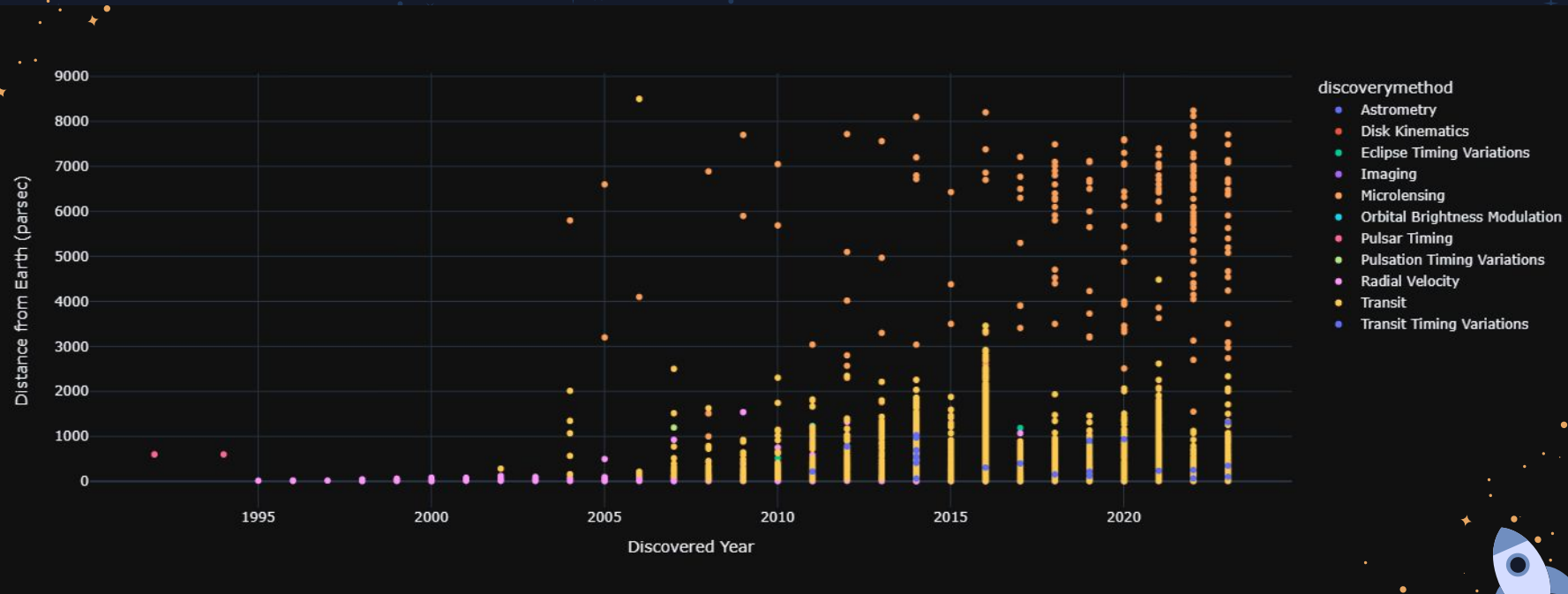
Visualising the Exoplanet
features



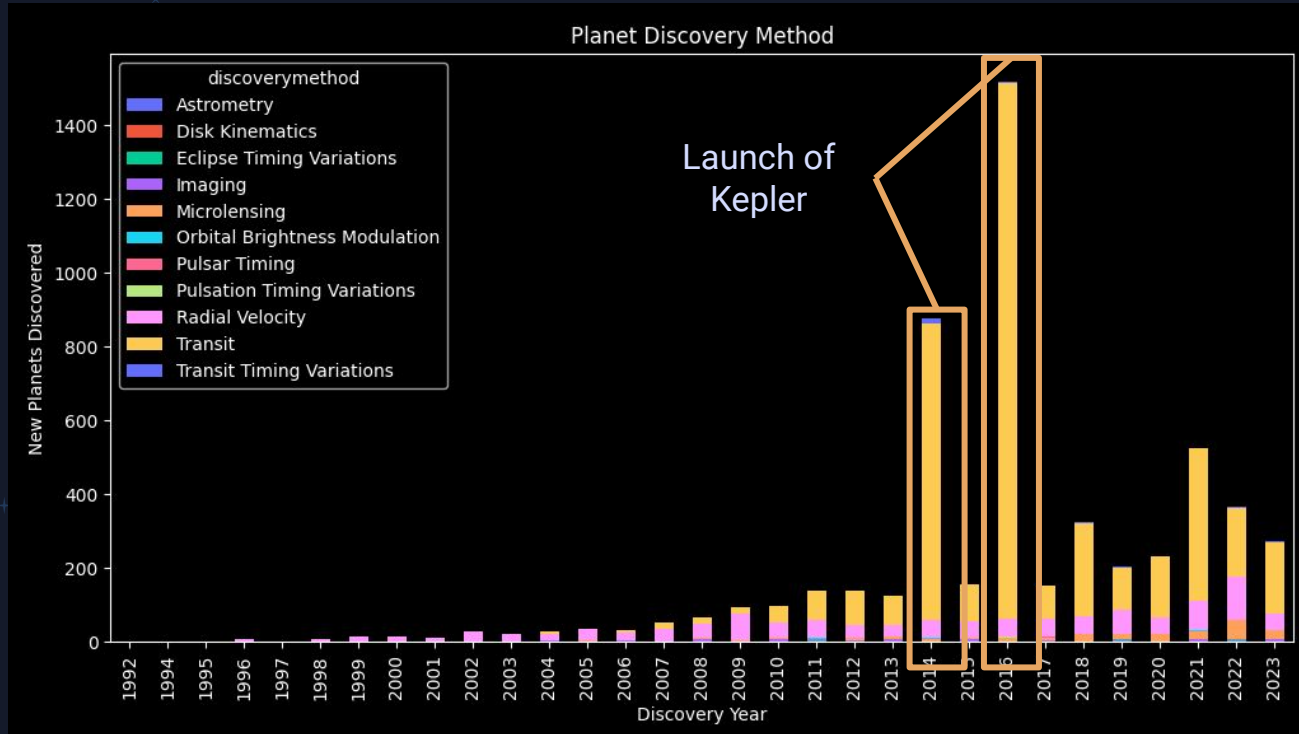
