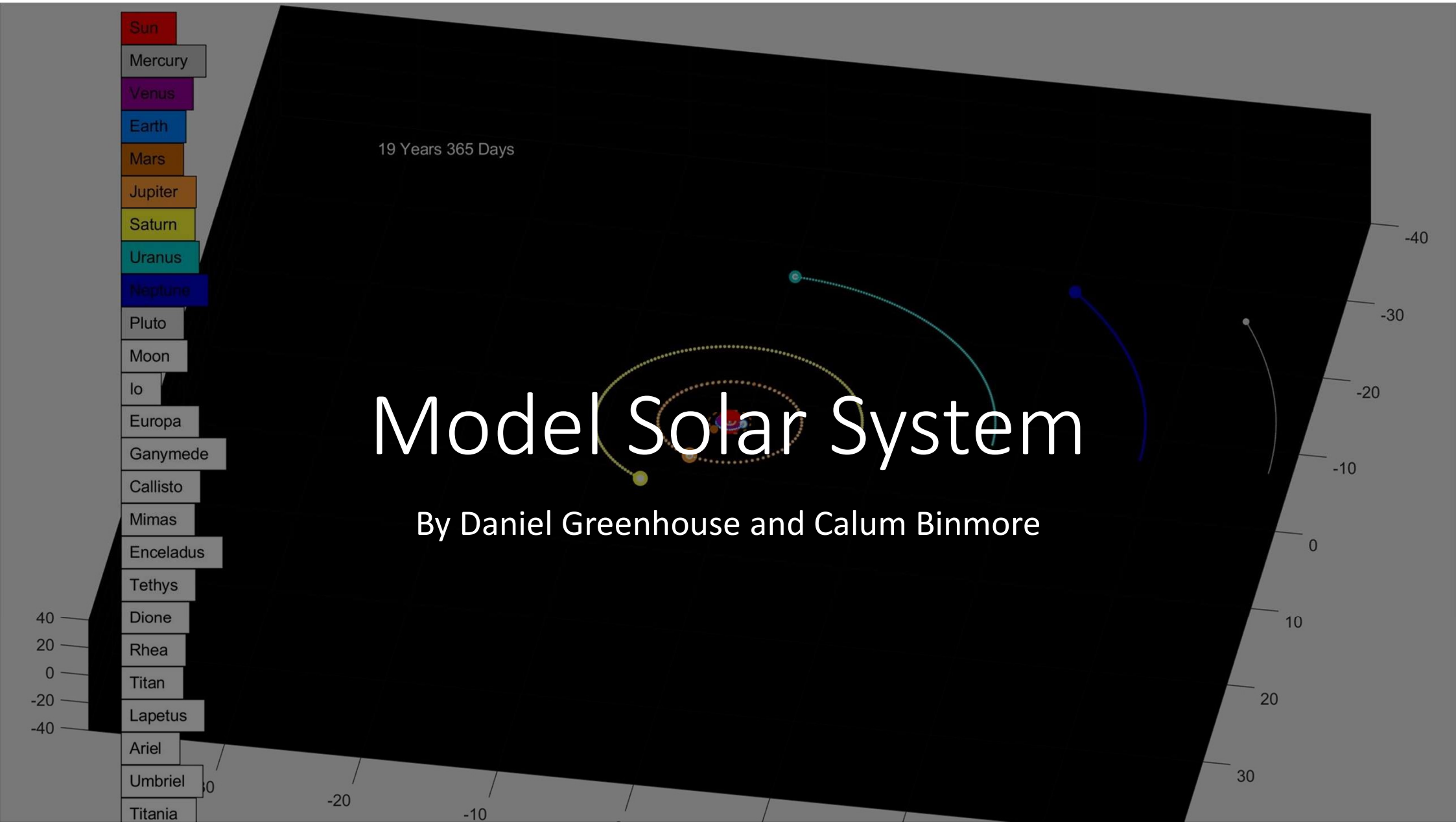
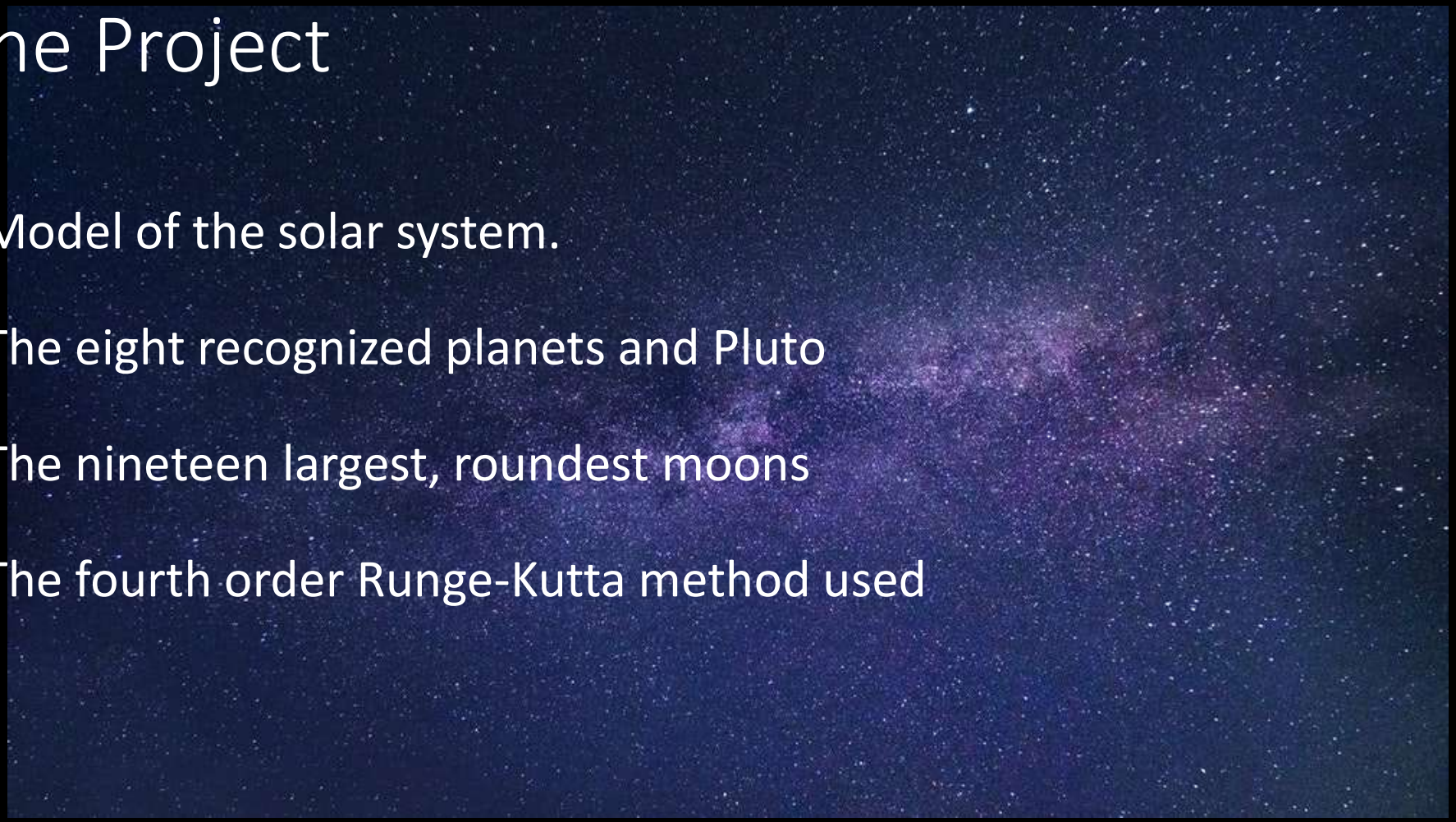


