In-Depth Study of a TESS Hot Jupiter System

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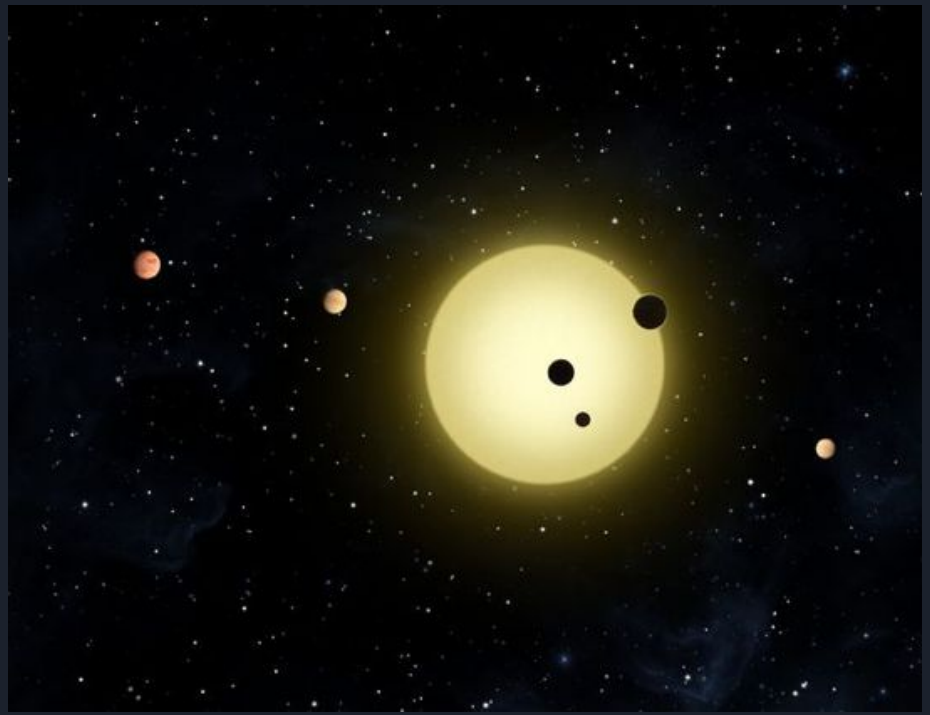
Lab: Batygin Group (B-Team)

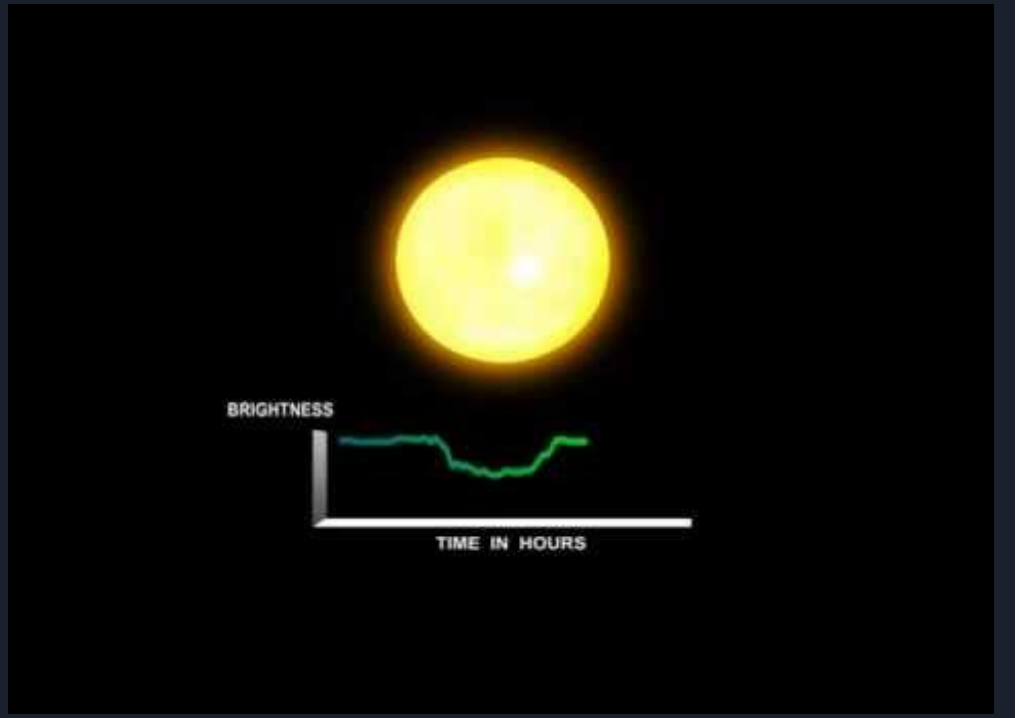
Introduction:
What is an Exoplanet?