Exoplanet Interactive Visualisation



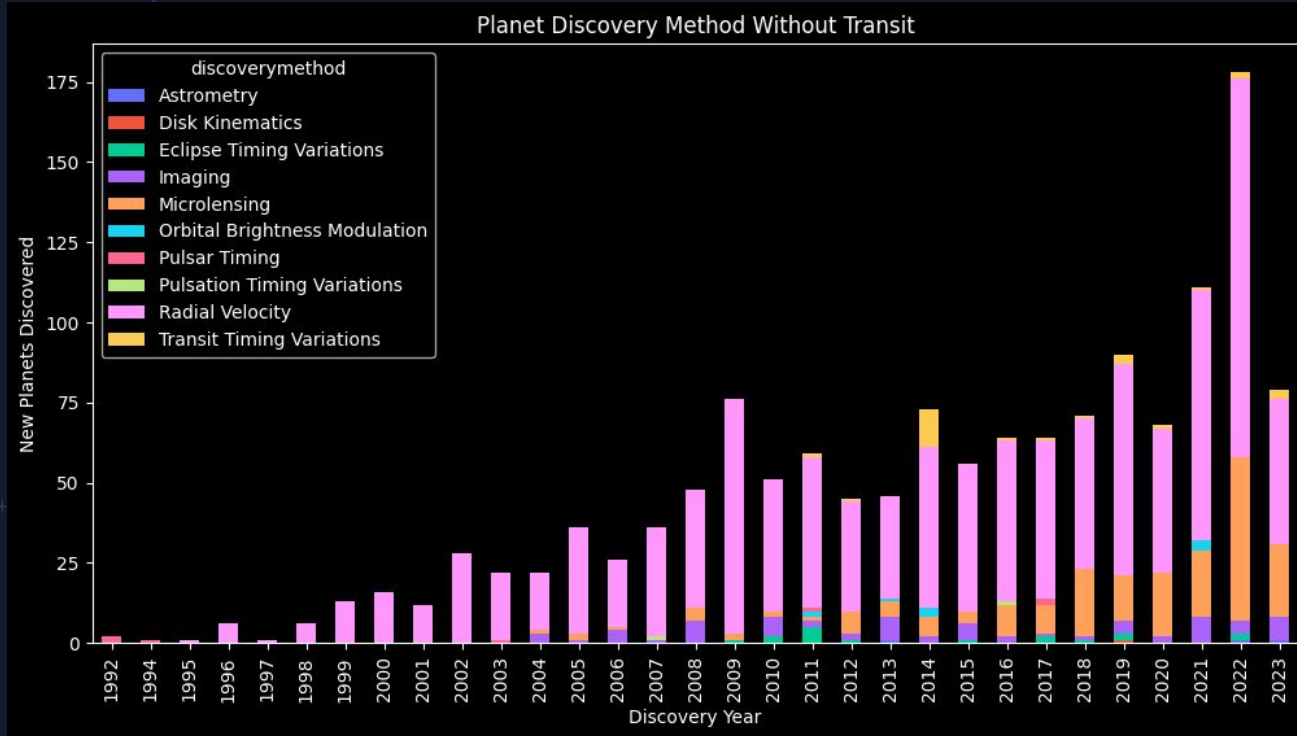
Exoplanets Discovery Year, Distance and Method



