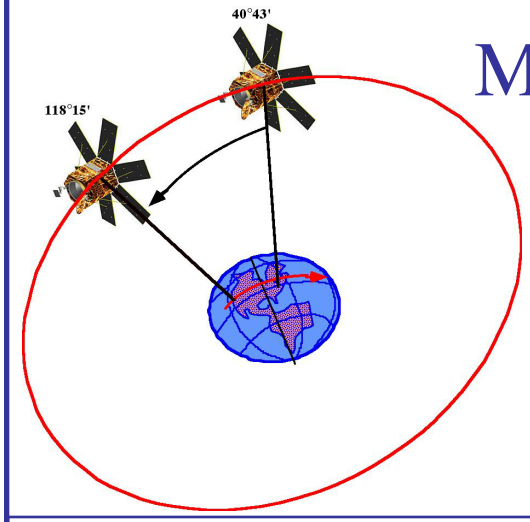
UtahState UNIVERSITY

Mechanical & Aerospace Engineering

Homework *5*

A Novel Application of the Rocket-Equation

Calculating the Fuel Budget for an Orbital Phasing Maneuver of a GeoStationary Satellite



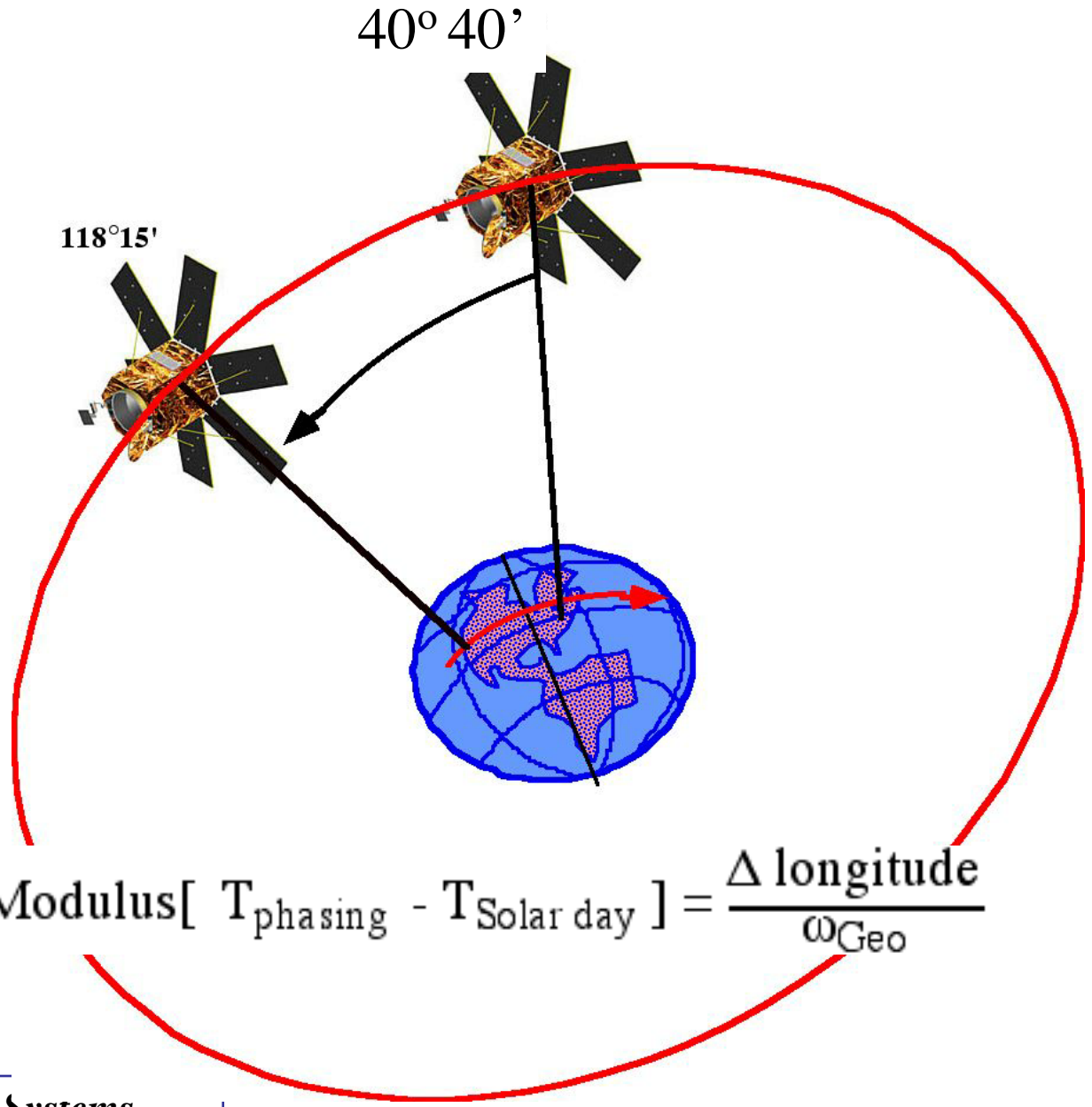
TT&C Satellite

- TT&C satellite used to monitor pacific coast battle has failed

- NACSOC has decided to transfer the functions of a spare Atlantic battle group satellite to the pacific until a replacement can be launched

… design an Orbital phasing Maneuver that Allows Transfer of a GEO Synchronous Communication Satellite from 40.40’ west Longitude To 118.15’ west longitude

