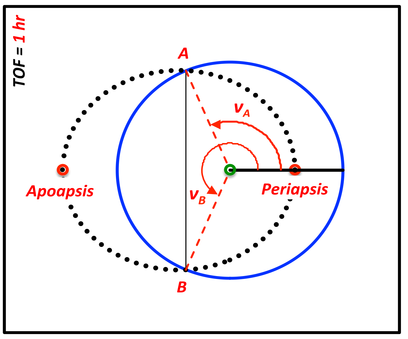
SUBORBITAL ANALYSIS: THE A-to-B PROBLEM IN PLANETARY SCIENCE

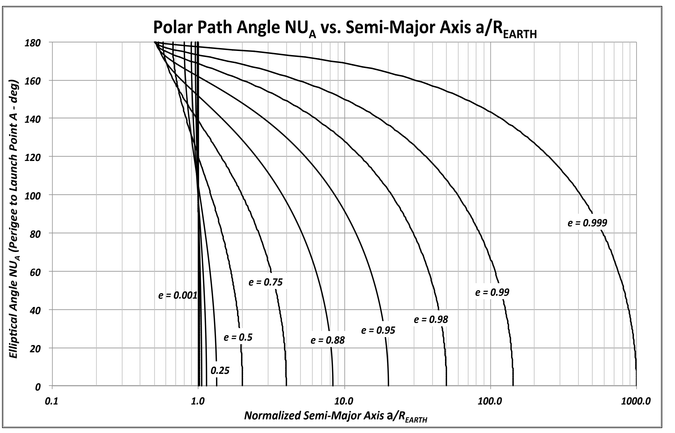
TIME OF FLIGHT (TOF): CORRELATING EJECTA & STREWN TO SOURCE

Derivations Within This SUBORBITAL ANALYSIS Are Based On The Simplified Two-Body Model Where The Satellite Is Assumed To Be Massless. System Mass Is Concentrated At The Center Of The Central Body, Which Is Also The Coordinate Origin Of The Body-Centered Inertial Frame. Higher Order Terms Are Neglected, Such As Planetary Oblateness, Lunar Gravity, Solar Pressure, Electro-Magnetic & Atmospheric Effects.

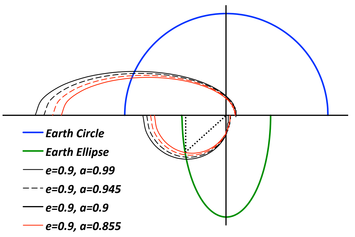
Basic Suborbital Trajectory: A-to-B Chord & Central Angles (Scaled To Earth's Gravity)



Suborbital Time Of Flight (TOF) Depends On Eccentricity "e" AND Semi-Major Axis "a" Instead of Semi-Major Axis Only as in FULL Orbits (Kepler's 3rd Law).

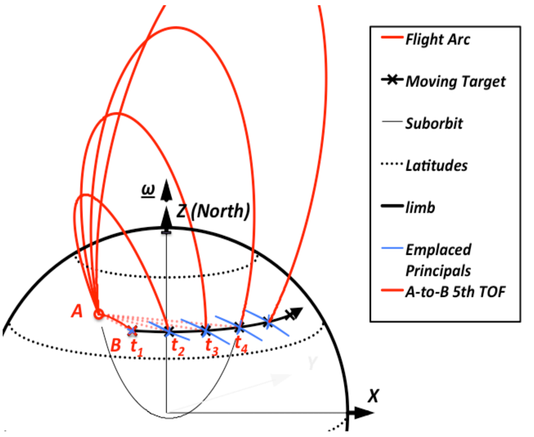


Normal and Oblique Plane Views: The b-Circle For TOF Calculation Per Kepler's 2nd Law: Constant Area Sweep Rate

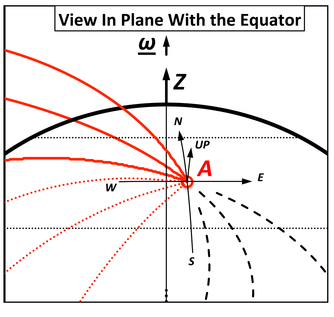


The Oblique Plane View Makes The Orbit Into A Circle Of Radius = "b": b Is The Semi-Minor Axis, So That Calculating Swept Area Is Trivial

Infinite Different A-to-B Trajectories Exist, Each With A Different TOF Value, For A Rotating Planet. This Complicates Analysis.



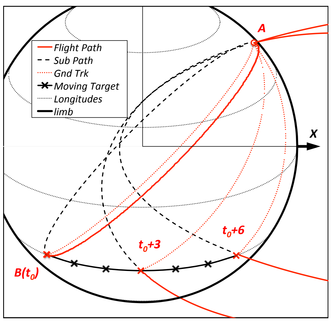
Infinite Trajectories Exist To Get From A-to-B: One Solution For Each Discrete TOF While B Rotates Through Inertial Space.

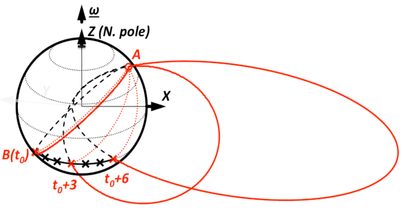


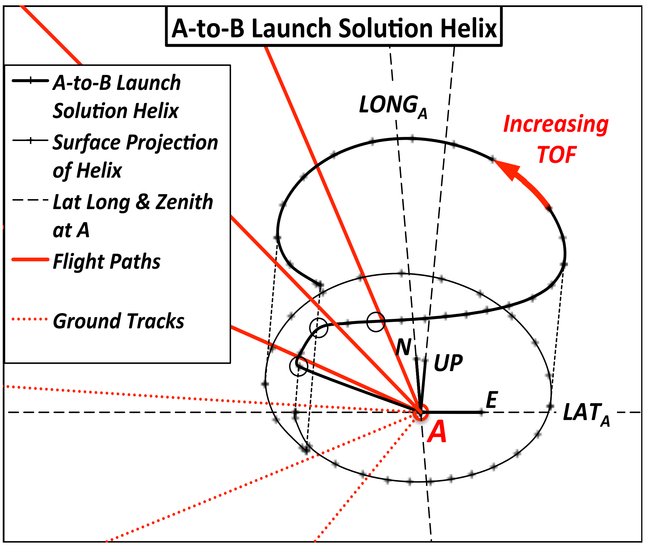
The Set Of All Solution Trajectories For A Given A-To-B Pair May Be Defined By The A-To-B Launch Solution Helix. This Useful Format Always Has Common Features From Bottom Up:

- ***A Base Leg Starting At The Min TOF Solution Trajectory***
- ***A Minimum KE Point Just Above Min TOF Point***
- ***A Transition Or "Knee" where ΔEL Gives Way To ΔAZ***
- ***An AZ Arc Which May Encircle 1, 2 or No Poles***
- ***A "Day Later" Point On Approximately The Min TOF AZ***

The Min TOF Trajectory Is Defined By A Circular Orbit At Zero Altitude, Smooth Spherical Planet, No Atmosphere. The Launch Solution Helix Is Defined In The Local Topocentric (Earth-Fixed) Frame For Comparison To Lab Test Ejection Patterns.







The A-To-B Launch Solution Helix Is Defined By Kinetic Energy Launch Vectors in Azimuth (AZ), Elevation (EL), and Magnitude Normalized To Earth Escape KE Or EEKE.

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