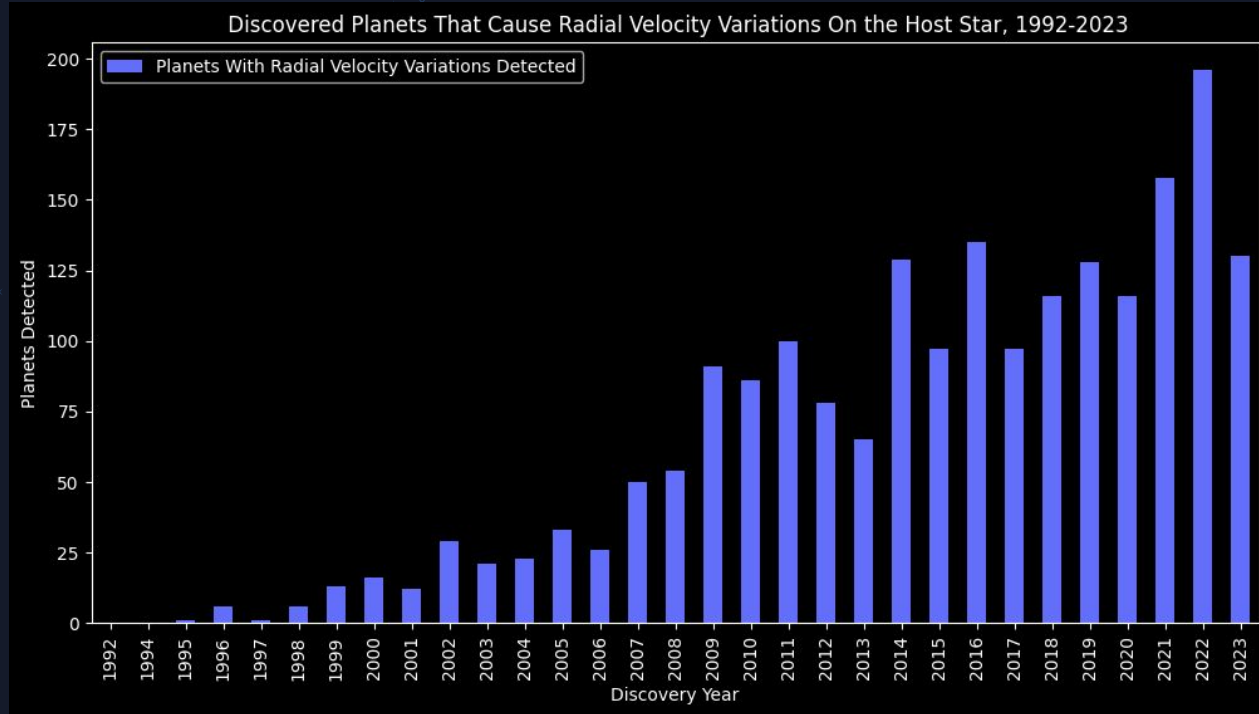
Planet Discovery Methods



Planet Discovery Methods – Without Transit



Detections Via Radial Velocity

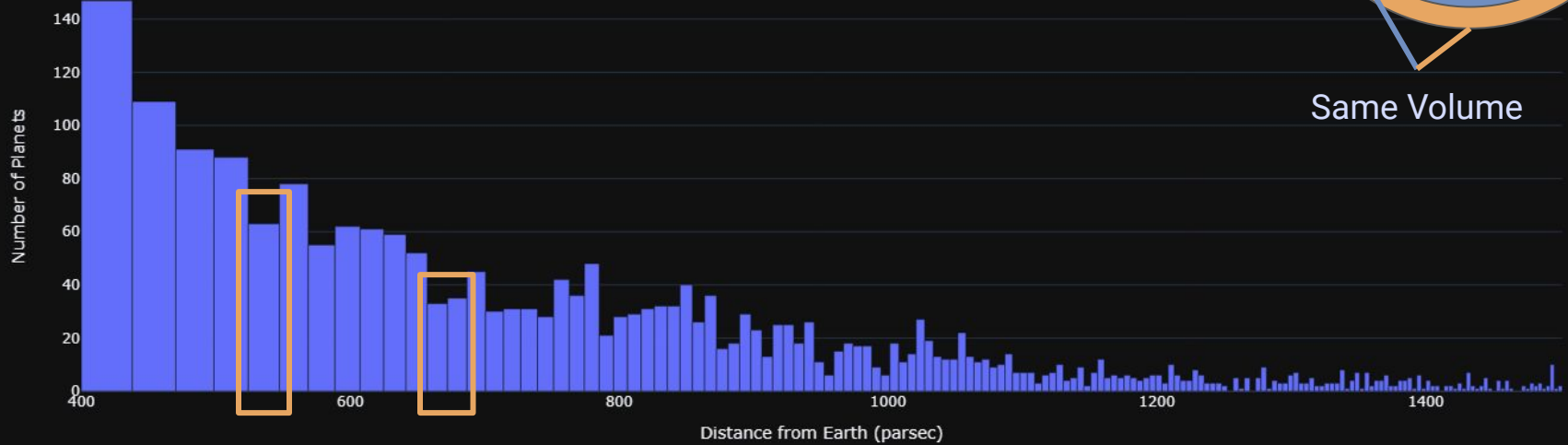


Equivolume Histogram



Same Volume

