Introduction

- We will take you through successfully launching a rocket and landing it on a different body
- This is a simplified version based on our vast KSP knowledge

Technicallities

Jargon

Orbit	When a one object is rotating around another object
Stable Orbit	An orbit that does not decay untill it is no longer an orbit
Inclination	How much the orbit differs from the parent body's plane.

Technicallities

delta-v

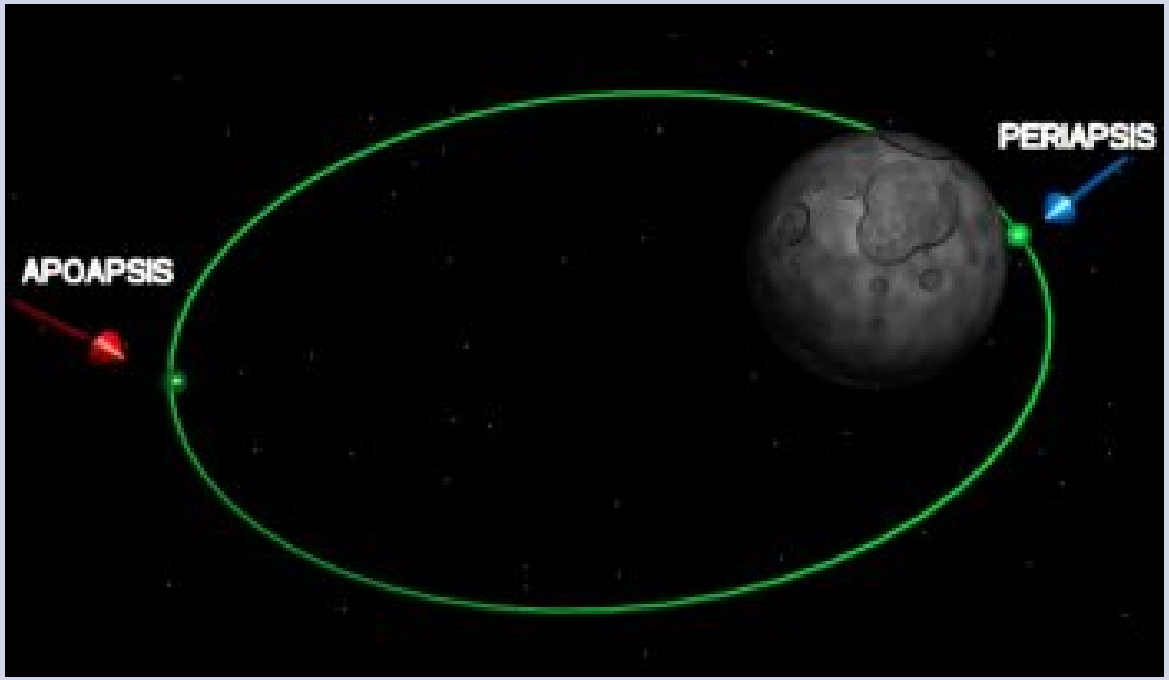
- aka: fuel budget
- how hard can i accelerate/decelerate my rocket
- dependent on:
  - fuel efficiency
  - thurst to weight ratio