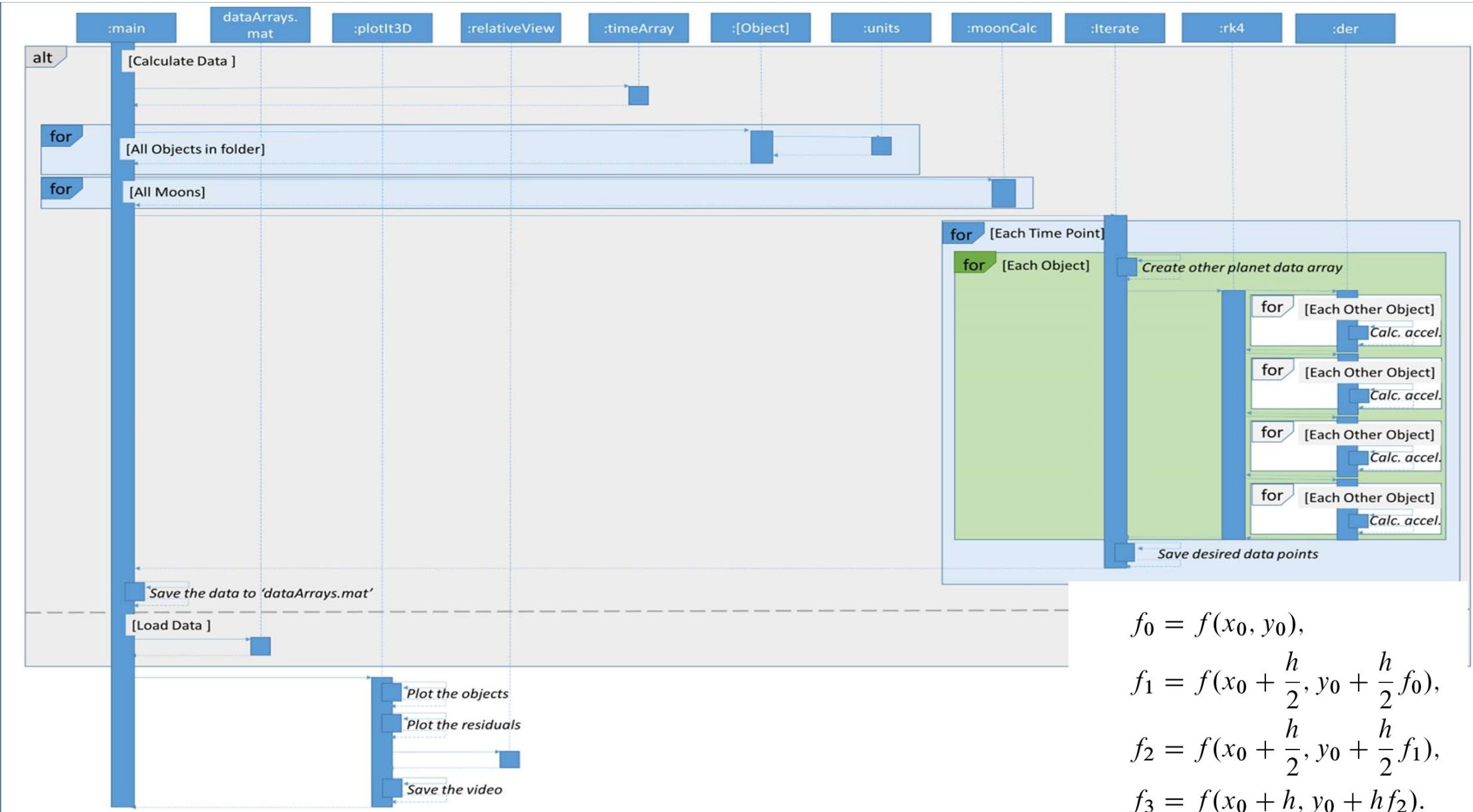
Model Solar System

By Daniel Greenhouse and Calum Binmore

The Project



- Model of the solar system.
- The eight recognized planets and Pluto
- The nineteen largest, roundest moons
- The fourth order Runge-Kutta method used



$$f_0 = f(x_0, y_0),$$
$$f_1 = f(x_0 + \frac{h}{2}, y_0 + \frac{h}{2} f_0),$$
$$f_2 = f(x_0 + \frac{h}{2}, y_0 + \frac{h}{2} f_1),$$
$$f_3 = f(x_0 + h, y_0 + h f_2).$$