Histogram of Exoplanets Discovered for Equivolume Bins





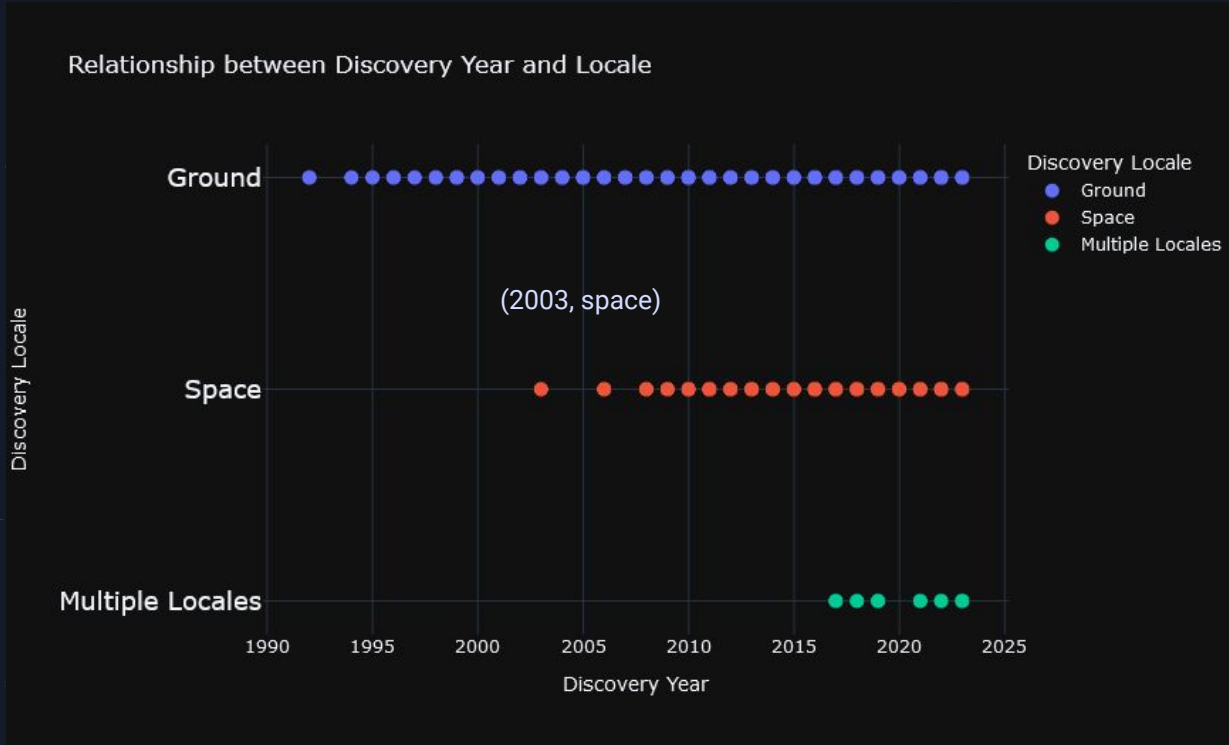
03

DISCOVERY VISUALIZATION

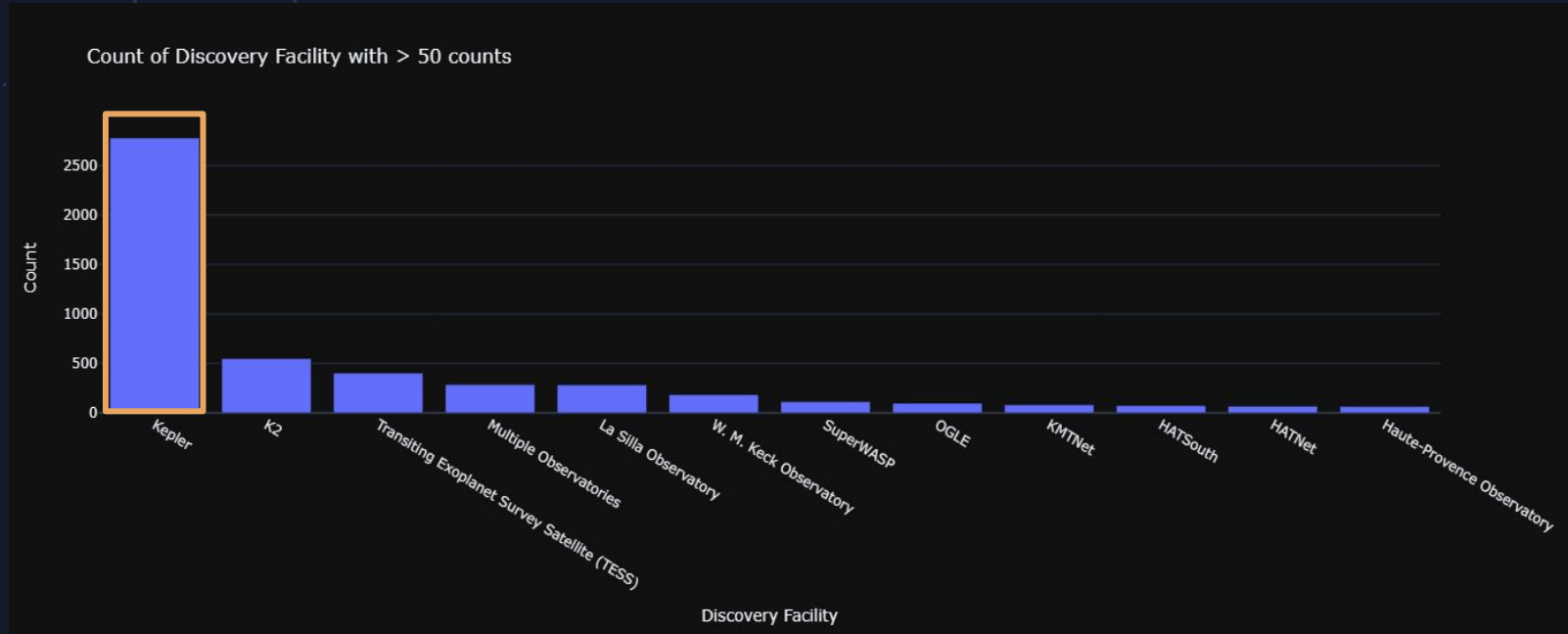
Visualising the Exoplanet
Discovery Details