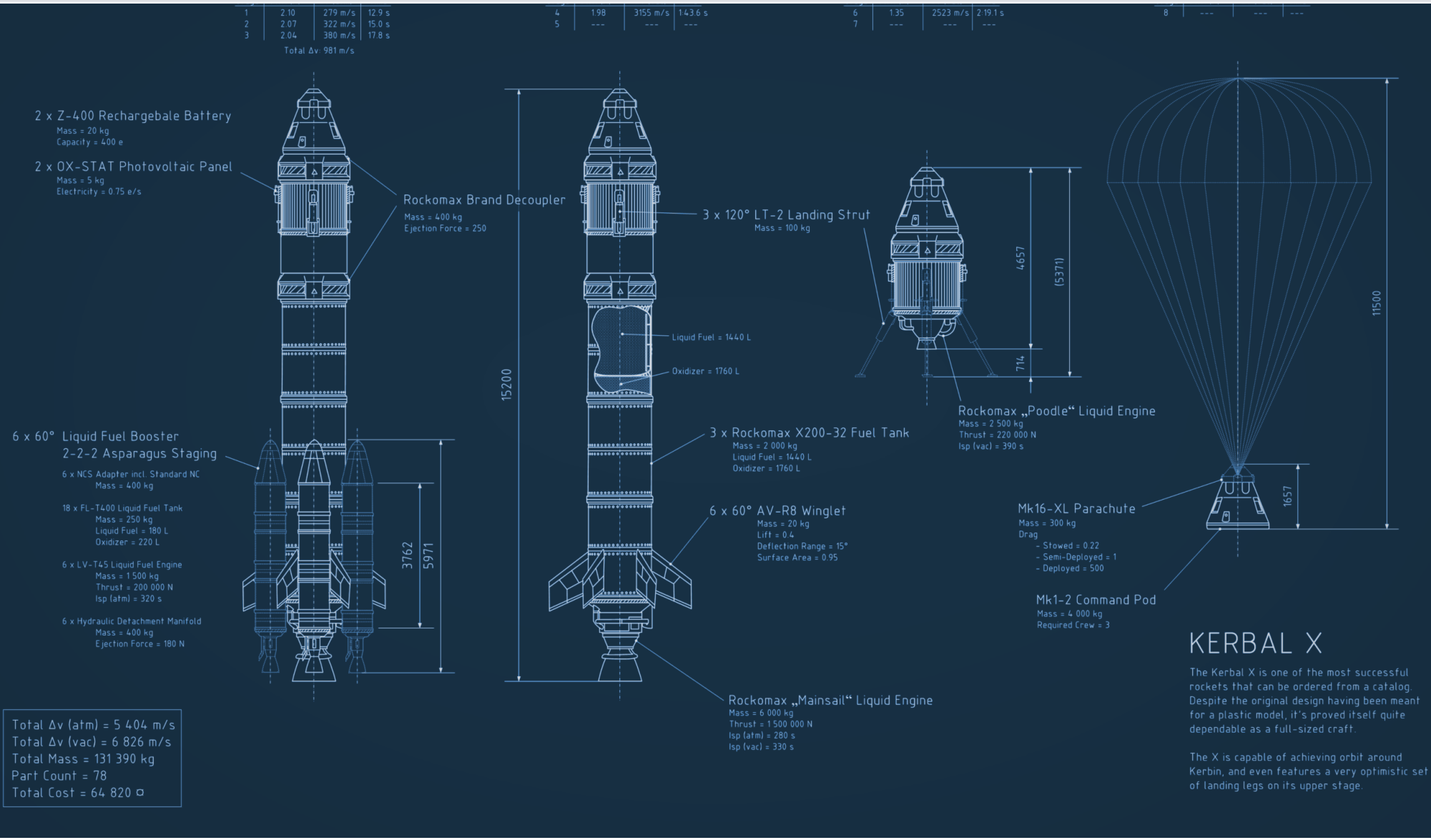
Technicallities

Points on orbit

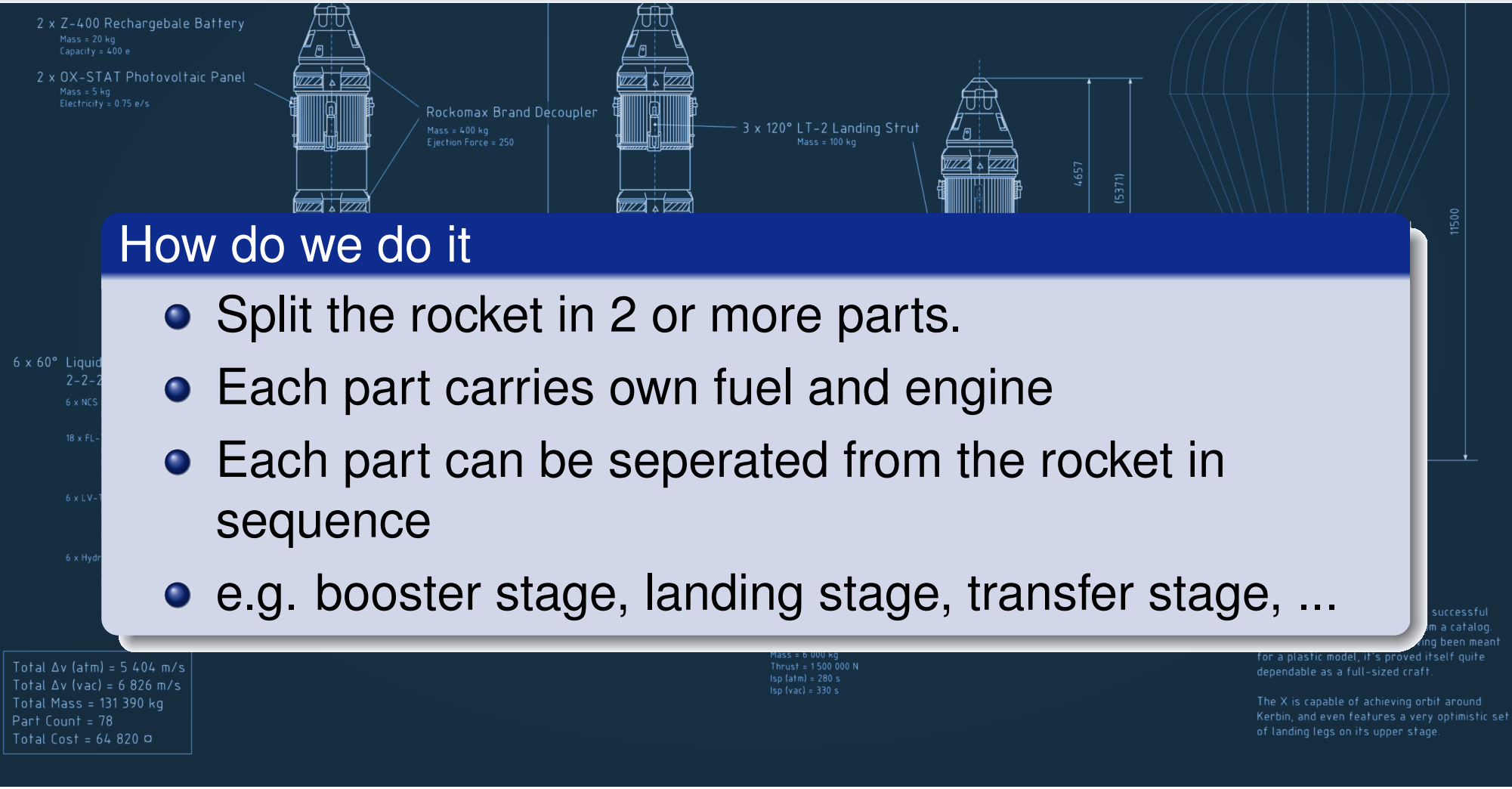
apoapsis : highest point on orbit

periapsis : Lowest point on orbit




1 2.10 279 m/s 12.9 s
2 2.07 322 m/s 15.0 s
3 2.04 380 m/s 17.8 s
Total Δv: 981 m/s
4 1.98 3155 m/s 143.6 s
5 ---
6 1.35 2523 m/s 219.1 s
7 ---
8 ---
2 x Z-400 Rechargebale Battery
Mass = 20 kg
Capacity = 400 e
2 x OX-STAT Photovoltaic Panel
Mass = 5 kg
Electricity = 0.75 e/s
Rockomax Brand Decoupler
Mass = 400 kg
Ejection Force = 250
3 x 120° LT-2 Landing Strut
Mass = 100 kg
Liquid Fuel = 1440 L
Oxidizer = 1760 L
15200
4657
(5371)
714
11500
1657
3762
5971
6 x 60° Liquid Fuel Booster
2-2-2 Asparagus Staging
6 x NCS Adapter incl. Standard NC
Mass = 400 kg
18 x FL-T400 Liquid Fuel Tank
Mass = 250 kg
Liquid Fuel = 180 L
Oxidizer = 220 L
6 x LV-T45 Liquid Fuel Engine
Mass = 1 500 kg
Thrust = 200 000 N
Isp (atm) = 320 s
6 x Hydraulic Detachment Manifold
Mass = 400 kg
Ejection Force = 180 N
