Team 1: Aero 351 Project

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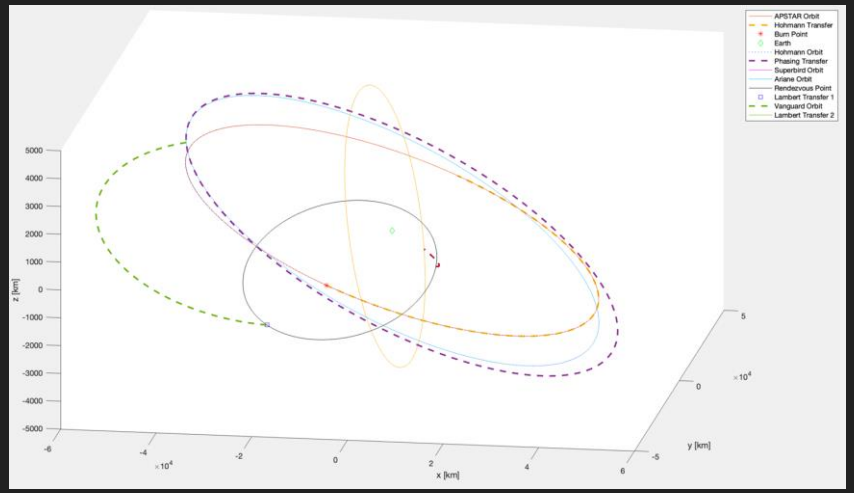
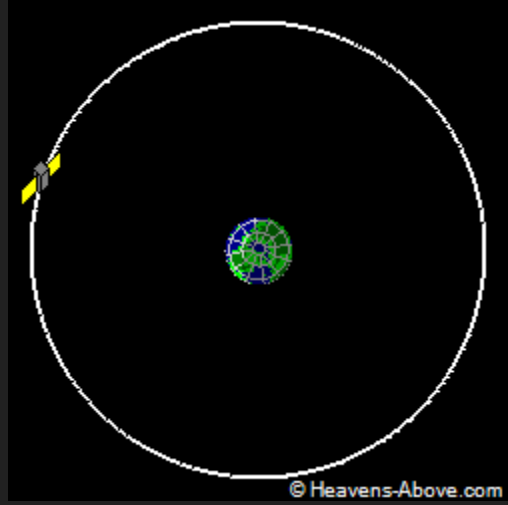
Mission Overview:

- Start Date of Mission: November 14th 2022 12:00 AM
- Object 1 (GEO): APSTAR 5(TELSTAR 18)
  - Parking Orbits
- Object 2 (GEO): Superbird 4
  - Inclination and Phase Change
  - Hohmann Transfer
- Object 3 (MEO): Ariane H10
  - Lambert Transfer orbit
- Object 4 (LEO) : Vanguard 1
  - Lambert Transfer orbit
- Wrap Up and Statistics



Object 1: **APSTAR 5 (TELSTAR 18)**



TLE:

```
1 28364U 04024A   22317.49472294 -.00000157  00000-0  00000-0 0  9993
2 28364   3.6100  84.6764 0001196 297.1834 149.4792  0.99013431 67314
```

The Apstar 5 is a geostationary satellite, and will be the mission start point. Once the spacecraft has remained a total of 5 orbits with Apstar 5, operations to transfer to Superbird 4 will commence.

Starting Orbit: **Parking Orbit Propagation**

With the APSTAR 5 as the starting point, there is little to do other then propagate the satellite and spacecraft for 5 orbits before beginning the first transfer.