Discovery Facility and Count



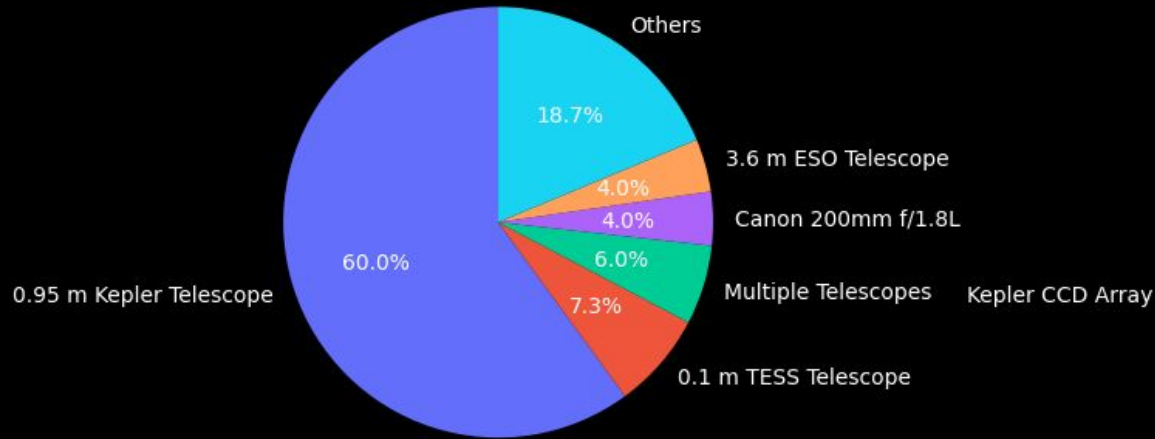
Discovery Facility and Count



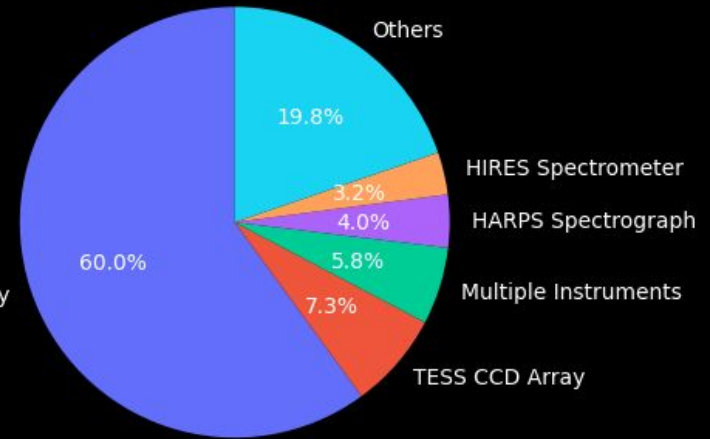
- Kepler emerges as the leading facility
- Top 3 are satellite telescopes