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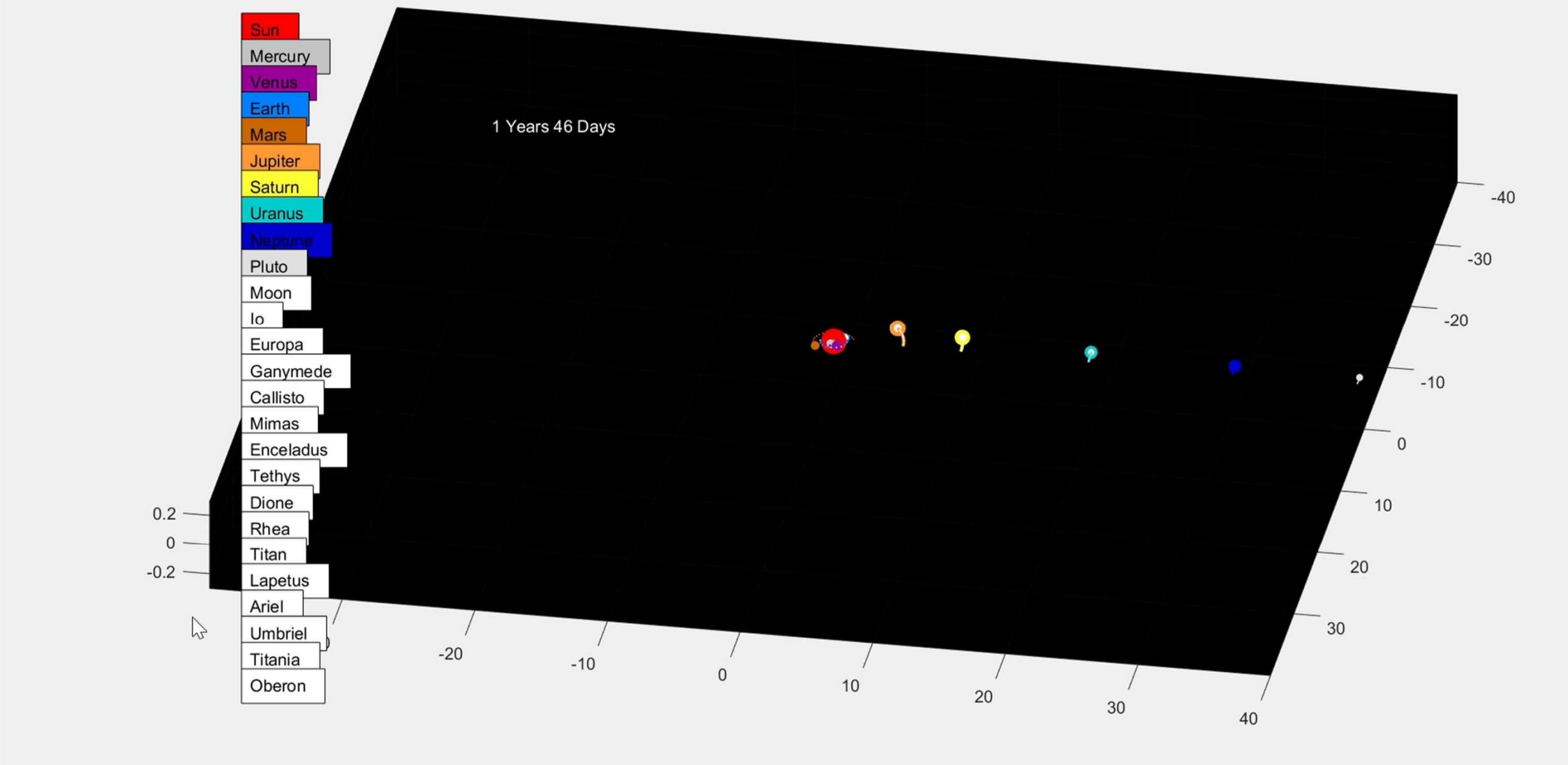
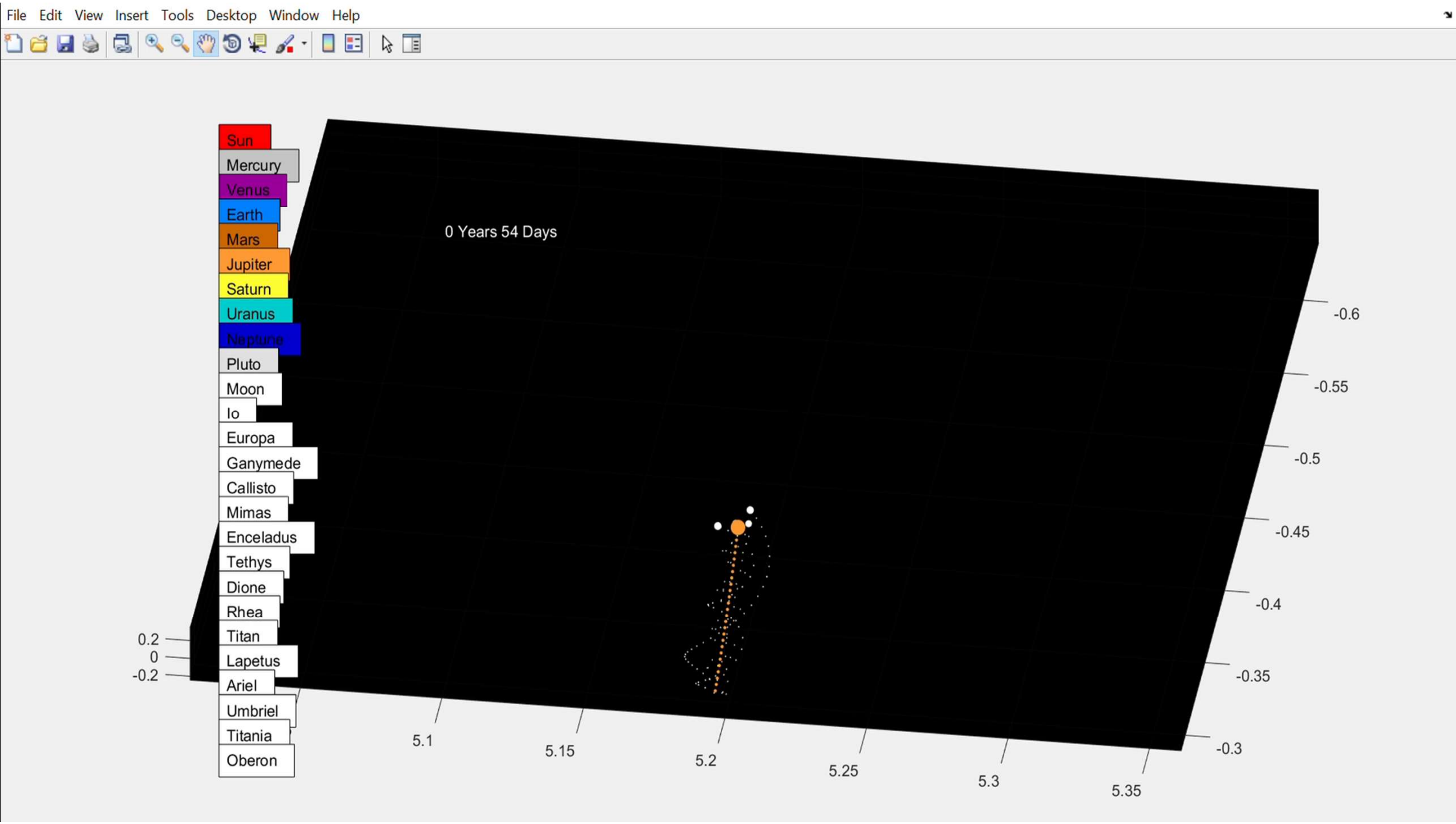