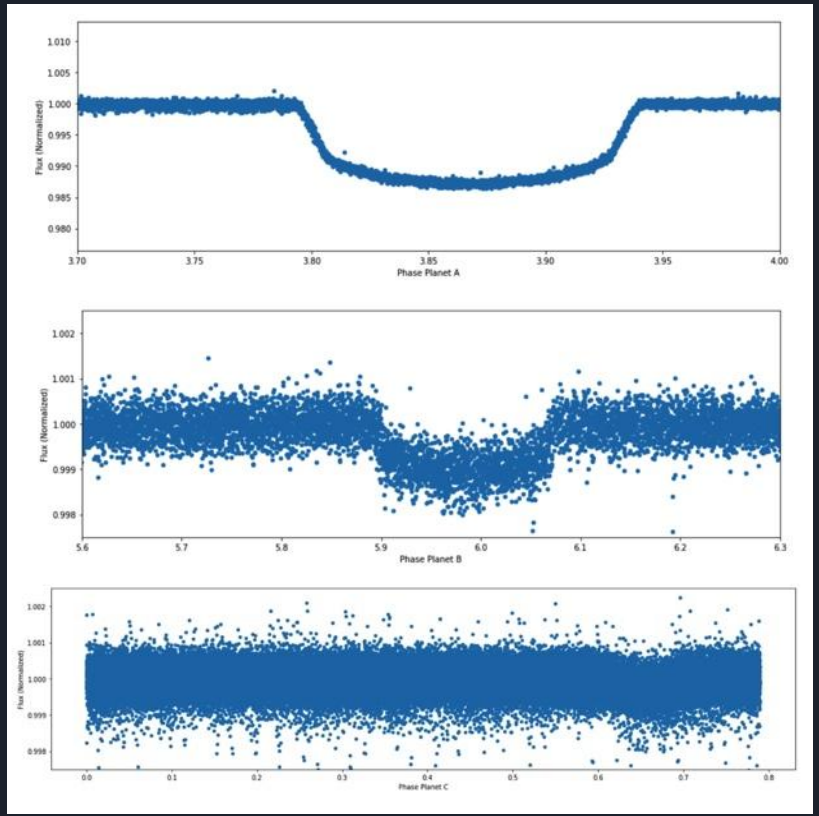
Kepler-11 and its six planets.

Credit: NASA/Tim Pyle

What is the Transit Method?