Distribution between Telescopes & Instruments

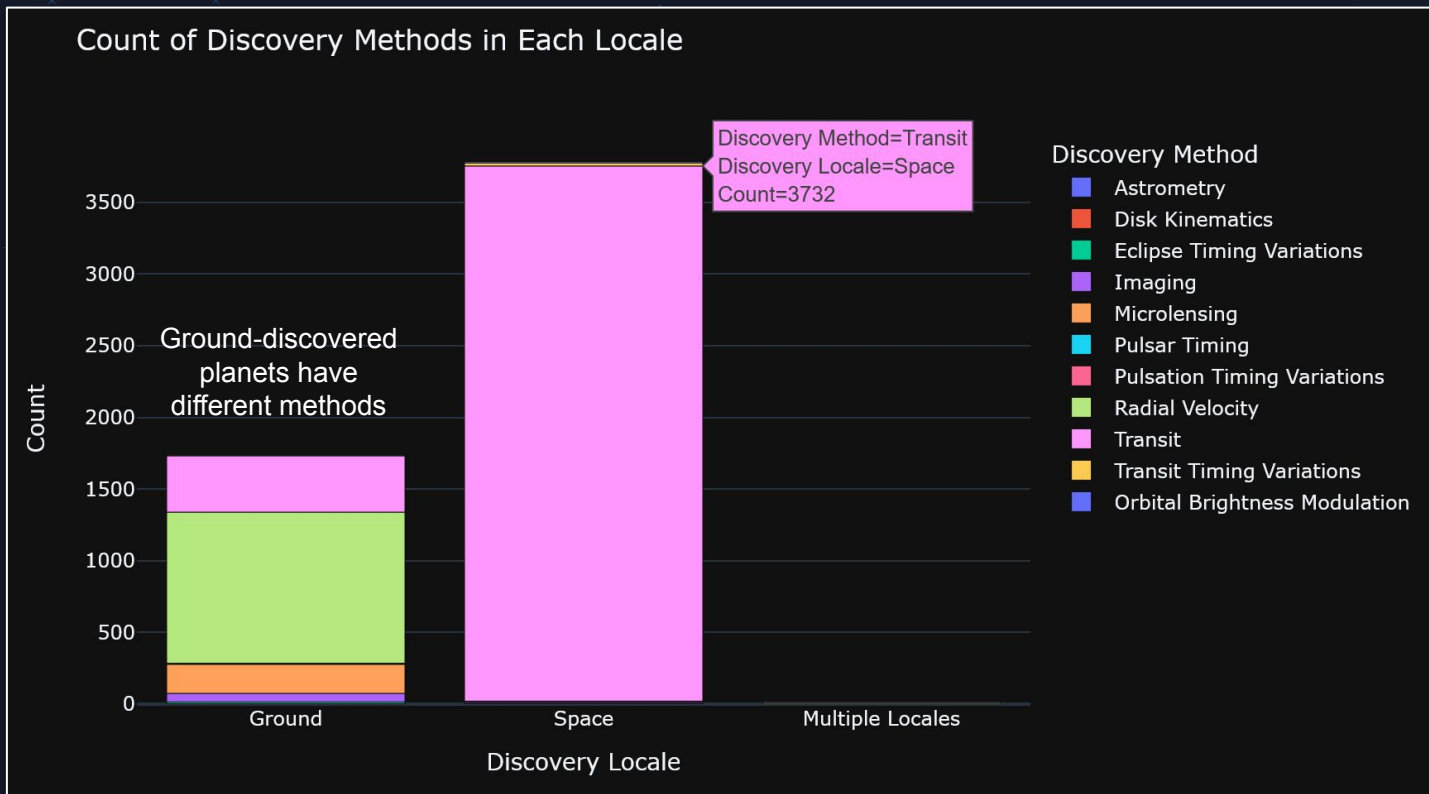
Distribution of Telescopes



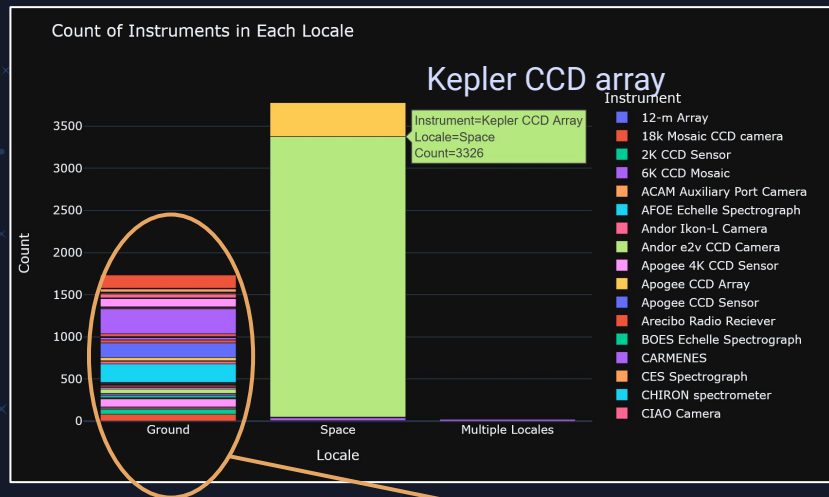
Distribution of Instruments



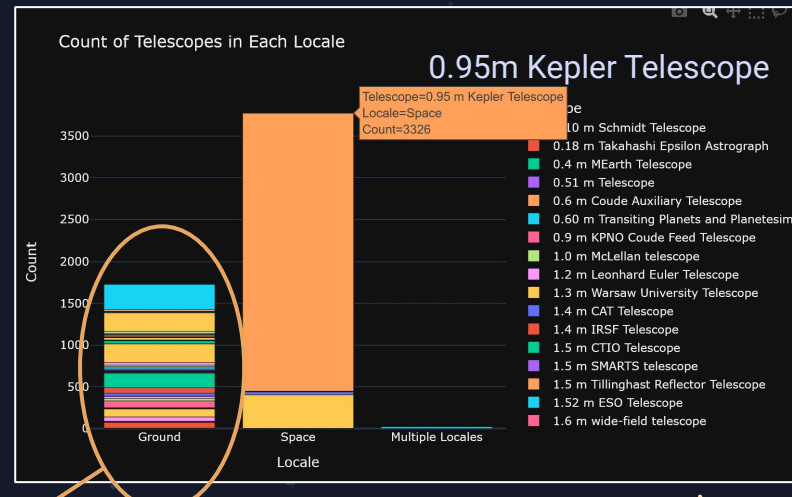
Discovery Facility, Method and Locale



Discovery Instrument

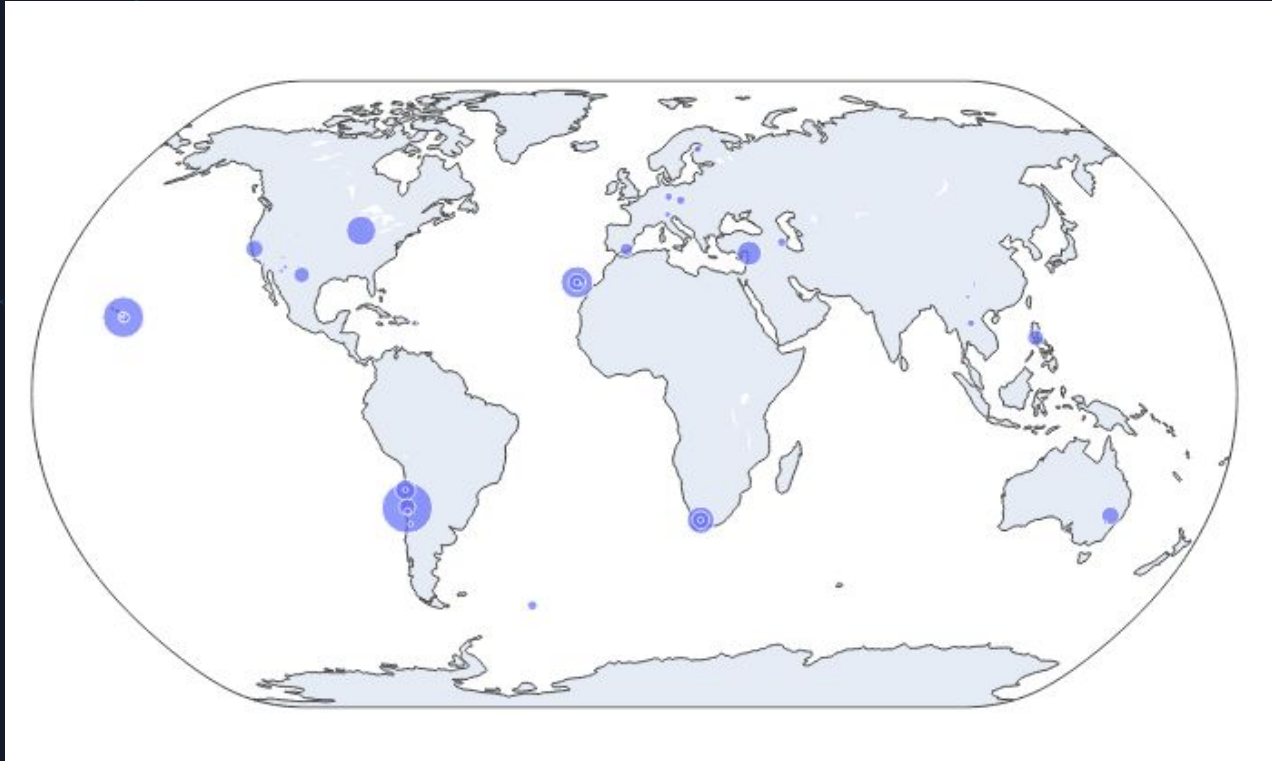


Discovery Telescope



Ground-discovered planets often involve a variety of instruments, and telescopes.

Ground Discovery Facilities on Map



04


PREDICTION

Predicting key exoplanet
features using ML models



Predicting the Density of Exoplanets