3 x Rockomax X200-32 Fuel Tank
Mass = 2 000 kg
Liquid Fuel = 1440 L
Oxidizer = 1760 L
Rockomax „Poodle“ Liquid Engine
Mass = 2 500 kg
Thrust = 220 000 N
Isp (vac) = 390 s
6 x 60° AV-R8 Winglet
Mass = 20 kg
Lift = 0.4
Deflection Range = 15°
Surface Area = 0.95
Mk16-XL Parachute
Mass = 300 kg
Drag
- Stowed = 0.22
- Semi-Deployed = 1
- Deployed = 500
Mk1-2 Command Pod
Mass = 4 000 kg
Required Crew = 3
Rockomax „Mainsail“ Liquid Engine
Mass = 6 000 kg
Thrust = 1 500 000 N
Isp (atm) = 280 s
Isp (vac) = 330 s
Total Δv (atm) = 5 404 m/s
Total Δv (vac) = 6 826 m/s
Total Mass = 131 390 kg
Part Count = 78
Total Cost = 64 820 ¤
KERBAL X
The Kerbal X is one of the most successful rockets that can be ordered from a catalog. Despite the original design having been meant for a plastic model, it's proved itself quite dependable as a full-sized craft.
The X is capable of achieving orbit around Kerbin, and even features a very optimistic set of landing legs on its upper stage.

