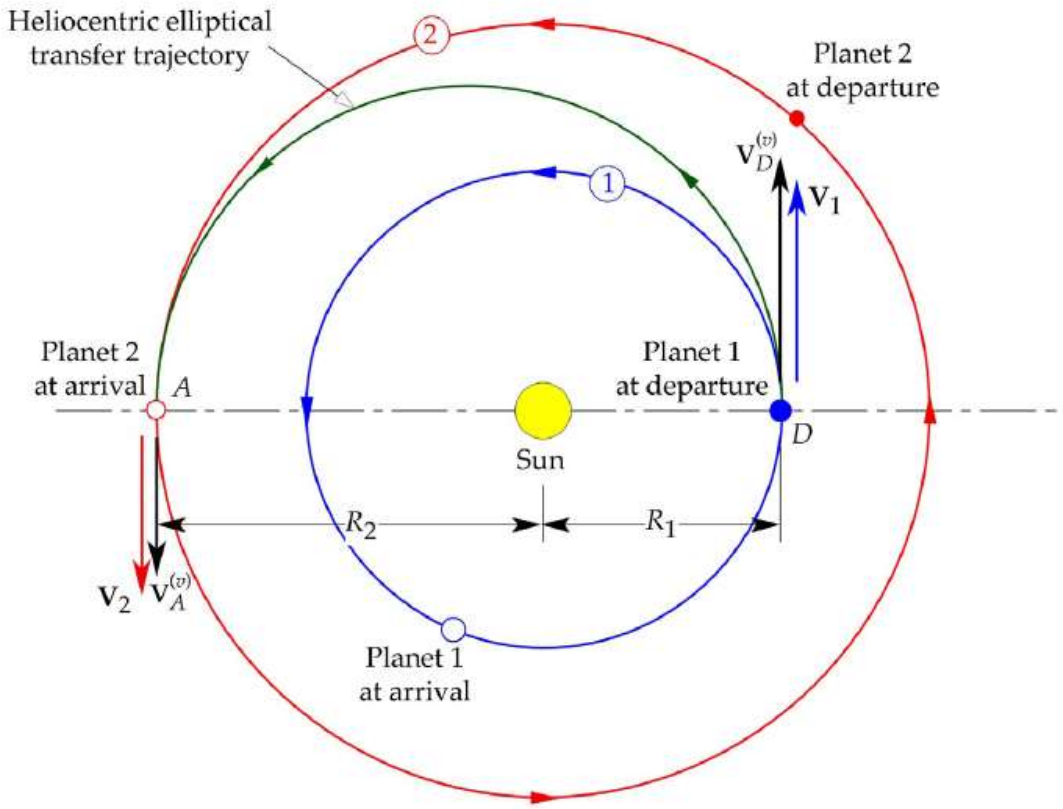
Interplanetary Trajectories



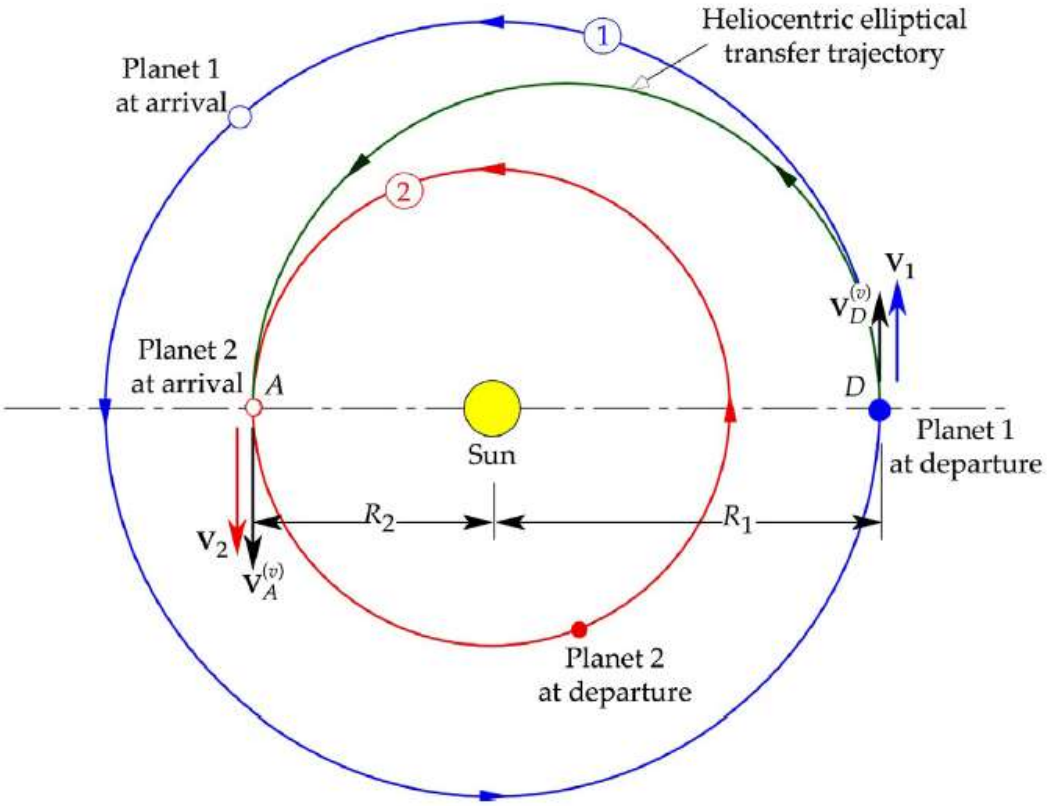
- $V_1 = \sqrt{\frac{\mu_{sun}}{R_1}}$

- $V_D^{(v)} = \frac{\|h\|}{R_1} = \sqrt{2\mu_{sun}} \sqrt{\frac{R_2}{R_1(R_1+R_2)}}$

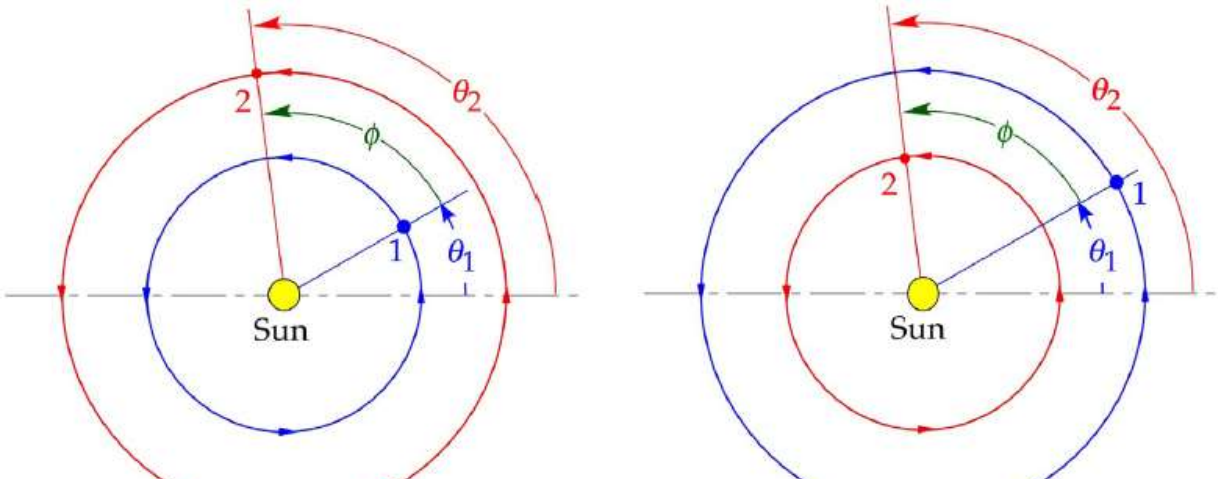
- $V_D^{(v)} > V_1$

- $\Delta V_D = V_D^{(v)} - V_1 = \sqrt{\frac{\mu_{sun}}{R_1}} \left(\sqrt{\frac{2R_2}{R_1+R_2}} - 1 \right)$

$$- \Delta V_A = V_2 - V_A^{(v)} = \sqrt{\frac{\mu_{sun}}{R_2}} \left(1 - \sqrt{\frac{2R_1}{R_1+R_2}} \right)$$