Why ?

1. $Density(\rho) = \frac{Mass(m)}{Volume(V)}$  Difficult to obtain for far away exoplanets
2. Helps to identify **earth-like** planets and observe them keenly

How ?

Easily obtainable
planet & system
features

ML Model

Predicted
Density



Input Features & Models Tested

Easy to obtain Exoplanet features

- Orbital period (days)
- SemiMajor axis (au)
- Eccentricity
- Radial Velocity (m/s)
- Transit depth (%)
- System Rotational Velocity (km/s)

Models Tested

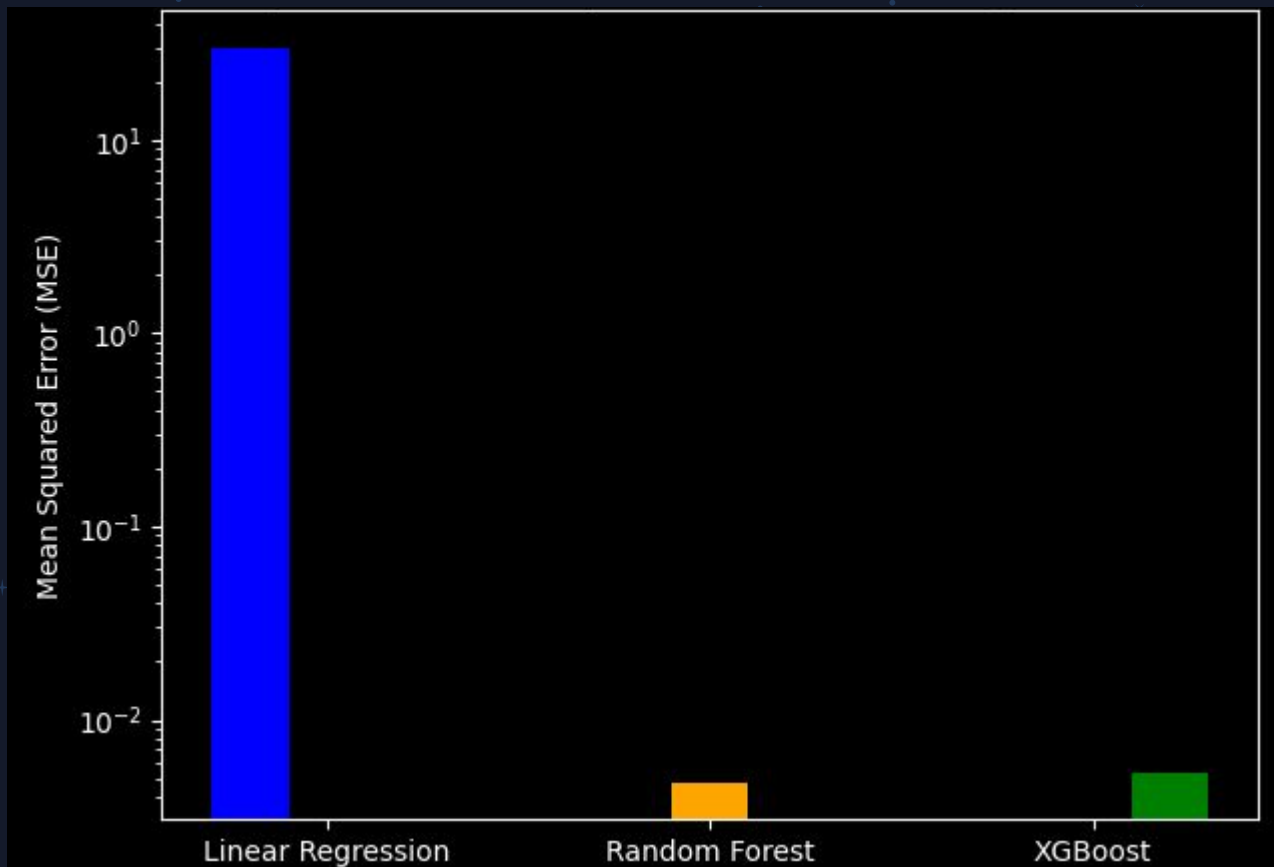
- Linear Regression
- Random Forest
- XGBoost

