Orbits and Mission Design
How well do you understand Hohmann Transfers?

• 1 to 2?
• 2 to 3?
• 3 to 1?
• 1 to 3?
At end of Class:
Getting to the Moon:

- Gravity Assist

\[ \Delta v_1 \quad \Delta v_2 \]
Earth to L1:

Lagrangian Points are orbits about an equilibrium point

There are 5 Lagrangian Points
Earth to L1:

- Solar wind collection in halo orbit about L1 (2 yrs.)
- Return leg (5 mos.)
- Outward leg (3 mos.)
- Lunar orbit
- Parking orbit (optional)
- Positioning for daylight reentry
Earth to Mars:

Initial Orbit

Earth Orbit

Transfer Orbit

Mars Orbit

Final Orbit

$\Delta v_1$

$\Delta v_2$
Earth to Beyond:

Say you are in a 250 km orbit...

Orbital Velocity:

\[ v_i = 7.75 \frac{km}{sec} \]

\[ v_i = 17,336 \text{ mph} \]
Earth to Beyond:

Velocity on parabolic (a=∞) escape trajectory:

\[ v = \sqrt{\frac{2\mu}{r}} \]

\[ v_{esc} = \sqrt{\frac{2 \times 398600.4}{250 + 6378.14}} \]

\[ v_{esc} = 10.97 \frac{km}{sec} \]

\[ v_{esc} = 24,539 \text{ mph} \]

\[ \Delta v_{esc} = 3.22 \frac{km}{sec} \]
Earth to Beyond:

$\Delta V$ needed is…

\[
\begin{align*}
    v_{esc} & = v_{esc} - v_i \\
    & = 10.97 - 7.75 \\
    & = 3.22 \text{ km/s} \\
    & = 7,202 \text{ mph}
\end{align*}
\]
At end of Class:
Today:

- Announcements
- Few One Minute Report Answers
- Lecture on Orbits
Announcements:

- Course Assistants do the grading of DD Rev A/B
- Liz will be rechecking scores
- Next round of grades next week
- Please don’t let your ordered hardware sit
One Minute Reports:
Next Tuesday...

Guest Speaker - ADCS

Colorado Space Grant Consortium
Next Thursday...

In-Class Mission Simulation + Spider

Then Break

Then launch week

Colorado Space Grant Consortium
Questions?