Animation Credit: NASA



Resonance and Disk Migration

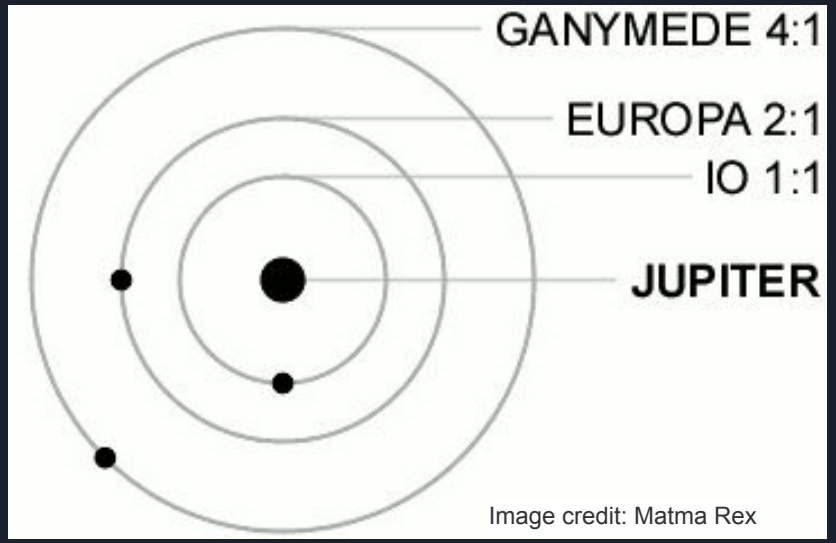
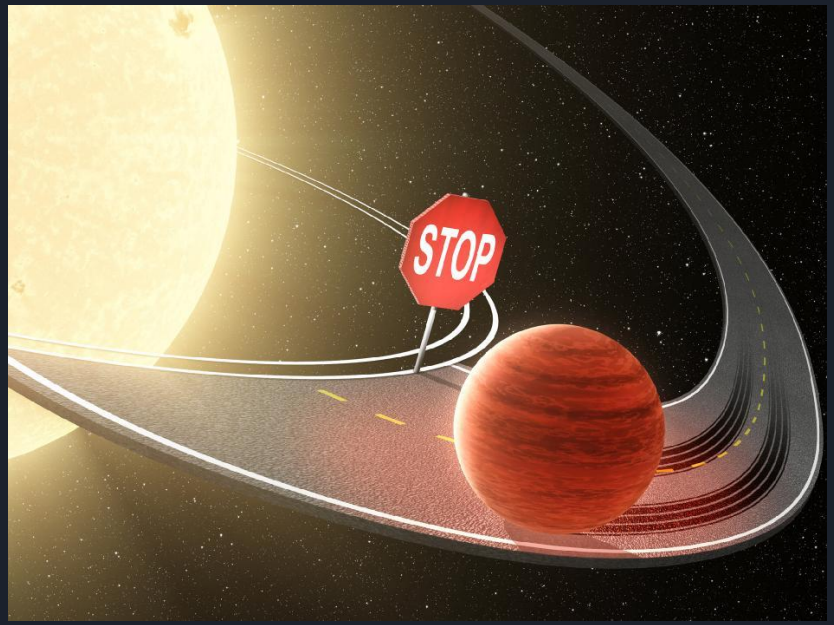
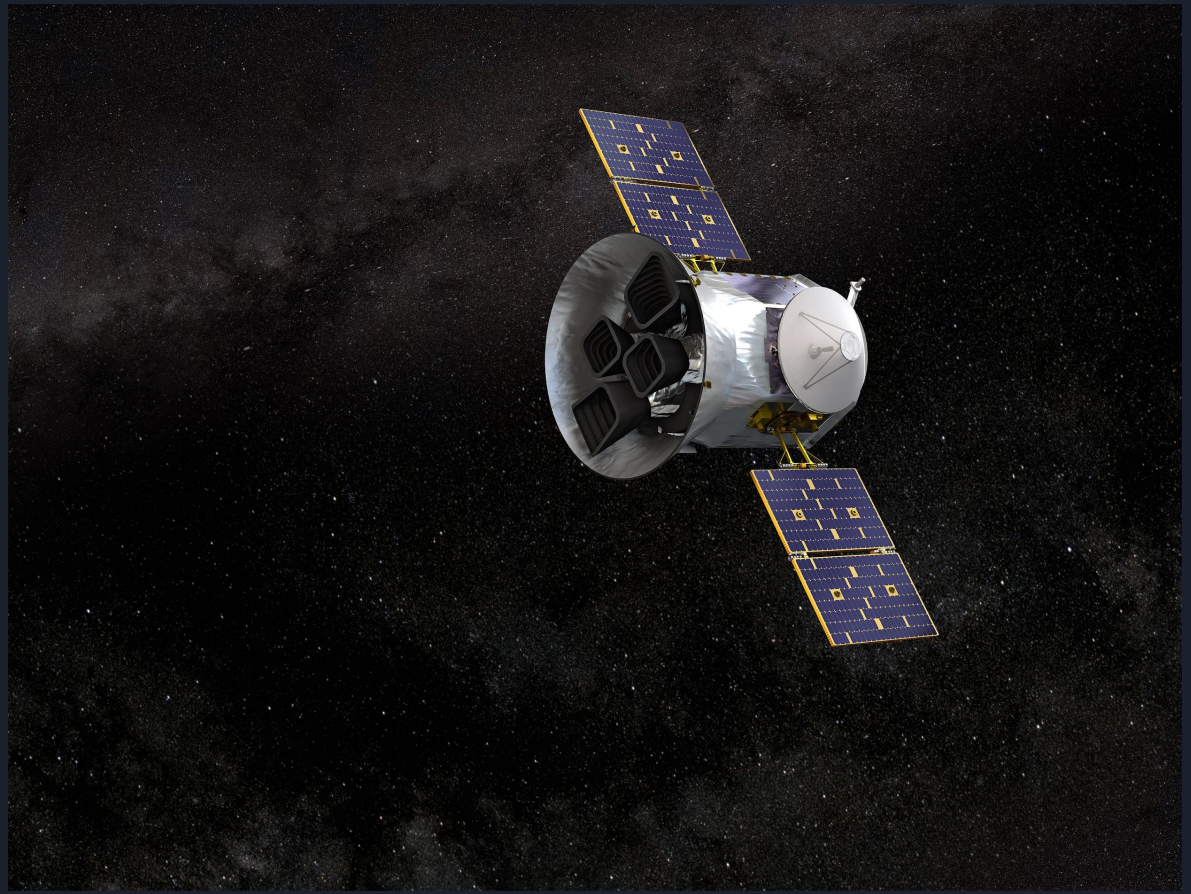