Train - Test Split

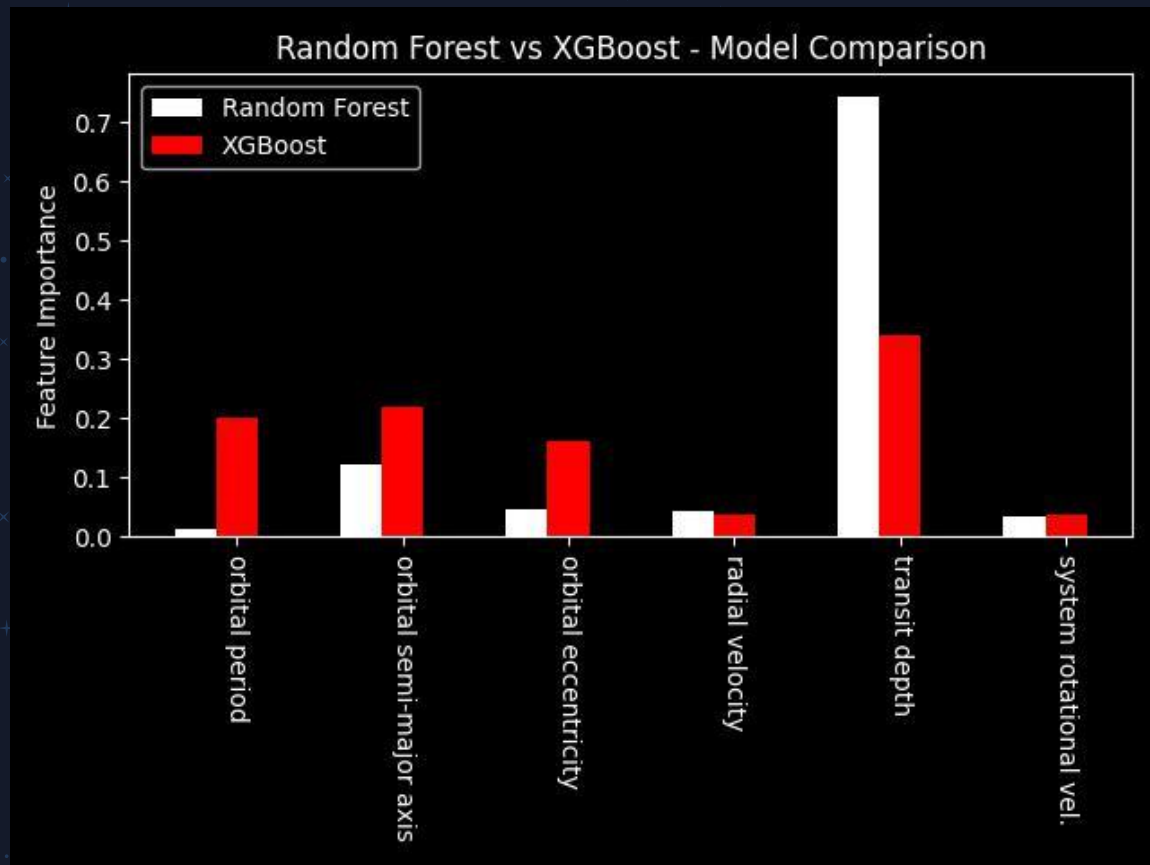
- **Train Dataset:** Nearby Exoplanets (<2000 parsecs)
- **Test Dataset:** Further away Exoplanets (>2000 parsecs)



Mean Squared Error (MSE) Comparison for all Models



Feature Importance of Random Forest & XGBoost



- XGBoost is more **robust**.
- It doesn't depend on transit depth alone

Thanks!