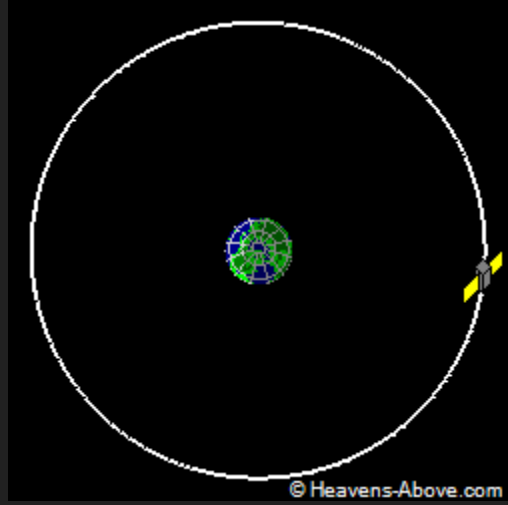
Mission Time at Departure: 00.000 days

Mission Time at Arrival:5.0498 days

Object 2: **Superbird 4**

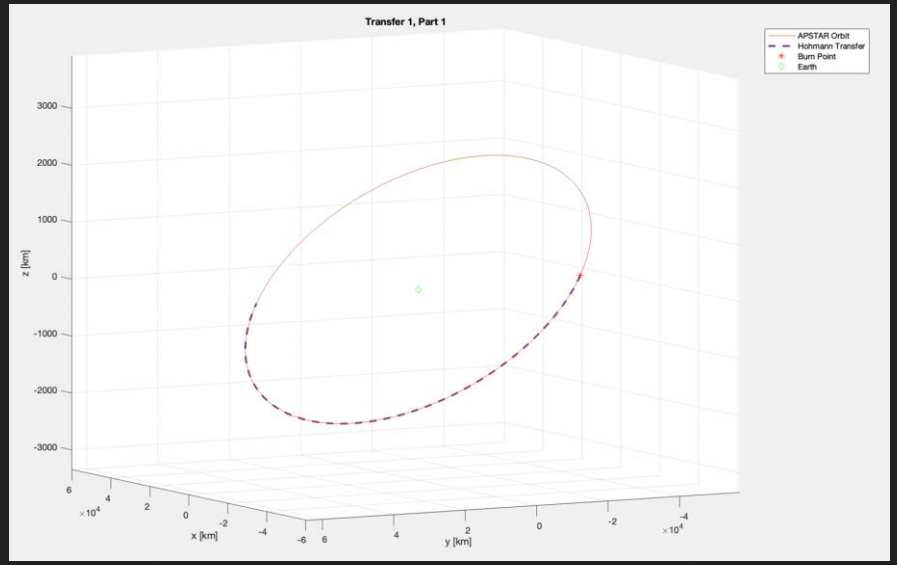
TLE:

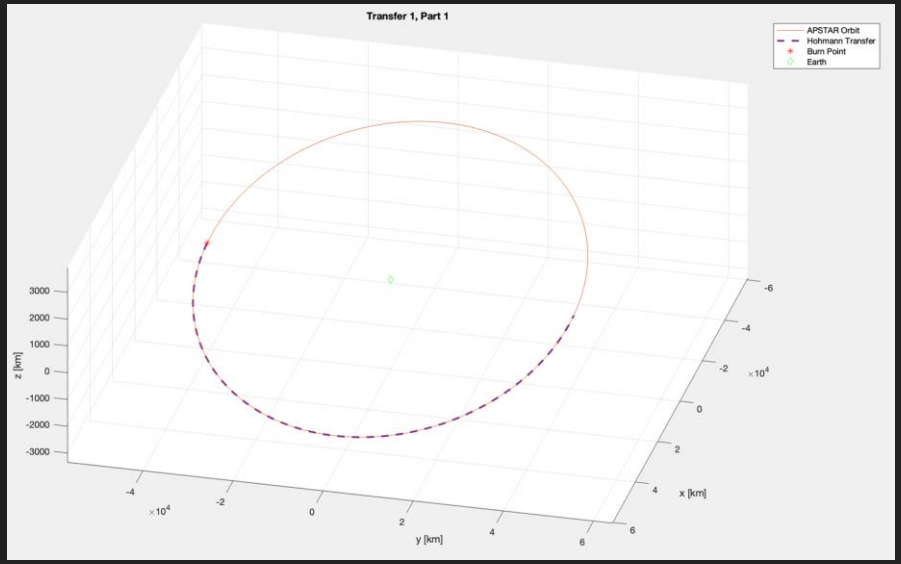
```
1 26095U 00012A   22317.39146487 -.00000240  00000-0  00000-0 0  9999
2 26095   4.9936  78.5232 0016364 114.3141 137.2103  0.98852896 31801
```



Geostationary satellite Superbird 4 is the second target, and was chosen for its conveniently similar orbit to third target APSTAR 5. An Hohmann transfer into a inc and Phasing transfer will effectively relocate the spacecraft from the starting object to the second target.