Image credit: Matma Rex



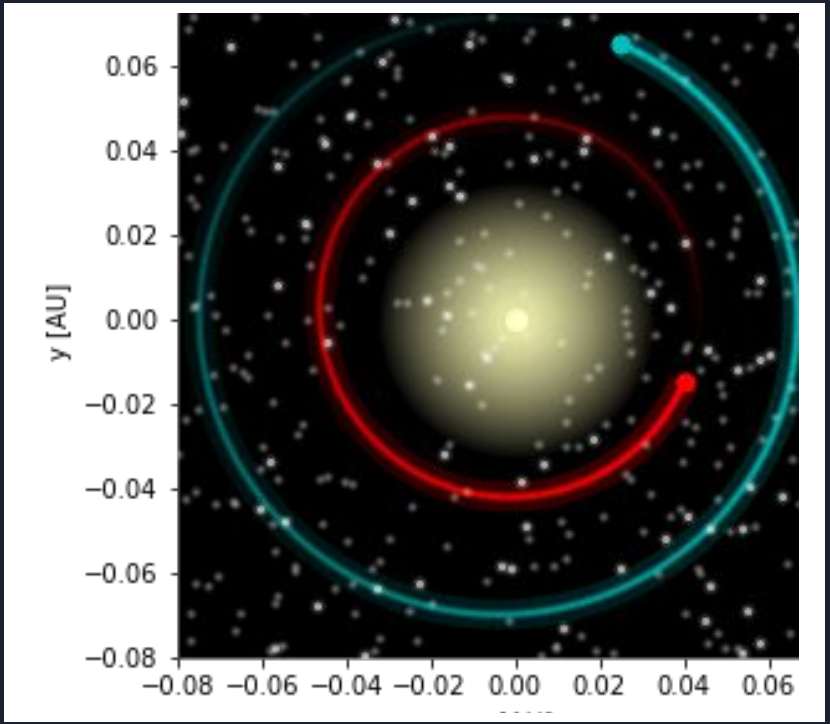
Credit: NASA



Credit: NASA /TESS

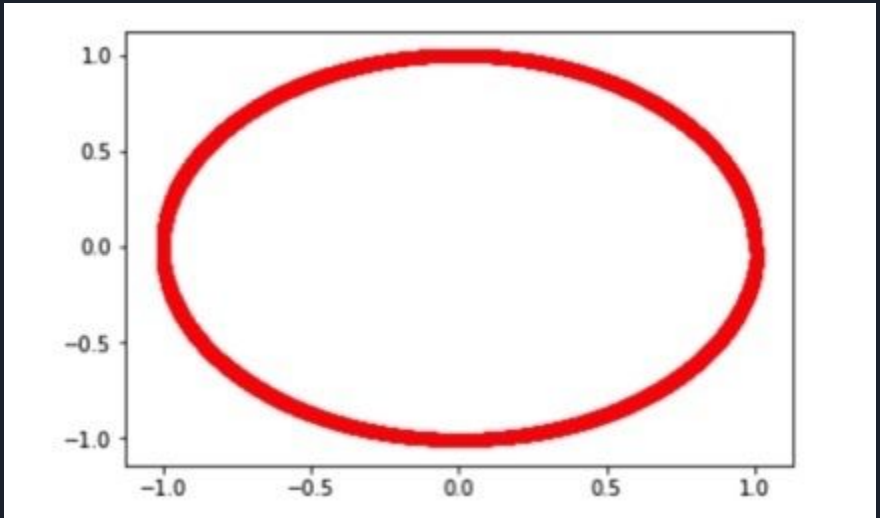
TOI-1130

- TOI-1130c: Hot Jupiter
- TOI-1130b: Neptune-sized companion
- Hot Jupiters rarely have companion planets