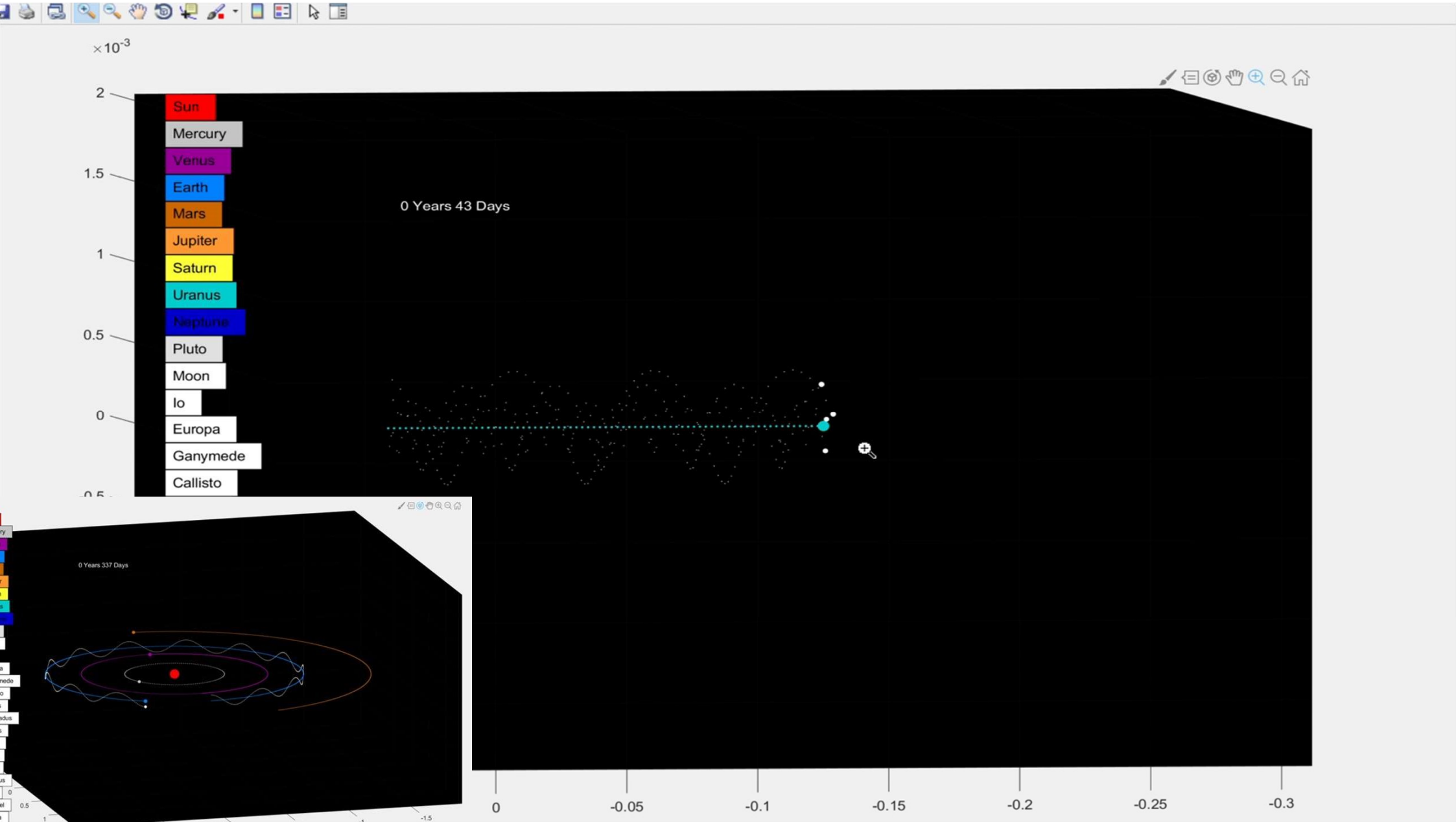
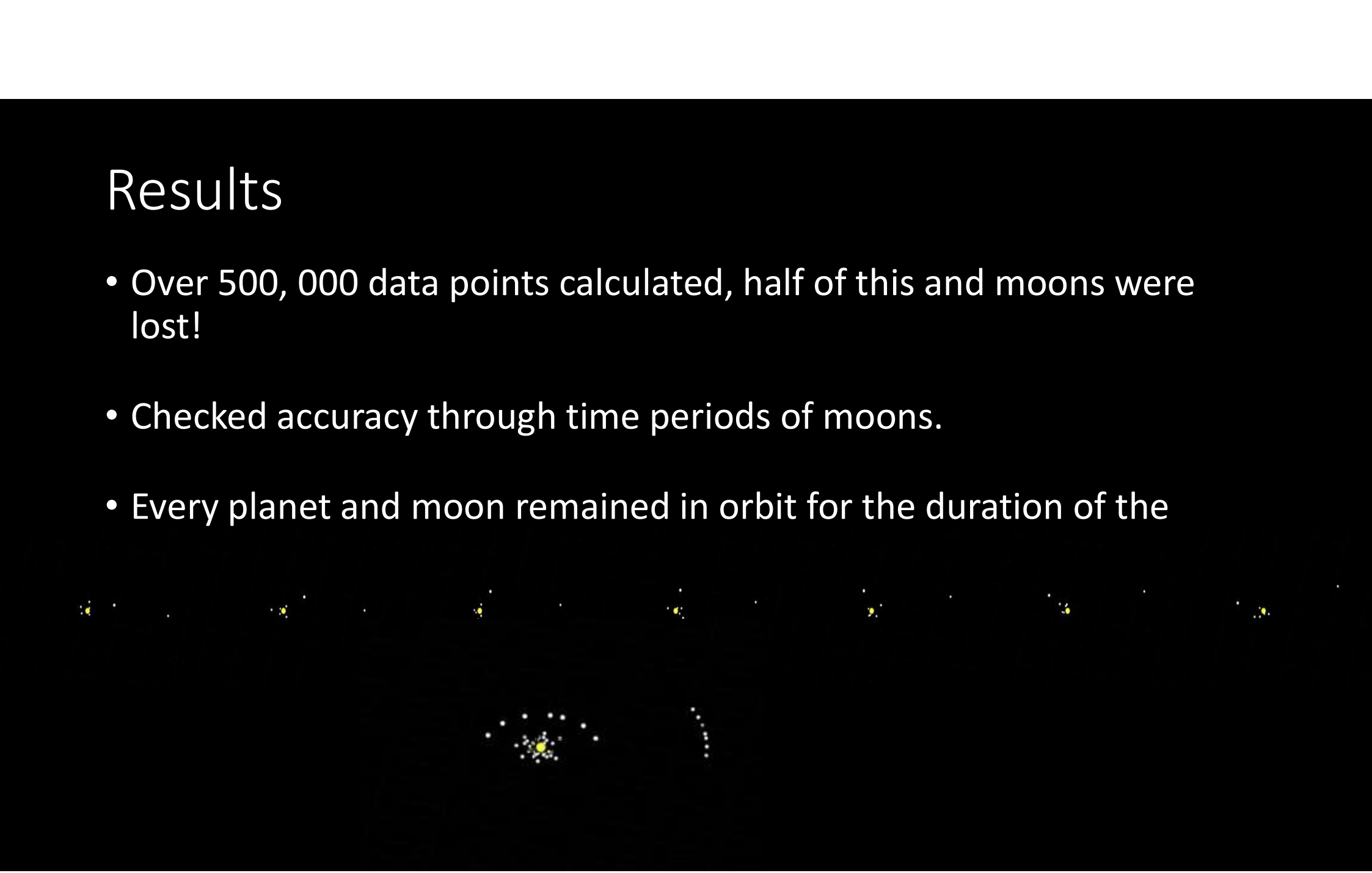