Transfer 1 (part i): **Hohmann Transfer**





Mission Time at Departure: 5.0498 days

Mission Time at Arrival: 5.5552 days

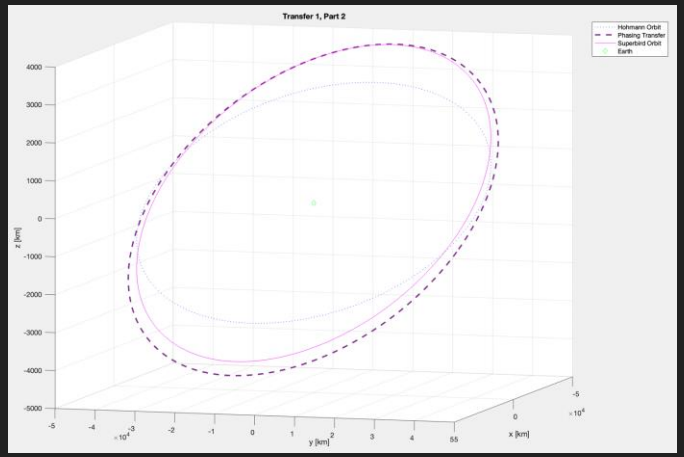
$\Delta V = 0.0017$ [km/s]

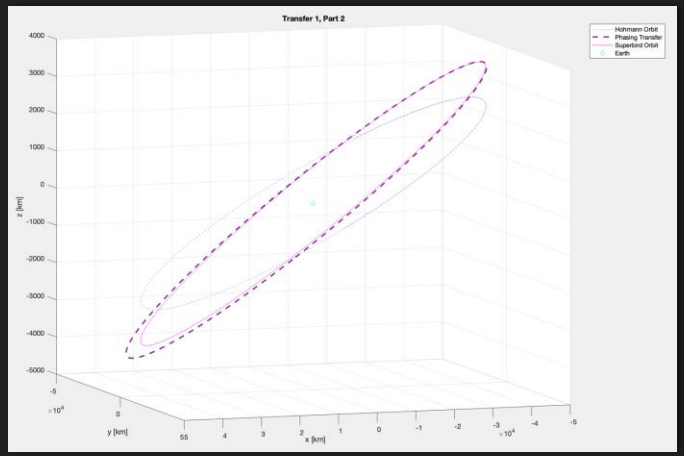
Transfer 1 (Part ii): **Inclination And Phasing Change**

Heart Check: Both orbits, since in GEO, have an ecc < 0.001. After defining as circular and finding the intersection points of the planes, a combined inc and phasing change was made (Apse line change was not needed for these circular orbits).