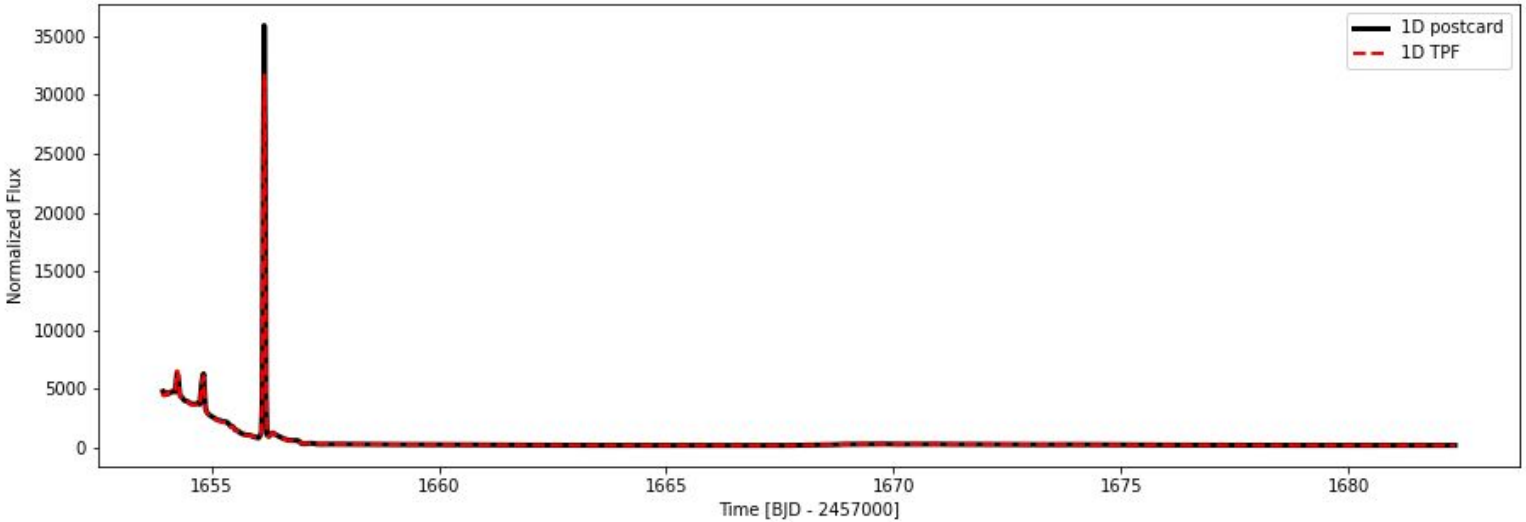


Methods: N-Body Integrator

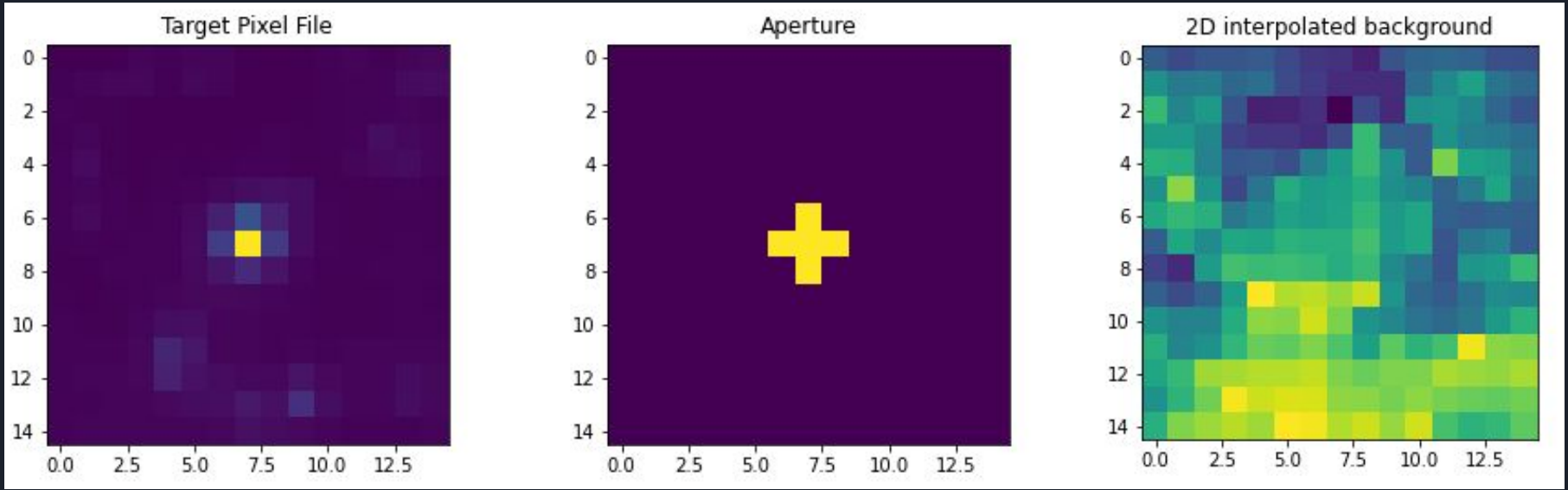
```
    #computing final position

    pfe = {'x': 0.0, 'y': 0.0}

    pfe['x'] = pie['x'] + (vie['x'] * dt)

    pfe['y'] = pie['y'] + (vie['y'] * dt)

    pie['x'] = pfe['x']

    pie['y'] = pfe['y']

    vie['x'] = vfe['x']

    vie['y'] = vfe['y']

    #results

    t += dt

    print("Loop " + str(i))
    print("The final position for " + planet_name + ": " + str(pie))
    print("The final velocity for " + planet_name + ": "  + str(vie))
    print(" ")

    #save results to csv file

    planet_dict = {
        'Planet Name': [planet_name],
        'Final Position': [pie],
        'Final Velocity': [vie]
    }

    df = df.append(planet_dict, ignore_index = True)
df.to_csv("nBodyOutput.csv", sep = ',', na_rep = '*')
df.to_csv("~/Documents/GitHub/FSRI-Research/nBodyOutput.csv")
```