File Edit View Insert Tools Desktop Window Help
Sun
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Io
Europa
Ganymede
Callisto
Mimas
Enceladus
Tethys
Dione
Rhea
Titan
Lapetus
Ariel
Umbriel
Titania
Oberon
0 Years 54 Days
0.2
0
-0.2
5.1
5.15
5.2
5.25
5.3
5.35
-0.6
-0.55
-0.5
-0.45
-0.4
-0.35
-0.3

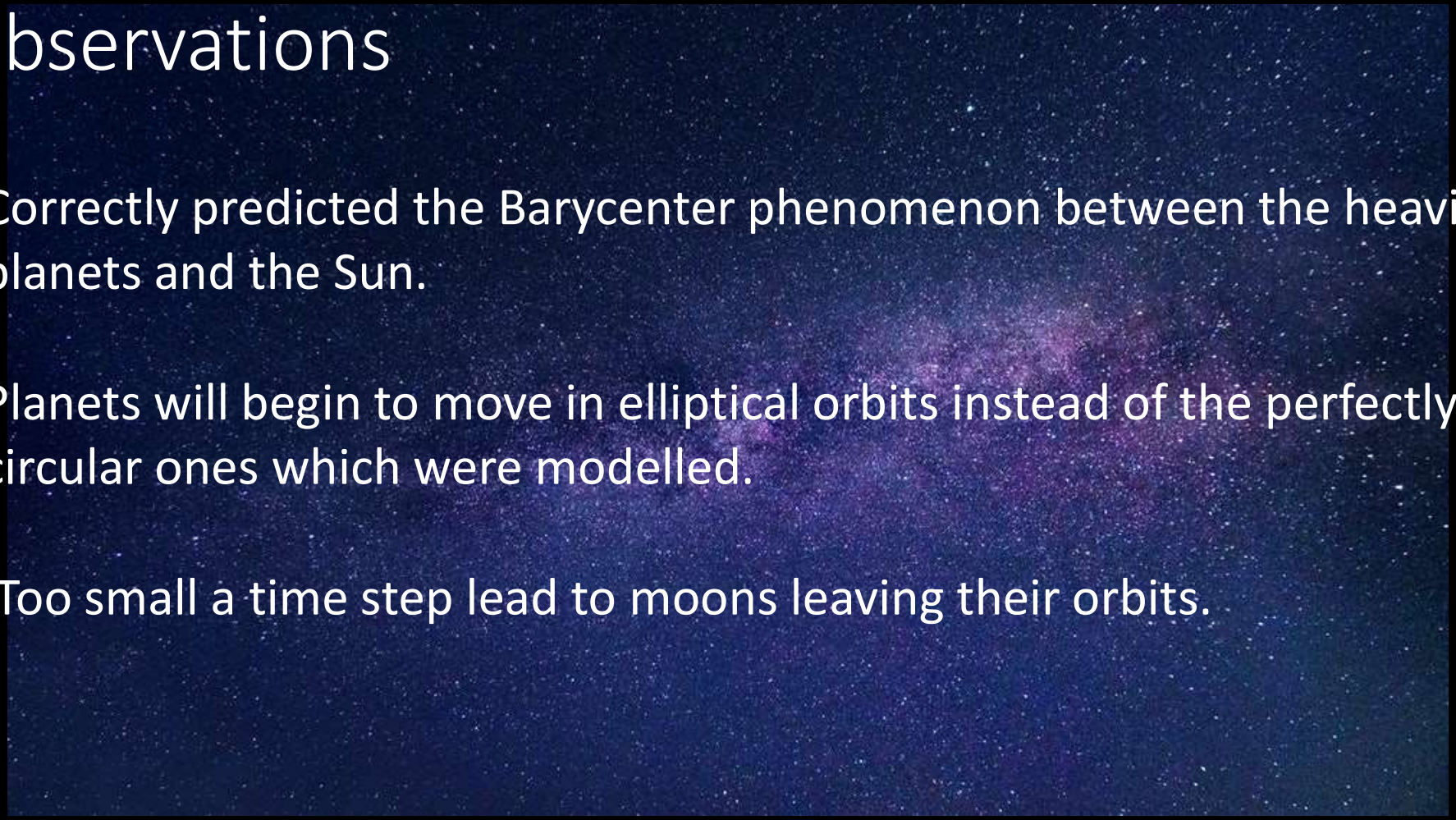

×10^-3
2
1.5
1
0.5
0
Sun
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Io
Europa
Ganymede
Callisto
0 Years 43 Days
0 Years 337 Days
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3

Results

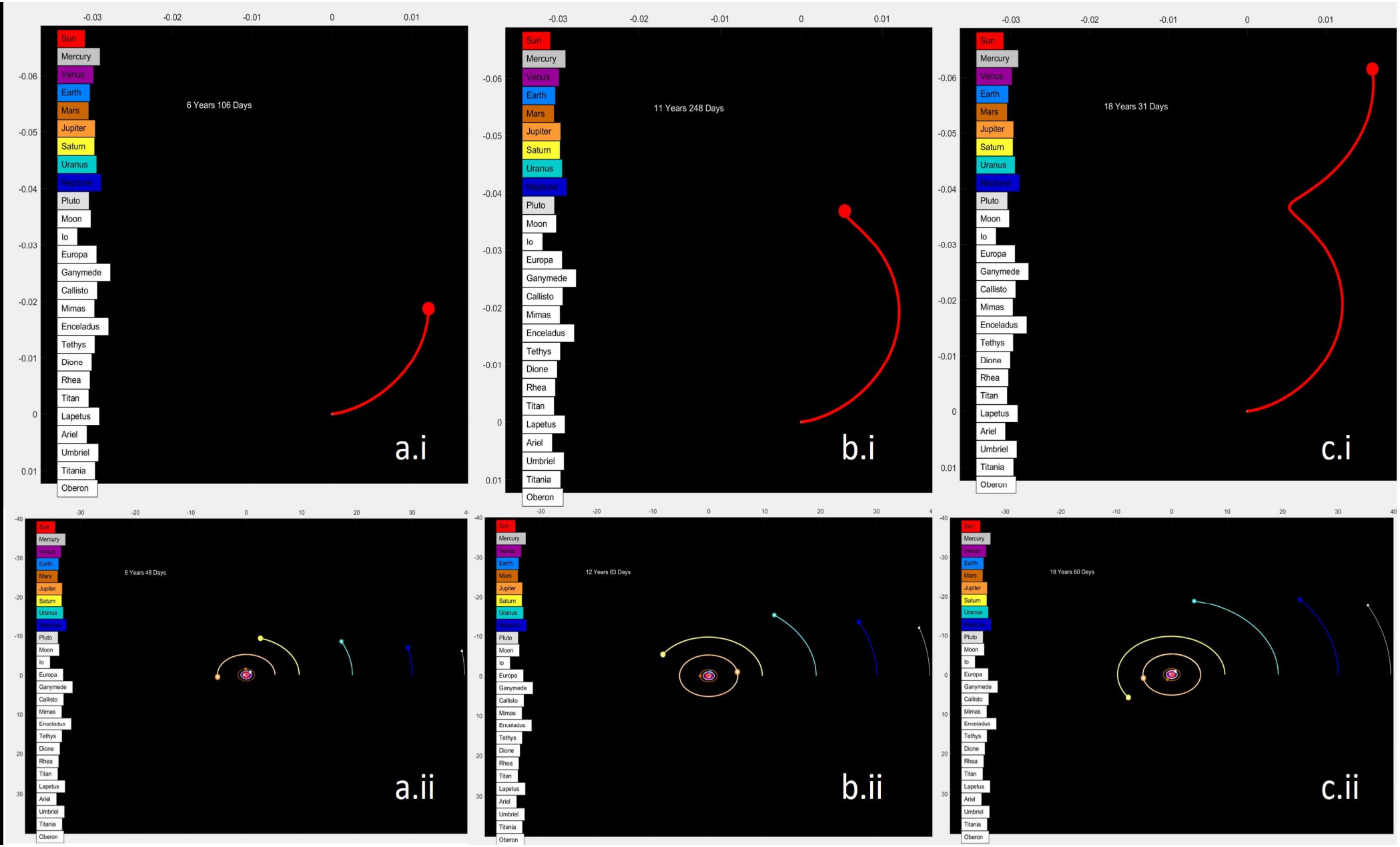
- Over 500, 000 data points calculated, half of this and moons were lost!
- Checked accuracy through time periods of moons.
- Every planet and moon remained in orbit for the duration of the