Rendezvous Opportunities



(a) (b)

- $\theta_1 = \theta_1)_0 + n_1 t$
  $\theta_2 = \theta_2)_0 + n_2 t$

- $\phi = \phi_0 + (n_2 - n_1)t$

- $\phi_0 - 2\pi = \phi_0 + (n_2 - n_1)\underbrace{T_{syn}}$

  T_{syn} ↓ synodic period

- $T_{syn} = \dfrac{2\pi}{n_1 - n_2}$ $(n_1 > n_2)$

  $T_{syn} = \dfrac{2\pi}{n_2 - n_1}$ $(n_1 < n_2)$

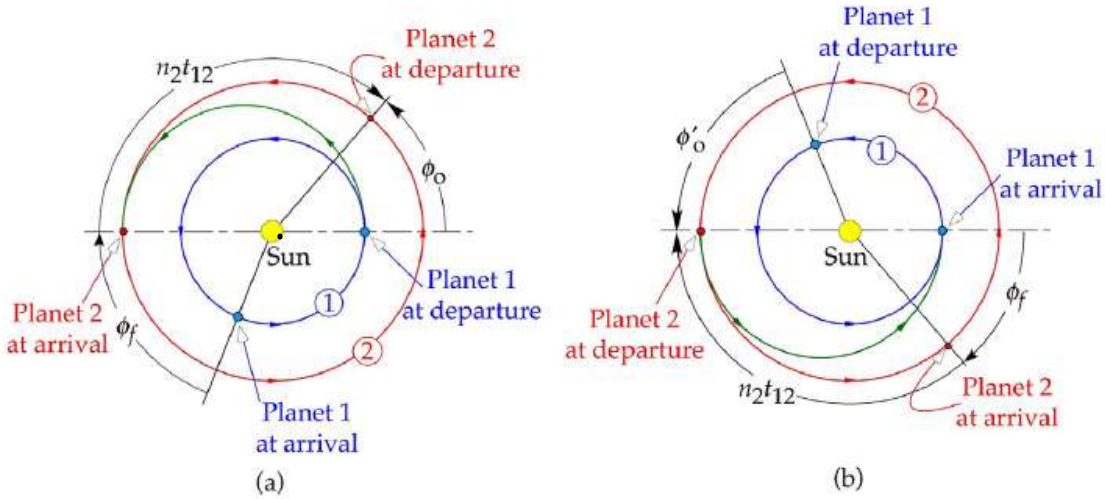
- $T_{syn} = \dfrac{2\pi}{|n_1 - n_2|}$

- $T_{syn} = \dfrac{T_1 T_2}{|T_1 - T_2|}$

Example

Calculate the synodic period of Mars relative to that of the earth.

Details



- $t_{12} = \dfrac{\pi}{\sqrt{\mu_{sun}}} \left(\dfrac{R_1 + R_2}{2} \right)^{3/2}$

- $\phi_o = \pi - n_2 t_{12}$

- $\phi_f = \phi_o + (n_2 - n_1) t_{12} = \pi - n_1 t_{12}$

- $\phi_o' = -\phi_f$

- $-\phi_f = \phi_f + (n_2 - n_1)t$

- $\underbrace{t_{wait}}_{\text{wait time}} = \dfrac{-2\phi_f}{n_2 - n_1}$

- $t_{wait} = \dfrac{-2\phi_f - 2\pi N}{n_2 - n_1}$ $(n_1 > n_2)$

$t_{wait} = \dfrac{-2\phi_f + 2\pi N}{n_2 - n_1}$ $(n_1 < n_2)$

Example

Calculate the minimum wait time for initiating a return trip from Mars to earth.

Details