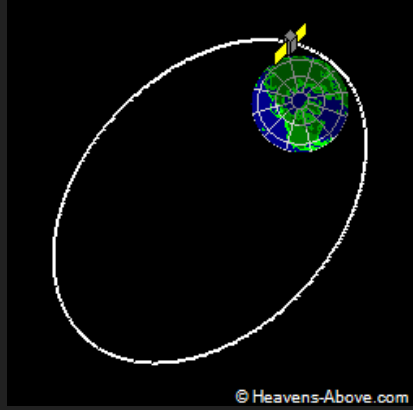
$$\Delta V = 3.9870 \text{ [km/s]}$$

Mission Time at Arrival: 6.7091 Days





Object 3: **Ariane H10**

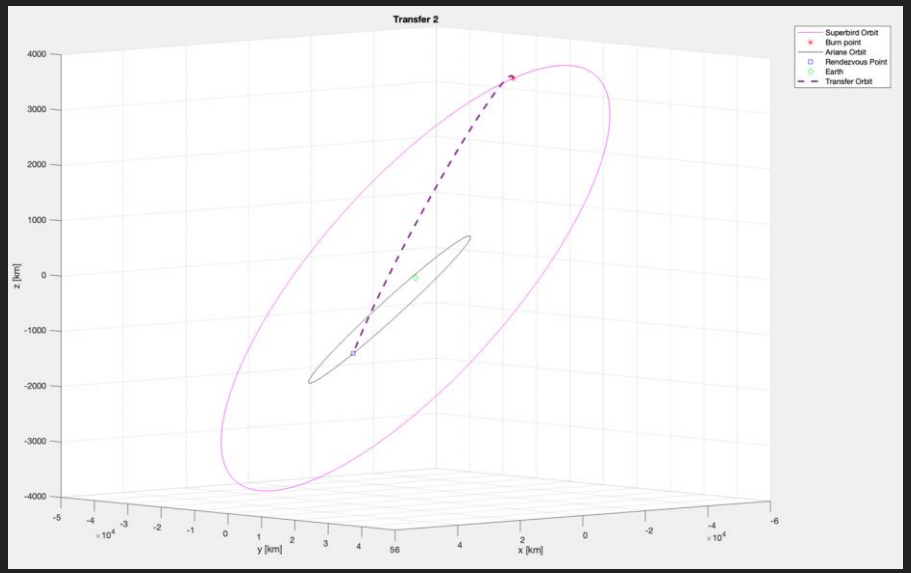


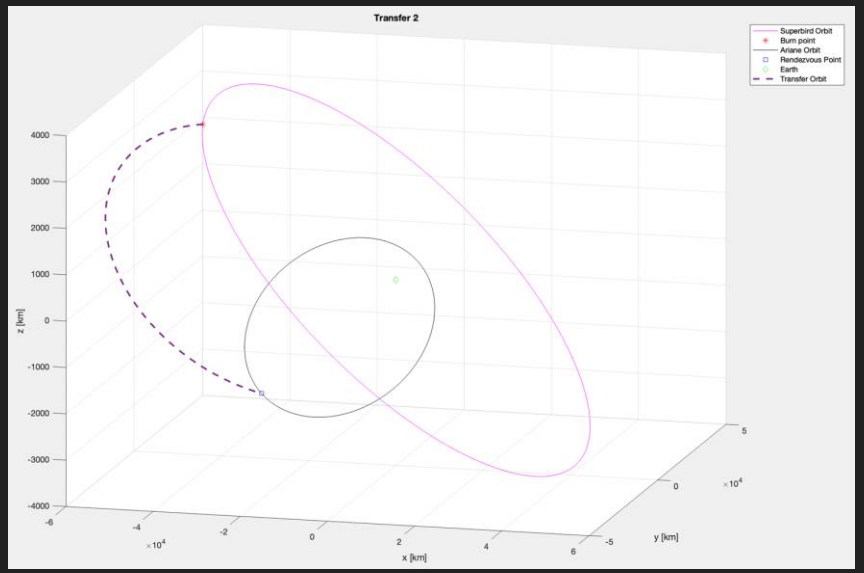
TLE:

```
1 21223U 91026B   22317.41885961  .00000143  00000-0  81964-3 0  9994
2 21223   4.2580  29.6657 7189723  32.6945 356.0749  2.31135527242351
```

The Ariane H10 is a MEO satellite with a highly elliptical orbit, quite different from the current orbit of the spacecraft propagating with Object 2. A Lambert transfer was deemed best to accomplish the required drastic change in orbits.

Transfer 2: **Lambert Transfer Orbit**



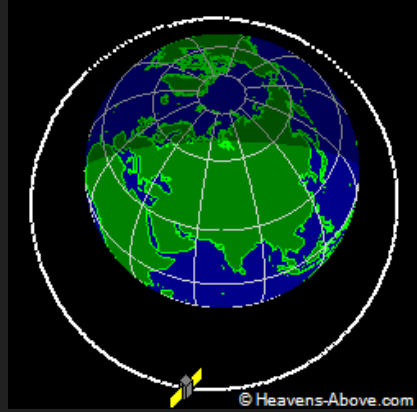


Mission Time at Departure: 11.7891 days

Mission Time at Arrival: 12.3446 days

$\Delta V = 1.2048$ [km/s]