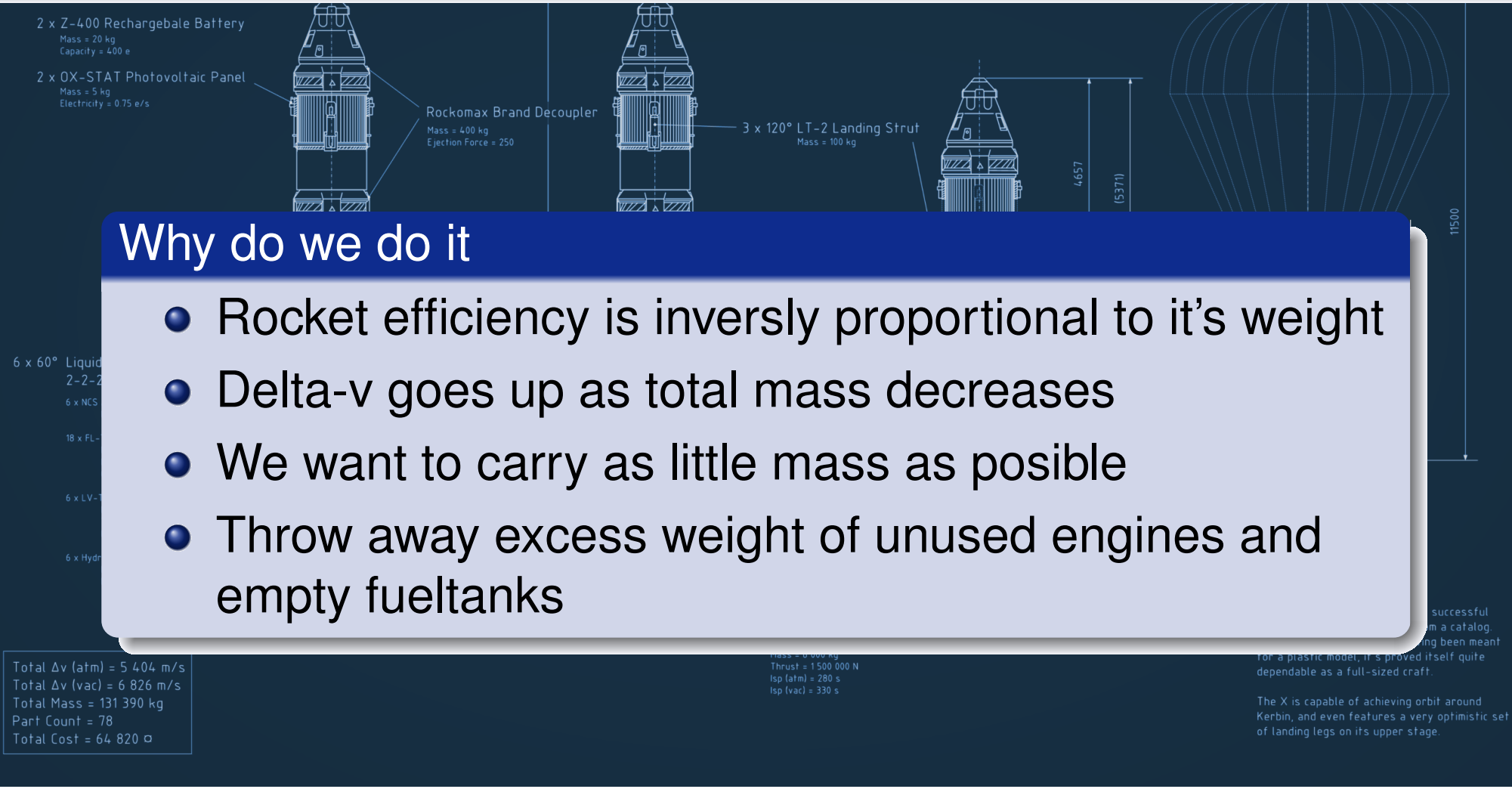
Staging



How do we do it

- Split the rocket in 2 or more parts.
- Each part carries own fuel and engine
- Each part can be seperated from the rocket in sequence
- e.g. booster stage, landing stage, transfer stage, ...

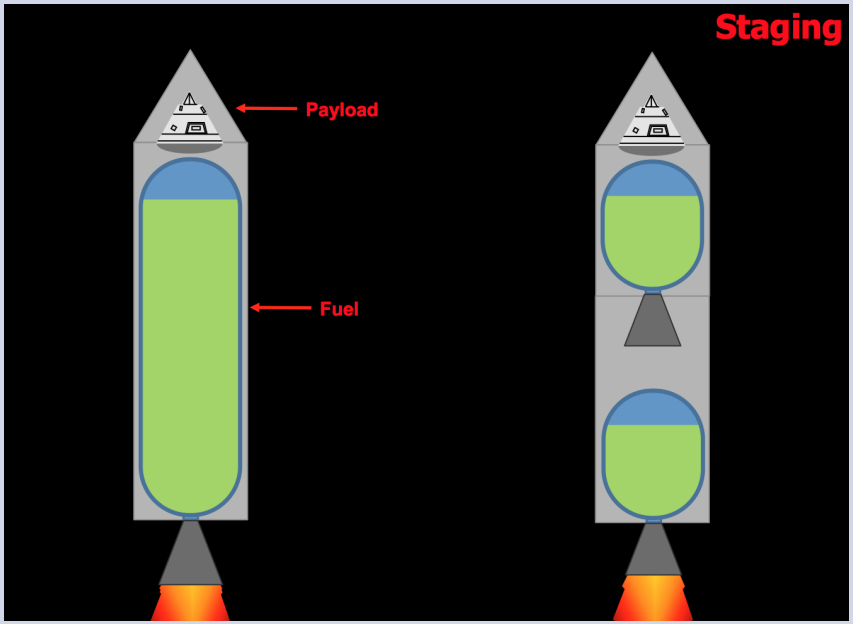
Staging



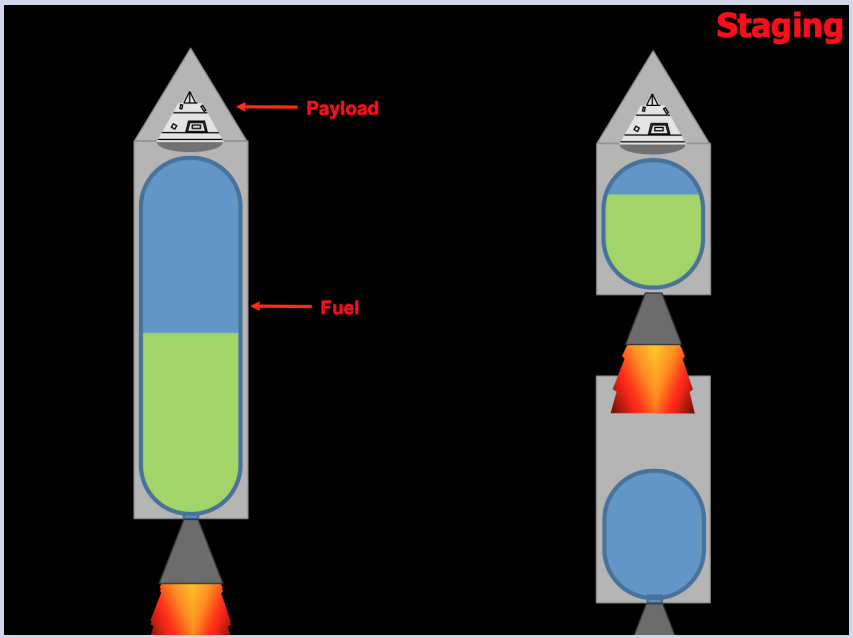
Why do we do it

- Rocket efficiency is inversly proportional to it's weight
- Delta-v goes up as total mass decreases
- We want to carry as little mass as posible
- Throw away excess weight of unused engines and empty fueltanks