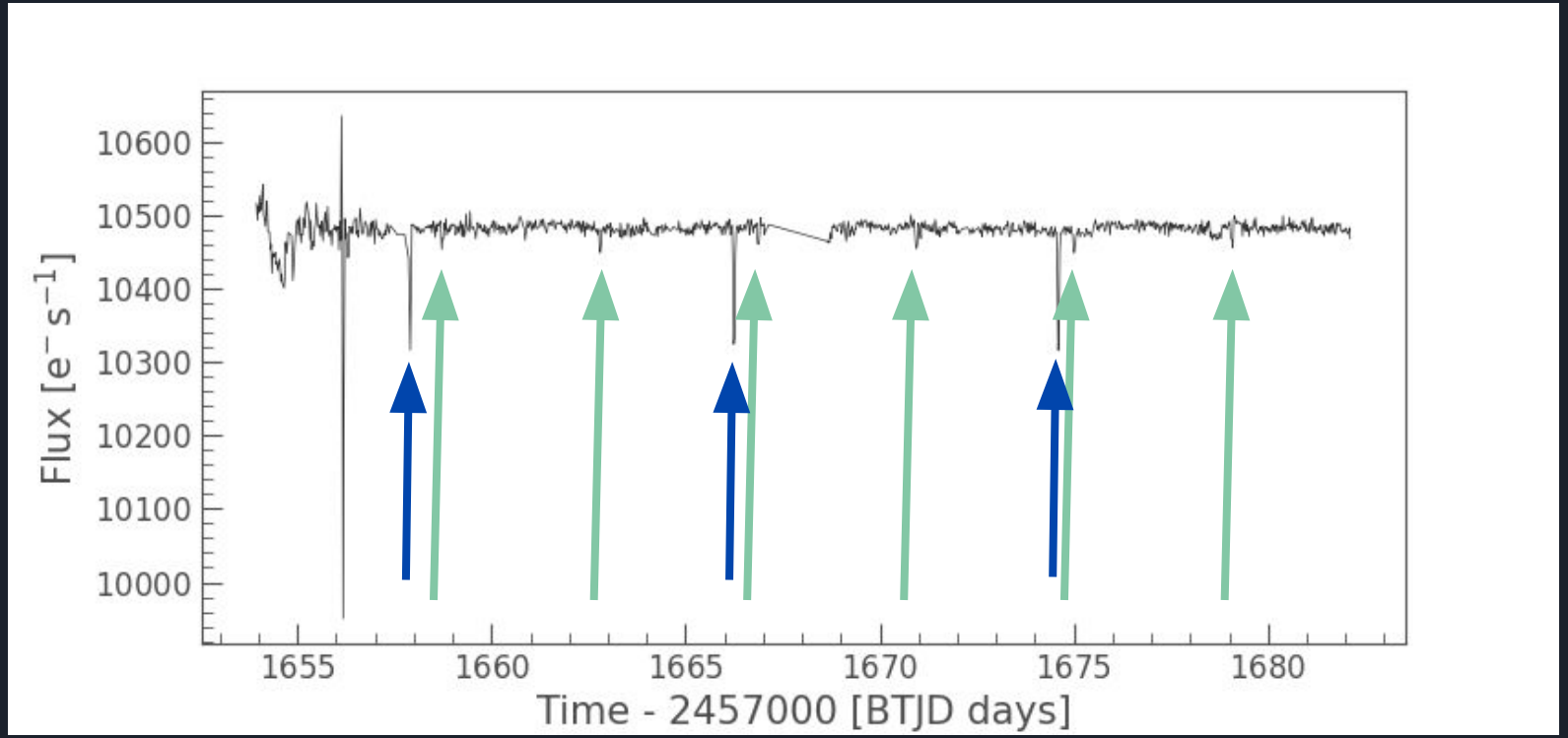
Results: Light Curve Testing



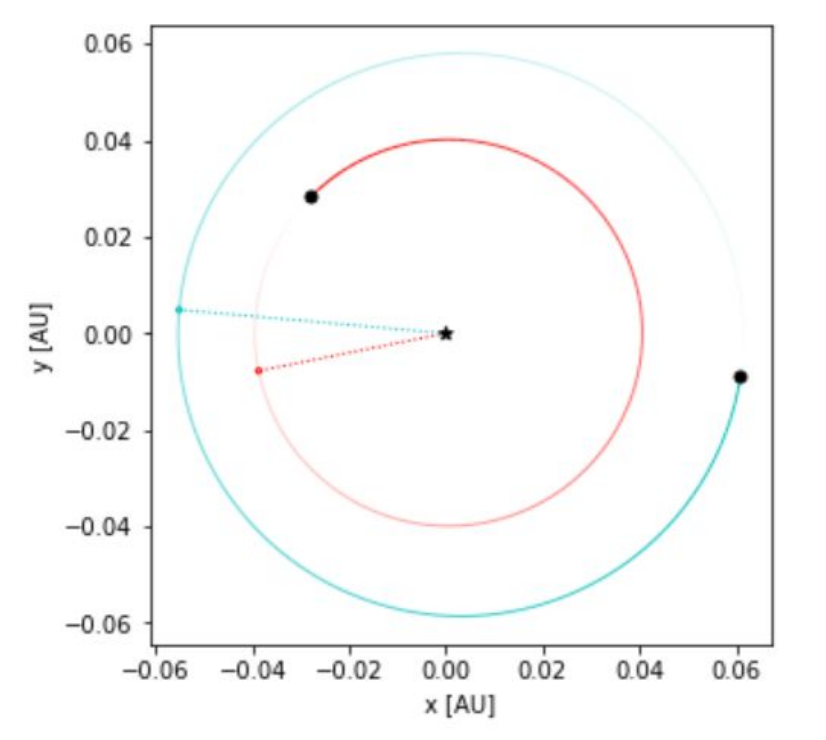
Pixel Graphs:



Final Light Curve:



Simulation Graphs



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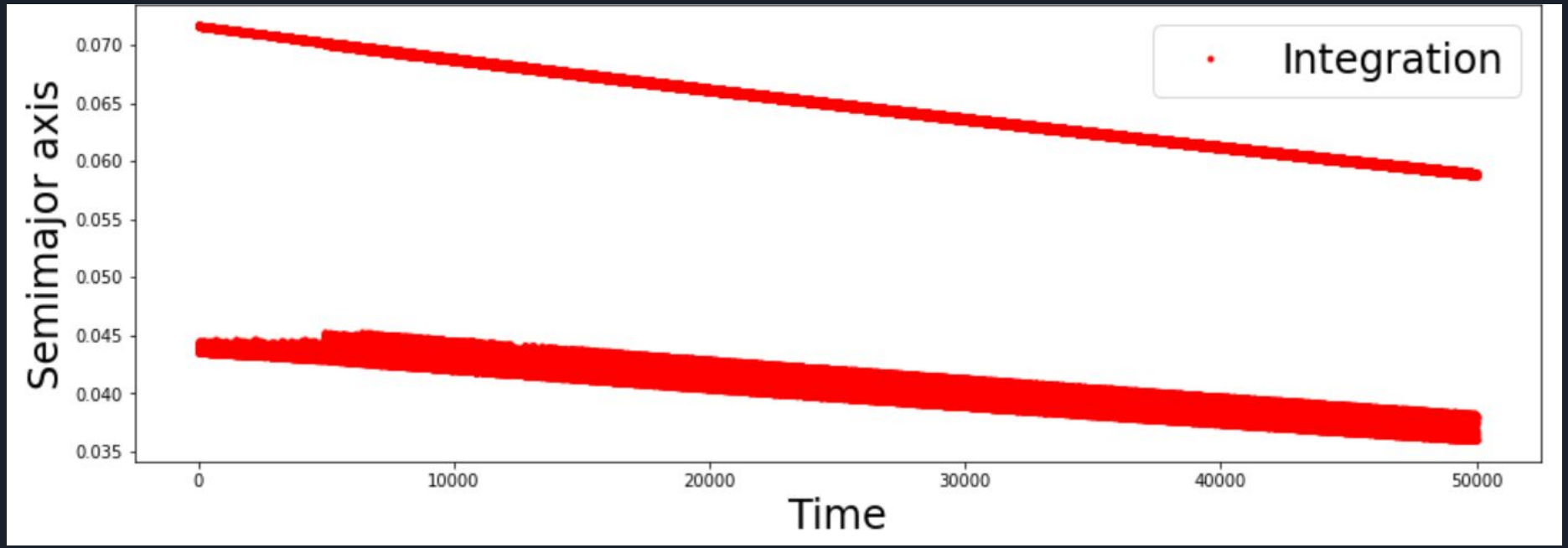

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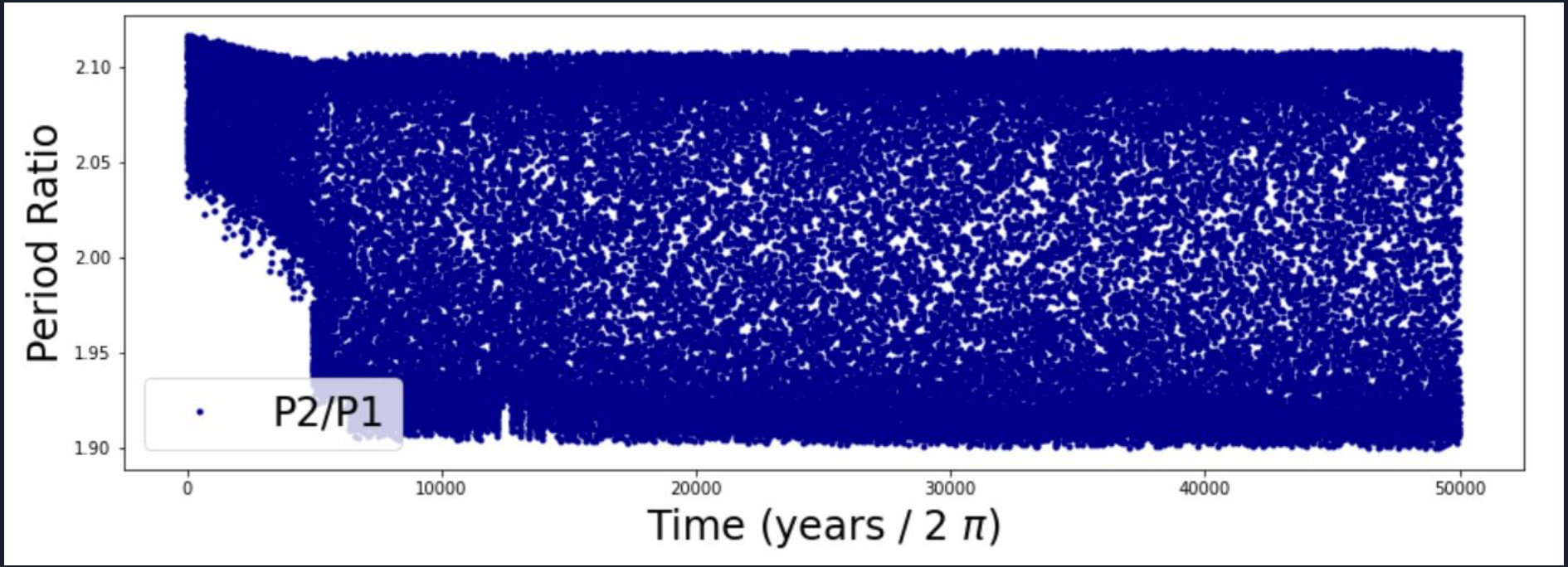