Object 4: **Vanguard 1**

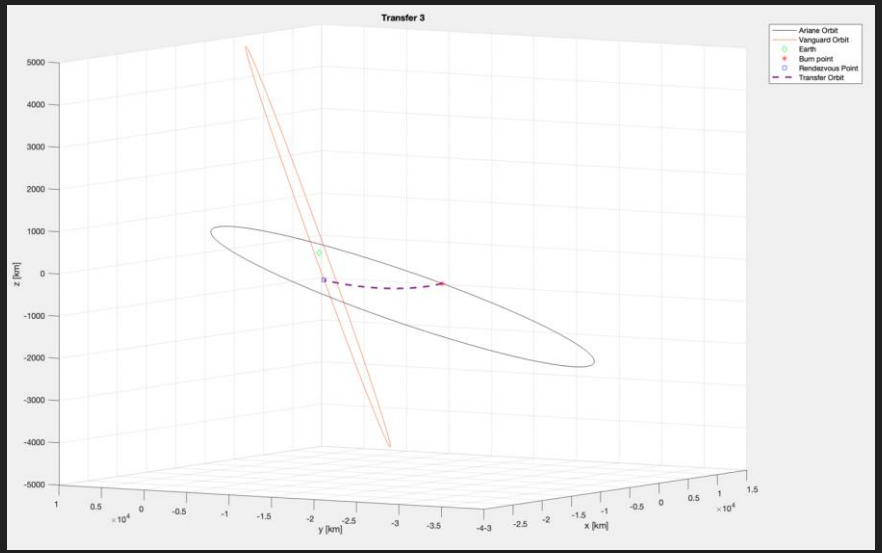


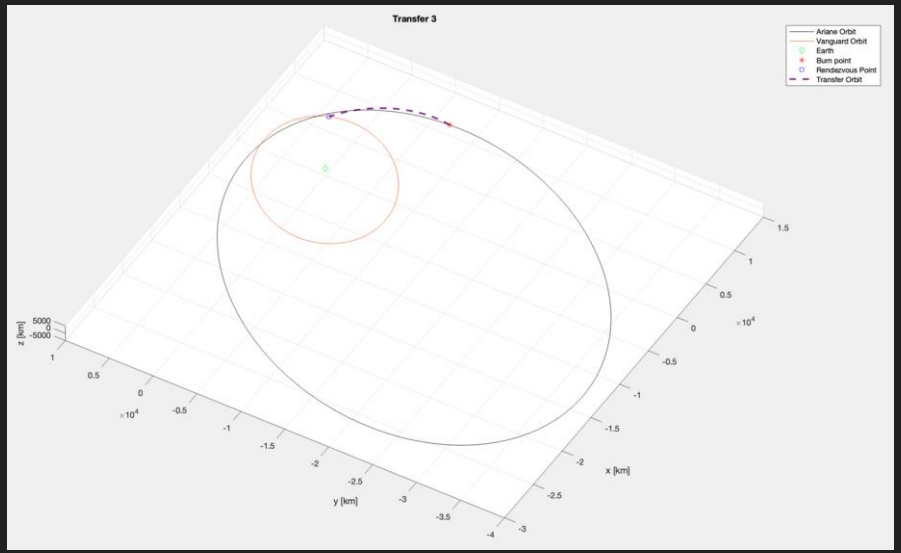
TLE:

```
1 00005U 58002B   22317.43201831  .00000189  00000-0  24375-3 0  9999
2 00005  34.2528  40.2866 1846262 348.1324   8.0865 10.85033307300720
```

The final target is the Vanguard 1, a satellite located in LEO with a slightly elliptical orbit. The mission will be deemed accomplished once its orbit is reached and the spacecraft has realized the desired 5 orbits of propagation.

Transfer 3: **Lambert Transfer Orbit**





Mission Time at Departure: 14.7033 days

Mission Time at Arrival: 14.7252 days

$\Delta V = 1.7708$ [km/s]

Mission Wrap-Up and Statistics:

ΔV Per Transfer:

- Object 1 → Object 2
  - ΔV = 3.9887 [km/s]
- Object 2 → Object 3
  - ΔV = 1.2048 [km/s]
- Object 3 → Object 4
  - ΔV = 1.7708 [km/s]

Total ΔV = 6.9643 [km/s]

Total Mission Time = 15.164 days

= 15d 3h 56m 10s