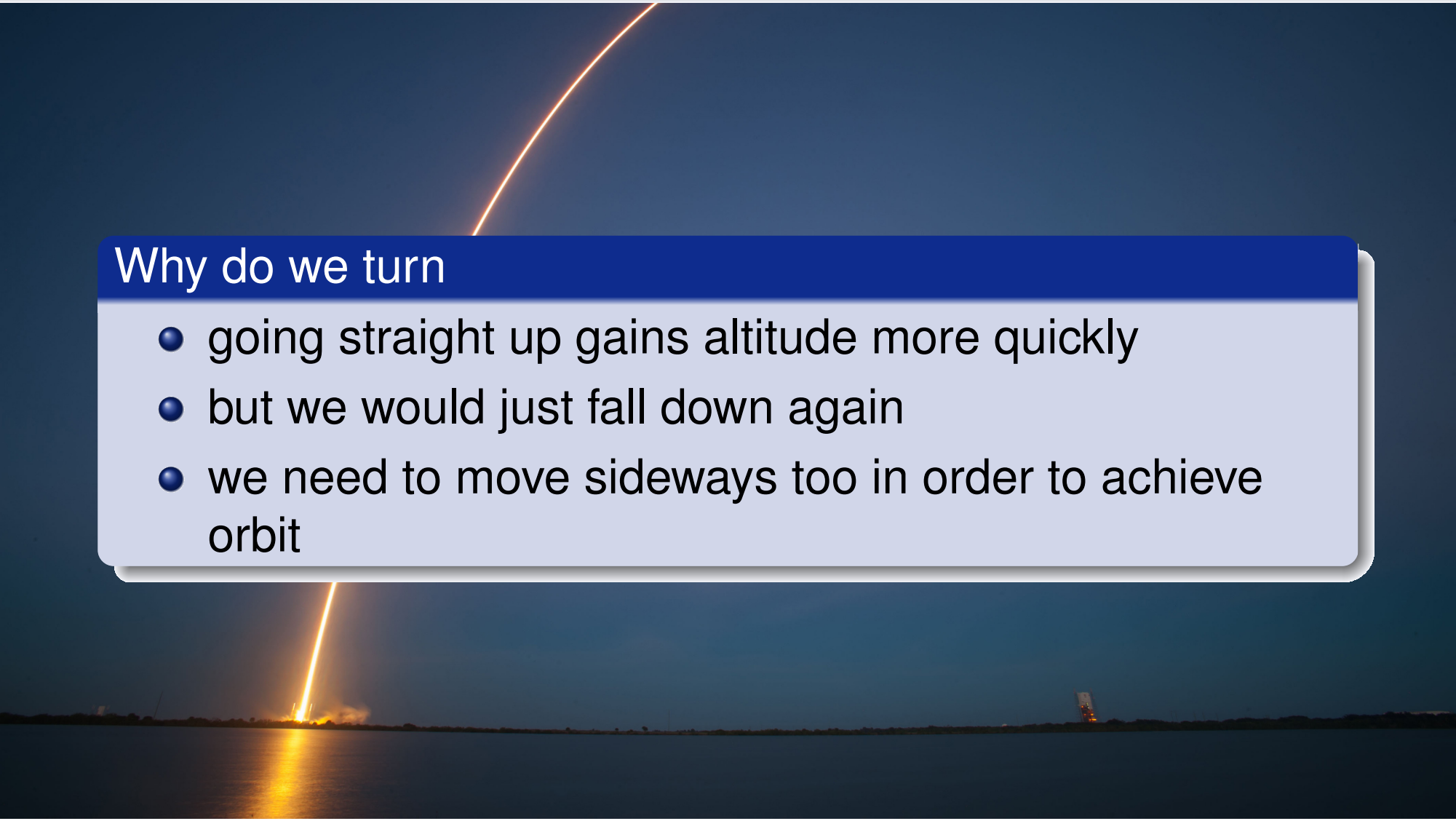
Staging



Staging



Gravity turn



Why do we turn

- going straight up gains altitude more quickly
- but we would just fall down again
- we need to move sideways too in order to achieve orbit

Gravity turn

Why to the east

- Rotation of earth is already moving us towards the east at 1.5km/h
- escape velocity of earth is just over 7km/s
- rotational velocity is higher around the equator that why we want to launch from Cape Canaveral
- 1.5km/h does not seem to be a lot compared to 7km/s but keep in mind that we are heaviest at the start of launch.

Launch

How do we do it

- throttle up
- point at the right angle
- don't. touch. anything. let gravity do it's work
- activate staging at the appropriate times
- keep apoapsis in front of you untill desired hight
- circularize orbit
- It easy, it's not ro... oh...