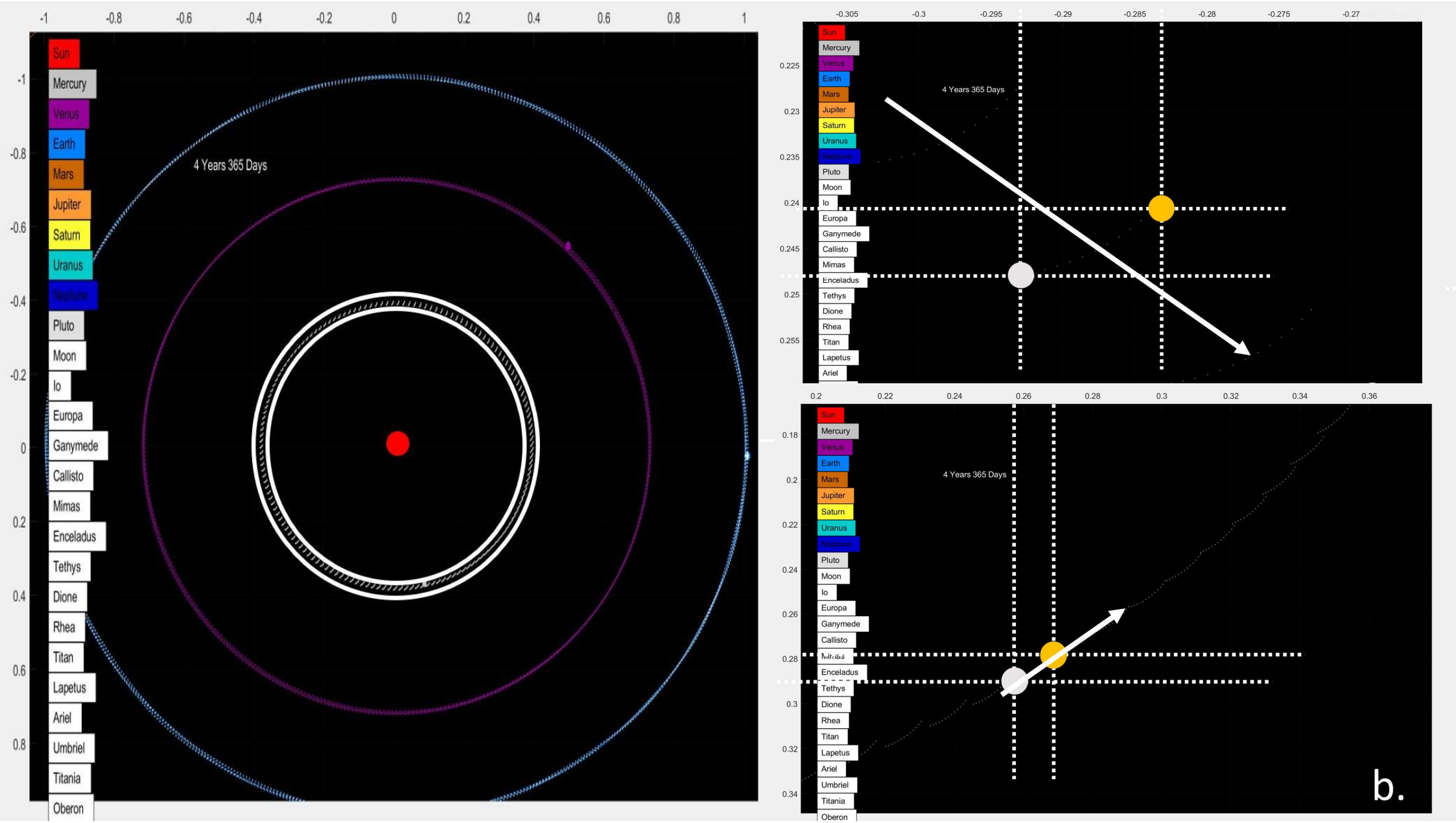


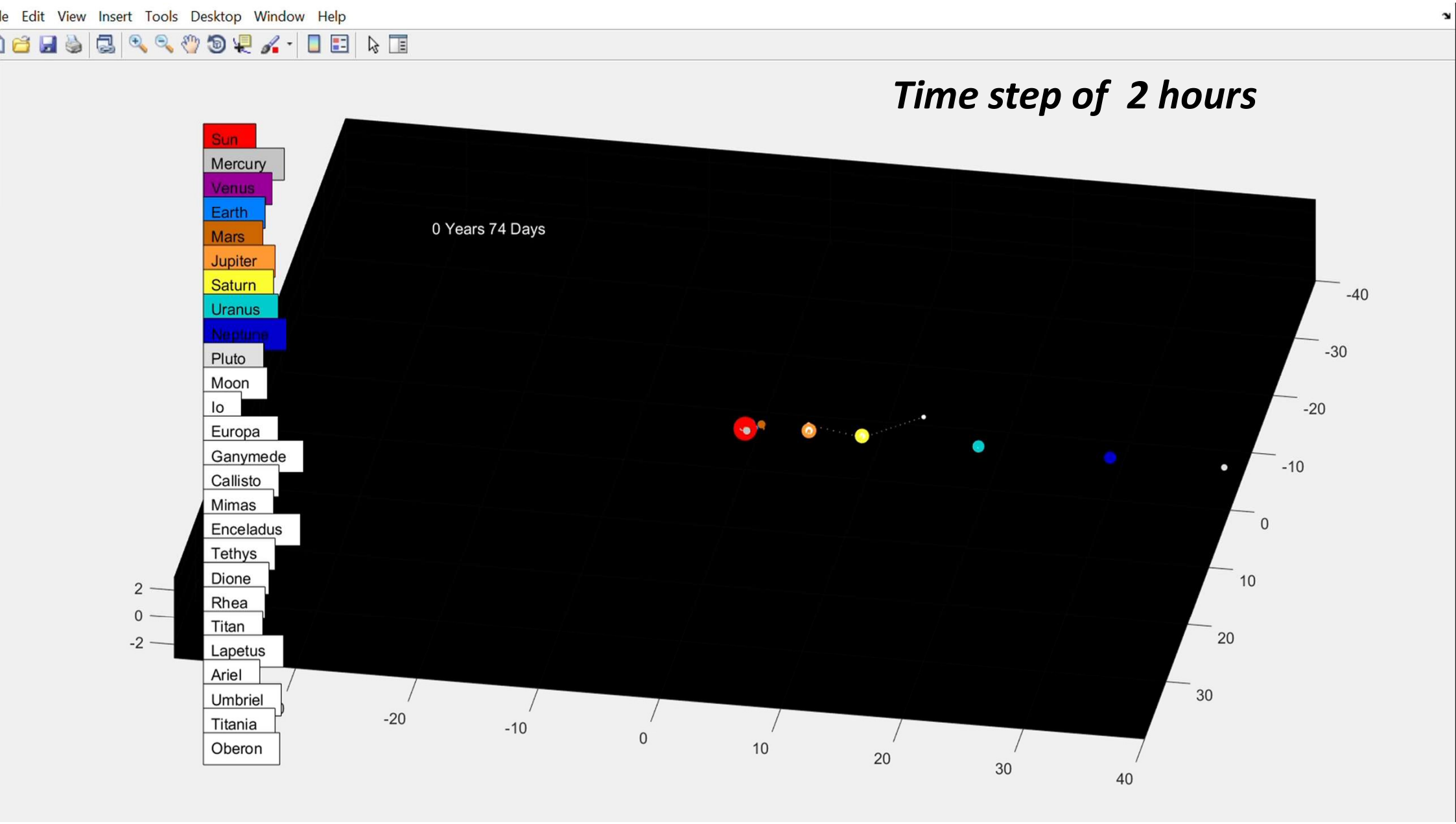
Observations



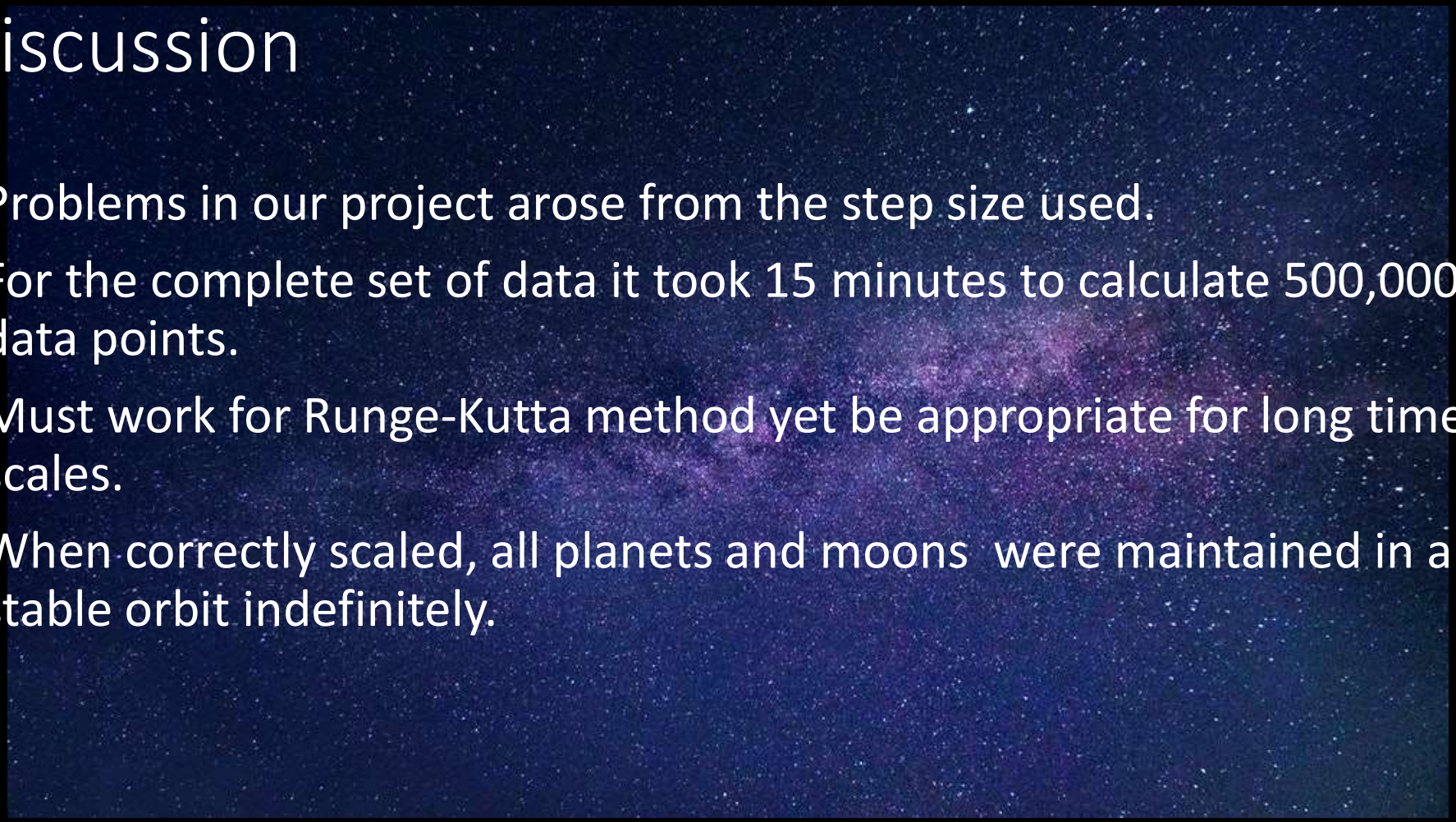
- Correctly predicted the Barycenter phenomenon between the heavier planets and the Sun.
- Planets will begin to move in elliptical orbits instead of the perfectly circular ones which were modelled.
- Too small a time step lead to moons leaving their orbits.


6 Years 106 Days
a.i
11 Years 248 Days
b.i
18 Years 31 Days
c.i
6 Years 48 Days
a.ii
12 Years 83 Days
b.ii
18 Years 60 Days
c.ii
Sun
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Io
Europa
Ganymede
Callisto
Mimas
Enceladus
Tethys
Dione
Rhea
Titan
Lapetus
Ariel
Umbriel
Titania
Oberon


Sun
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Io
Europa
Ganymede
Callisto
Mimas
Enceladus
Tethys
Dione
Rhea
Titan
Lapetus
Ariel
Umbriel
Titania
Oberon
4 Years 365 Days
b.


Edit View Insert Tools Desktop Window Help
Time step of 2 hours
0 Years 74 Days
Sun
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
Io
Europa
Ganymede
Callisto
Mimas
Enceladus
Tethys
Dione
Rhea
Titan
Lapetus
Ariel
Umbriel
Titania
Oberon
2
0
-2
-20
-10
0
10
20
30
40
-40
-30
-20
-10
0
10
20
30

Discussion



- Problems in our project arose from the step size used.
- For the complete set of data it took 15 minutes to calculate 500,000 data points.
- Must work for Runge-Kutta method yet be appropriate for long time scales.
- When correctly scaled, all planets and moons were maintained in a stable orbit indefinitely.