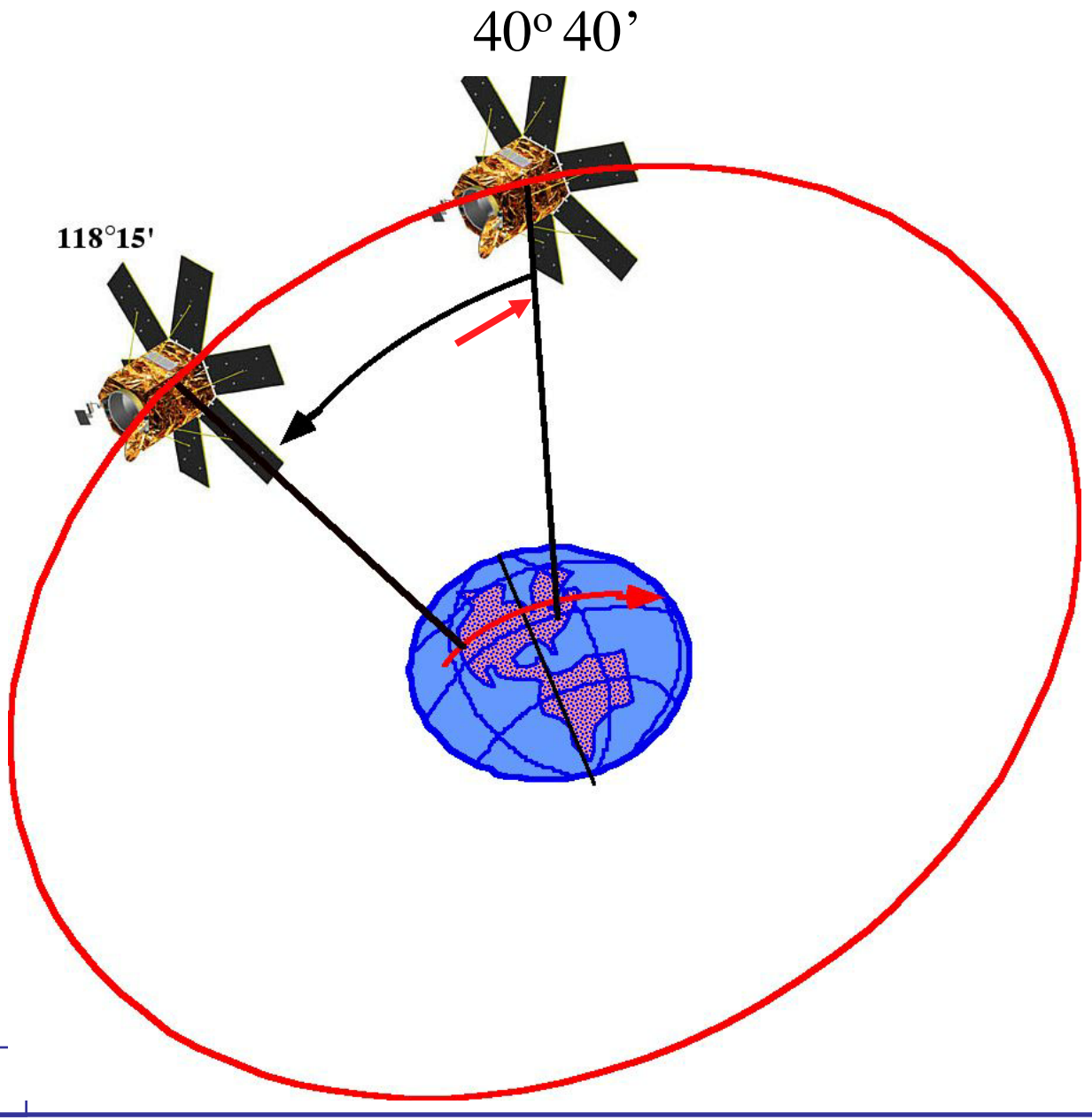
Phasing Maneuver



$$\text{Modulus}[\ T_{phasing} - T_{Solar\ day}\ ] = \frac{\Delta\ \text{longitude}}{\omega_{Geo}}$$

Phasing Maneuver (part 2)

- Design a Reverse Orbital Maneuver that Puts the Satellite Back to the Original Longitude after Mission has been accomplished



What To Compute

- Compute
  - … Phasing Orbit Parameters
  - … Phasing Orbit Period
  - … Required Delta V_1, Delta V_2

- Assume $R_{min} > 32{,}000$ km
(to stay above Van Allen belts)

- Note: It may take Multiple orbits of Phasing Orbit to accomplish this task

What To Compute (cont'd)

- Compute
  - … Burn time for Transfer Orbit Insertion
  - … Burn Time for Final Orbit Insertion