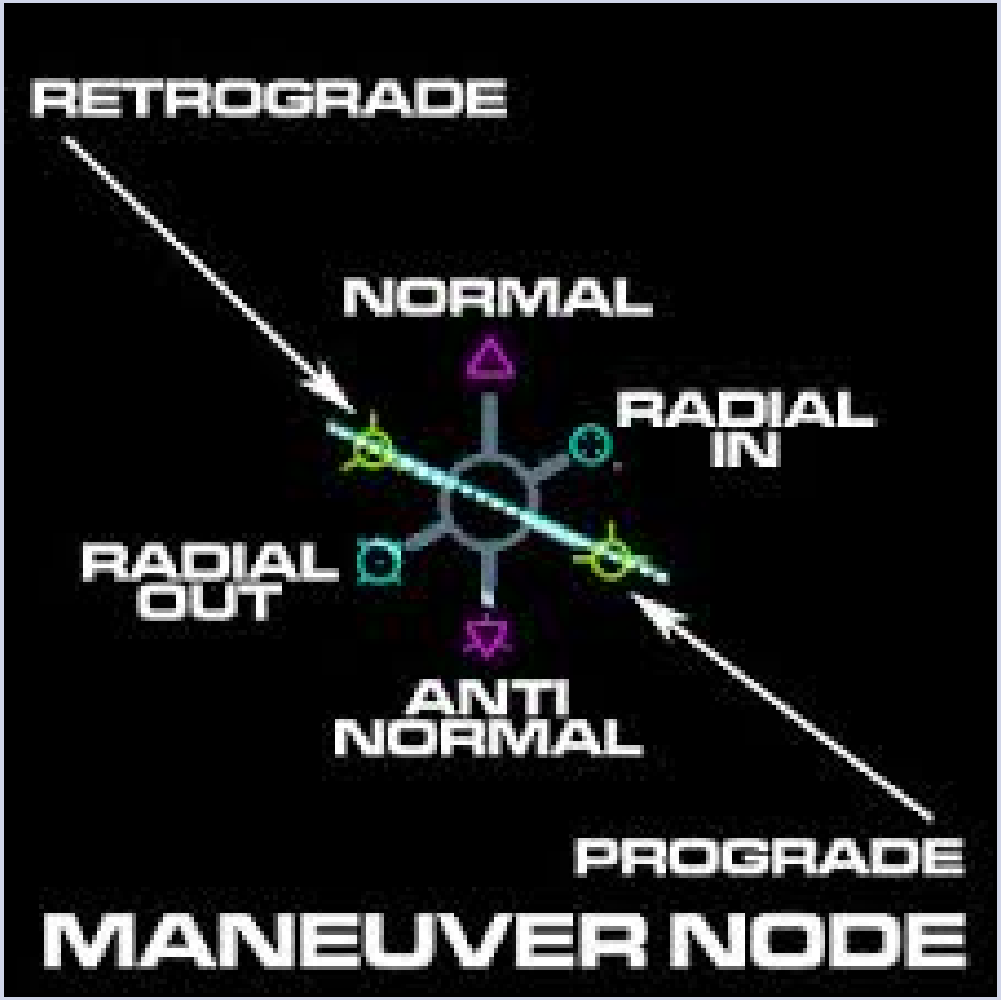
Low earth orbit

We are now almost in low earth orbit but still falling down. We need to circularize our orbit before we fall back. So we need to learn how to manipulate our orbit while in space.

