16.346 Astrodynamics
Fall 2008

According to Lambert's Theorem

$$\boxed{\sqrt{\mu}(t_2 - t_1) = F(a, r_1 + r_2, c)}$$

the orbit of the boundary-value problem can be transformed to a rectilinear orbit $(e = 1)$, keeping the sum of the radii $r_1 + r_2$, the length of the chord c and the semimajor axis a all fixed in value, and the time-of-flight will be unchanged. The transformation is illustrated in the following figure:

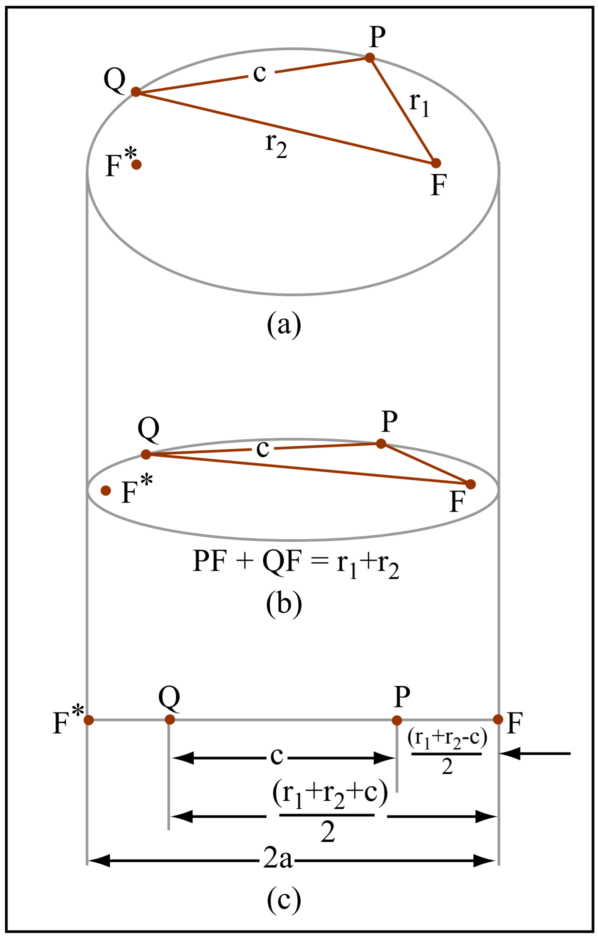

Figure by MIT OpenCourseWare.

The flight time for the rectilinear orbit is

$$\boxed{\begin{aligned}\sqrt{\frac{\mu}{a^3}}(t_2 - t_1) &= (\alpha - \sin\alpha) - (\beta - \sin\beta) \\ &= (E_2 - \sin E_2) - (E_1 - \sin E_1)\end{aligned}}$$

in terms of the Lagrange parameters and the eccentric anomalies.

Transformation of the Four Basic Ellipses

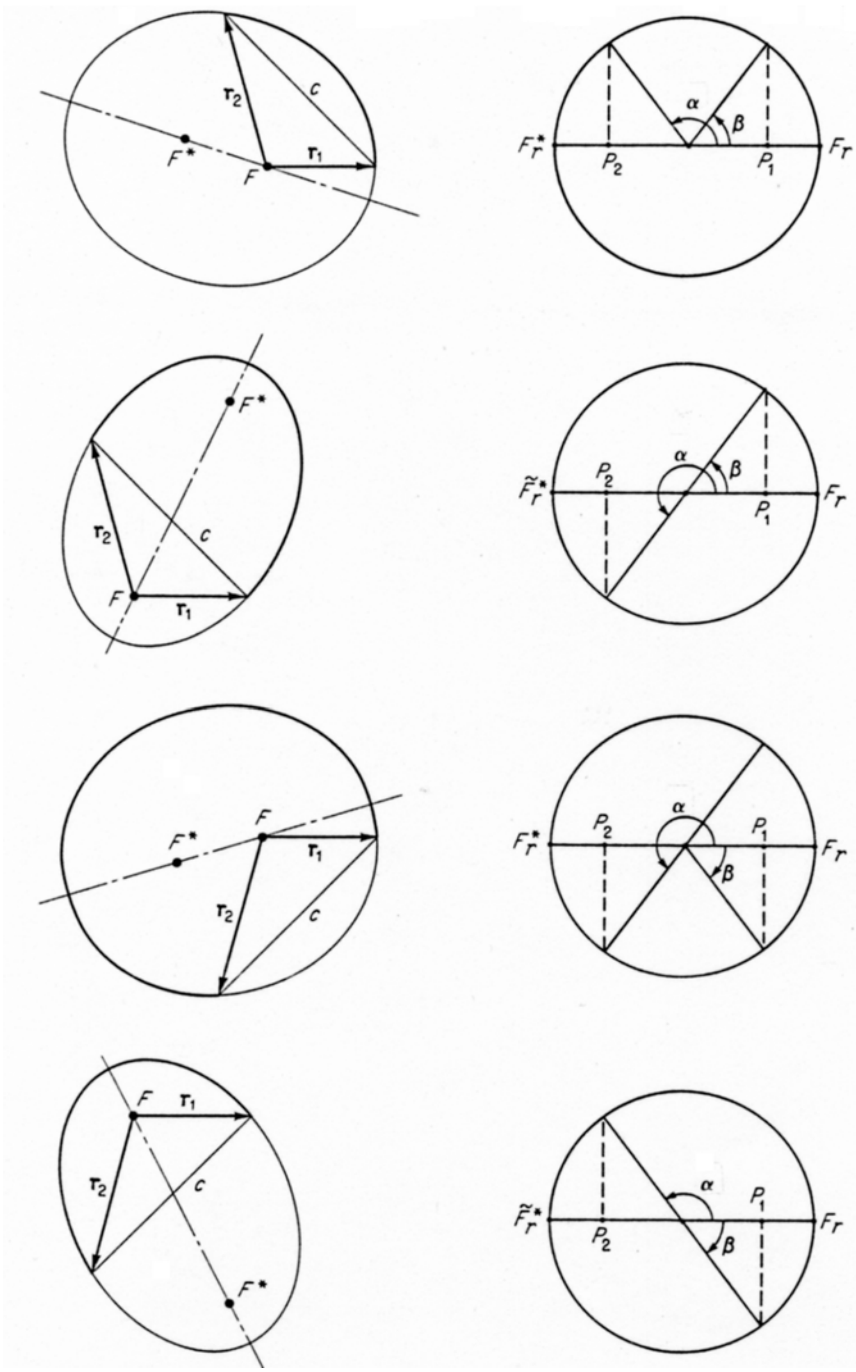

Fig. 6.20 from *An Introduction to the Mathematics and Methods of Astrodynamics.* Courtesy of AIAA. Used with permission.

We adopt the convention for assigning quadrants to the Lagrange parameters α and β

$0 \le \alpha \le 2\pi$	$0 \le \beta \le \pi$	for	$\theta \le \pi$
$0 \le \alpha \le 2\pi$	$-\pi \le \beta \le 0$	for	$\theta \ge \pi$

which will include all elliptic orbits.