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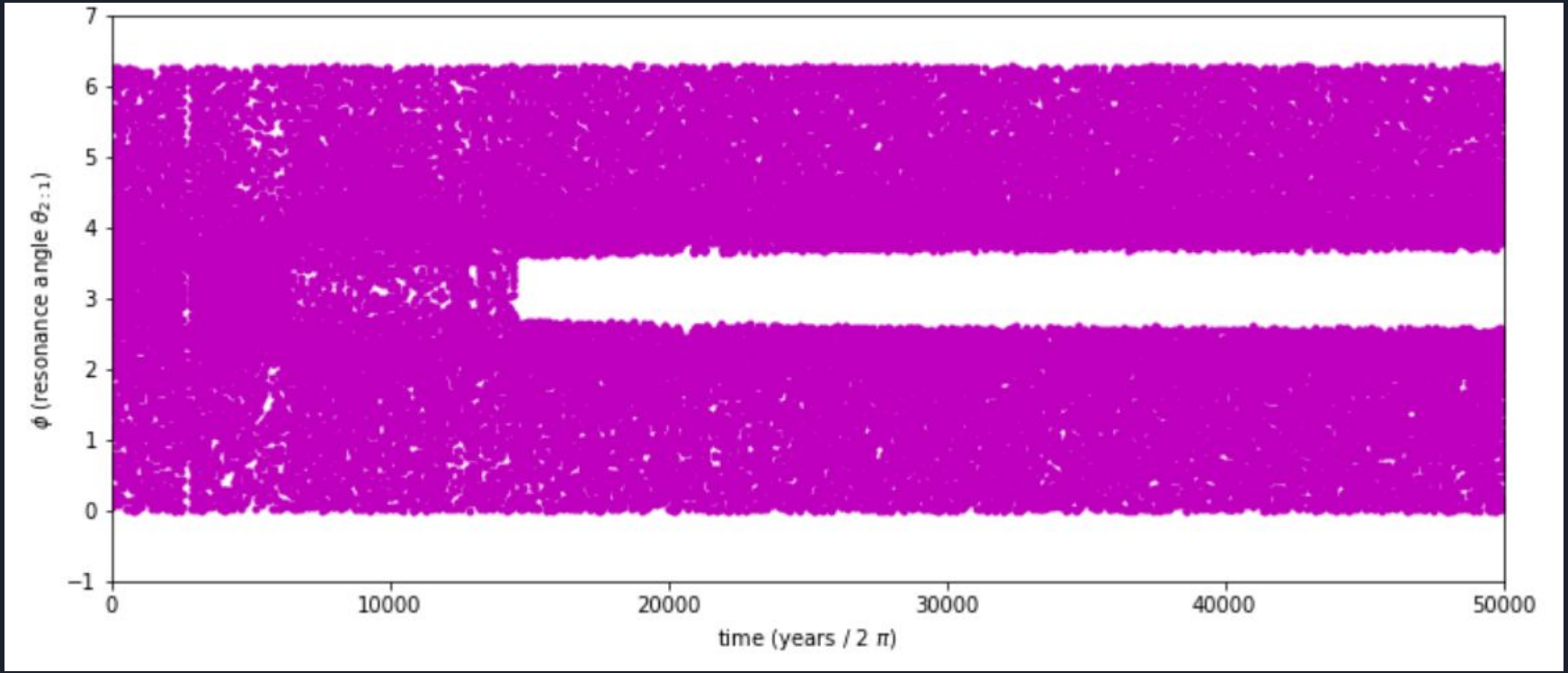


Discussion:

- Based on this, what do we know?
- Why is it important?

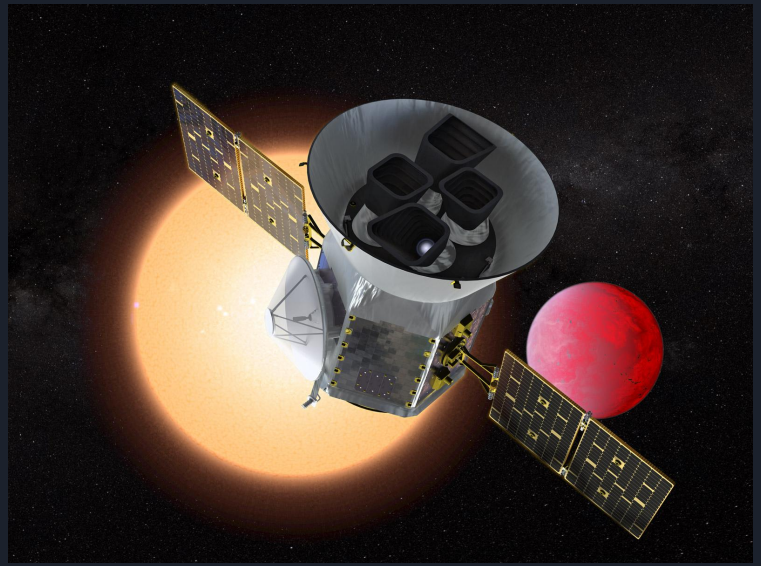
Credit: NASA

We’d like to take a moment to thank our mentor Juliette Becker, the Batygin lab (B-Team), Taso, Monique, Justin, Bob, the TAs, Caltech students, our fellow peers, and anyone who may not have been mentioned for making this project and FSRI possible.

Reference:

Huang, Chelsea X. et al. “TESS Spots a Hot Jupiter with an Inner Transiting Neptune.” The Astrophysical Journal 892.1 (2020): L7. Crossref. Web.

Questions?



Credit: NASA /TESS