Basis

Movement on an orbit always affect the oposite site of the orbit

Adjusting Orbits

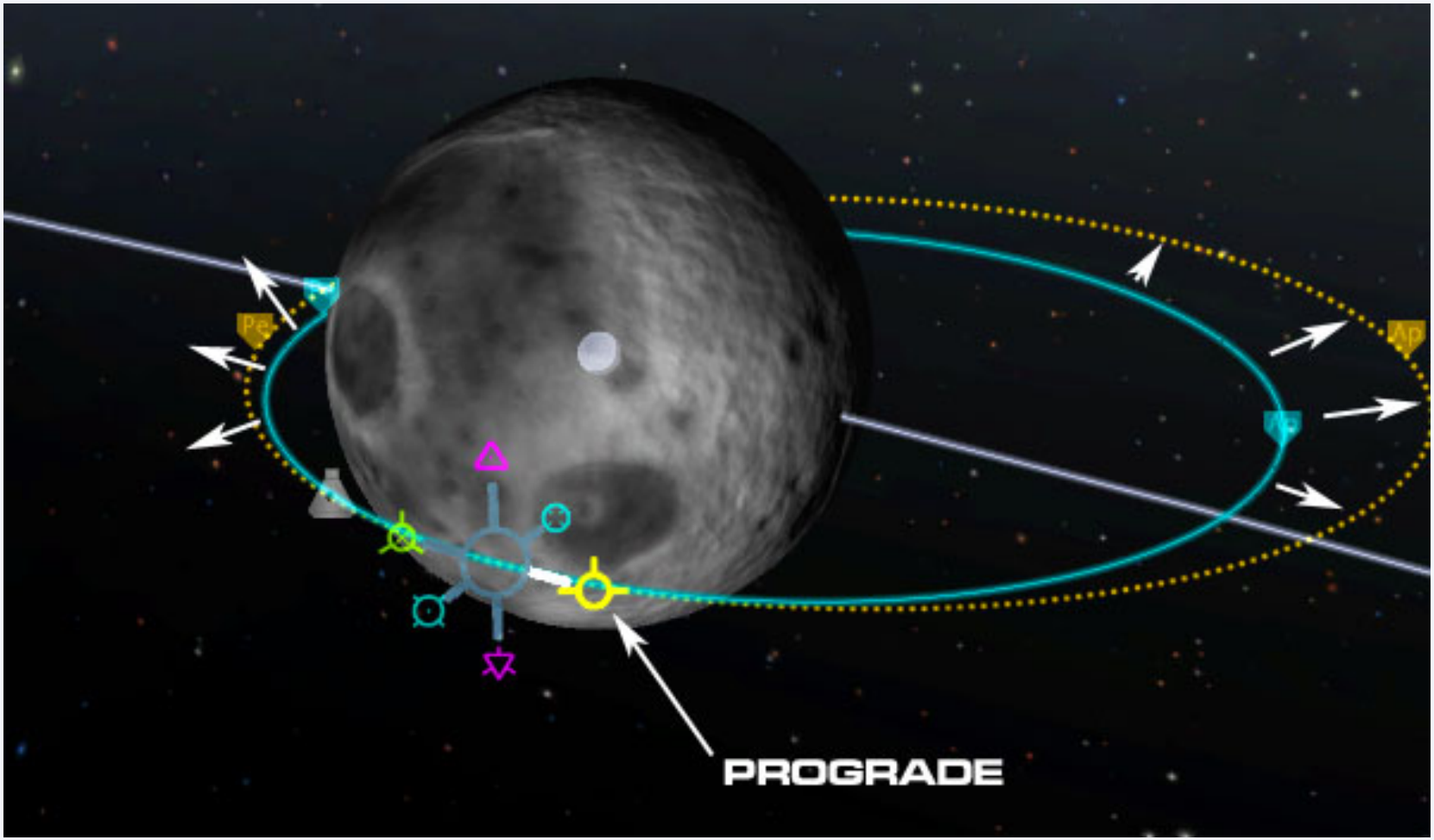


Low Orbit

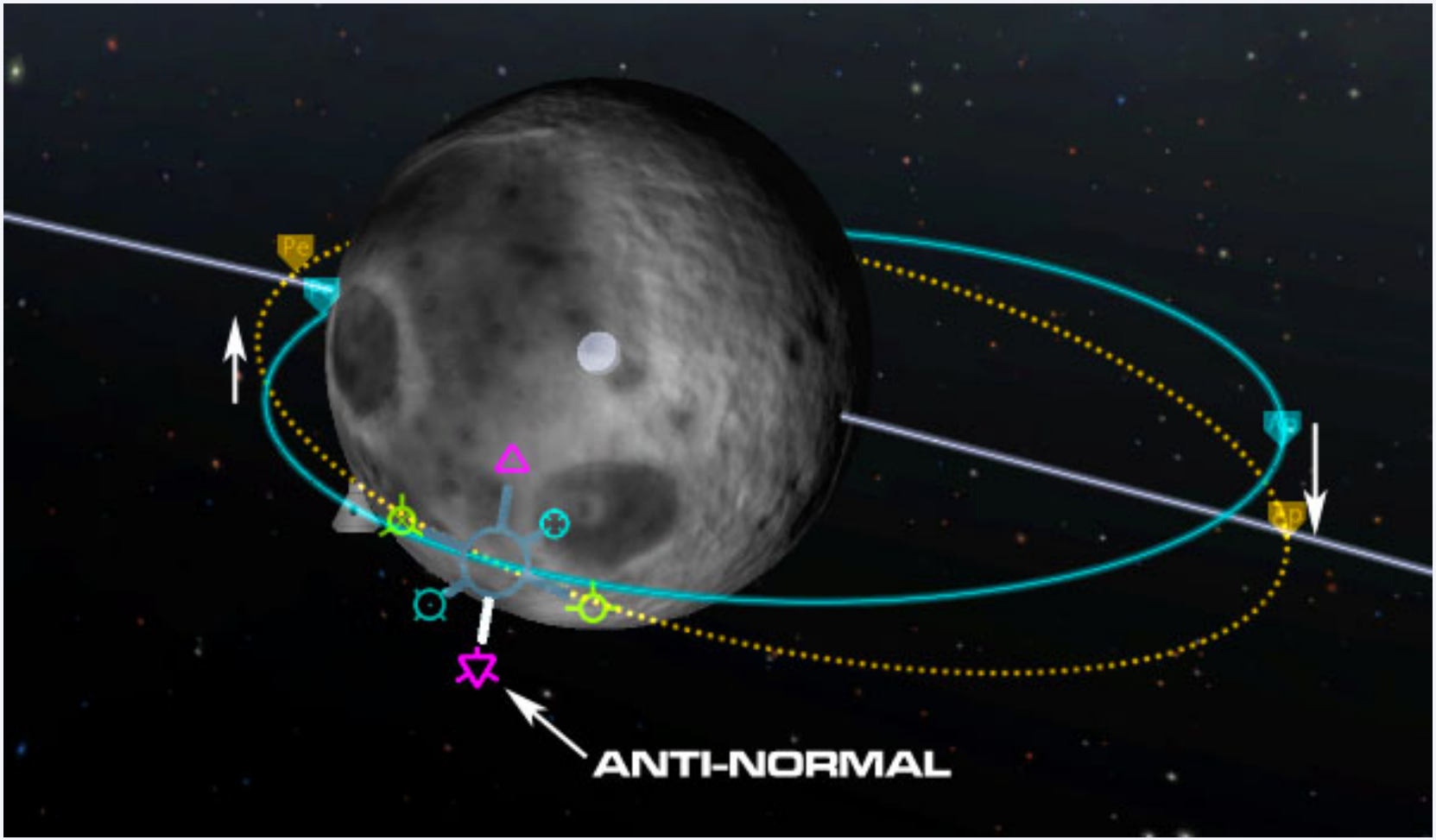
Maveuvering in space

prograde	Along your movement vector, used to increase orbit altitude
retrograde	Oposite your movement vector, used to decrease orbit altitude