  - … Required Fuel Budget for Delta V_1, Delta V_2

Parameters of the Problem

Solar Day: 23 hrs, 56 min, 4.1 seconds

Gravitational Parameter: $\mu = 3.9860044 \times 10^5 \quad \frac{km^3}{sec^2}$

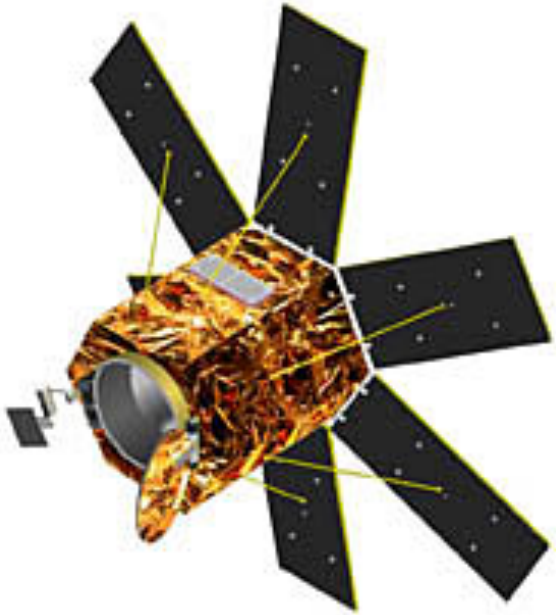
Original Longitude : 40 deg, 40 min West
Destination Longitude: 118 deg, 15 min West

Parameters of the Problem (cont'd)

Specific Impulse

Fuel	Oxidizer	Isp (s)
Liquid propellants		
Hydrogen (LH2)	Oxygen (LOX)	450
Kerosene (RP-4)	Oxygen (LOX)	260
Monomethyl hydrazine	Nitrogen Tetraoxide	310
Solid propellants		
Powered Al	Ammonium Perchlorate	270

Parameters of the Problem (Concluded)



- $F_{thruster} = 0.500$ kNt
- Spacecraft mass

  1000 kg "Dry"