normal	Perpendicular to orbit, used to increase/decrease inclination
anti-normal	perpendiculat to orbit, used to increase/decrease inclination
radial	Towards parent body, Used to shift orbit around
anti-radial	Away from parent body, used to shift orbit around

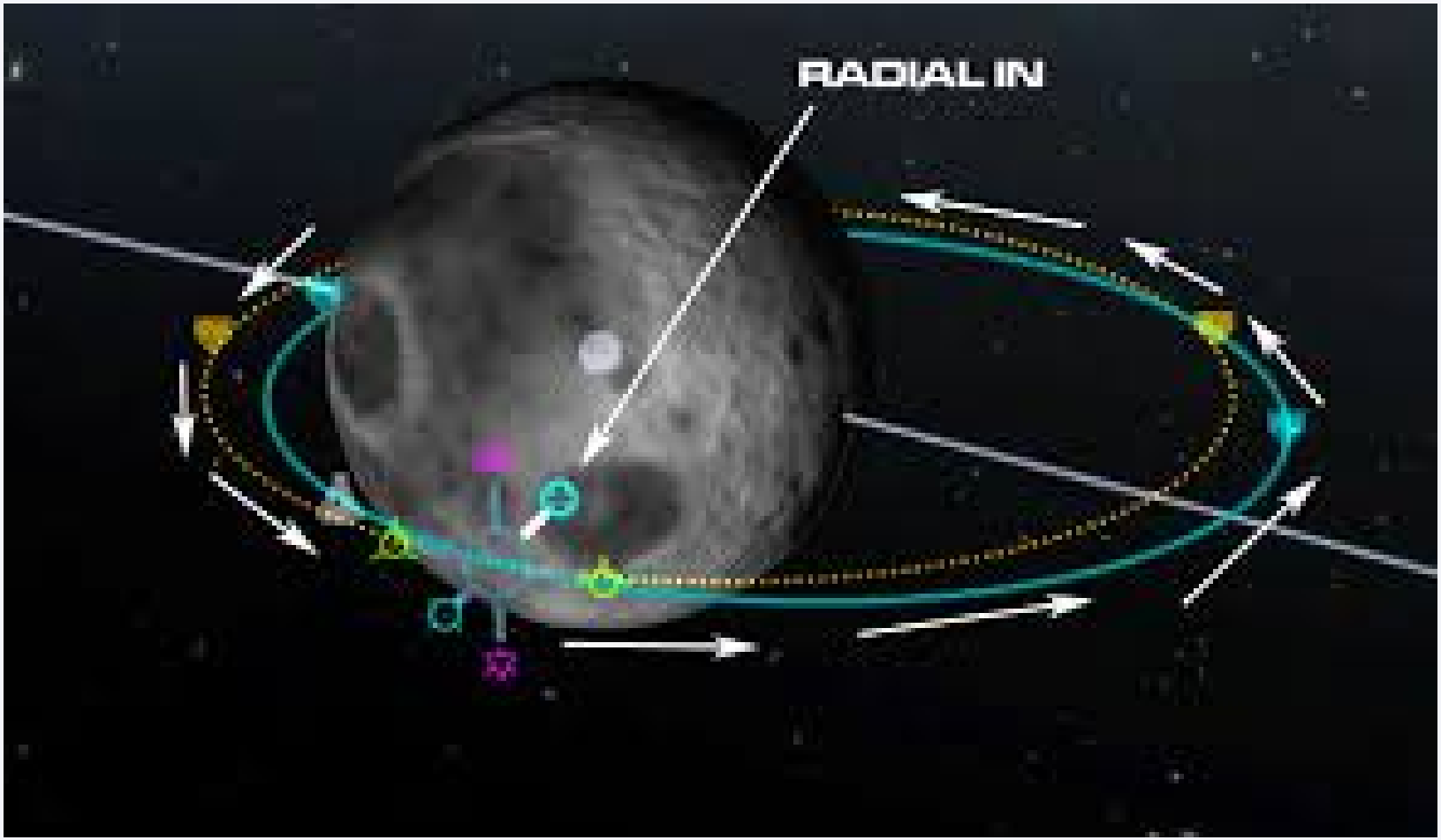
Prograde



Normal



Radial



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