SPACE MISSION

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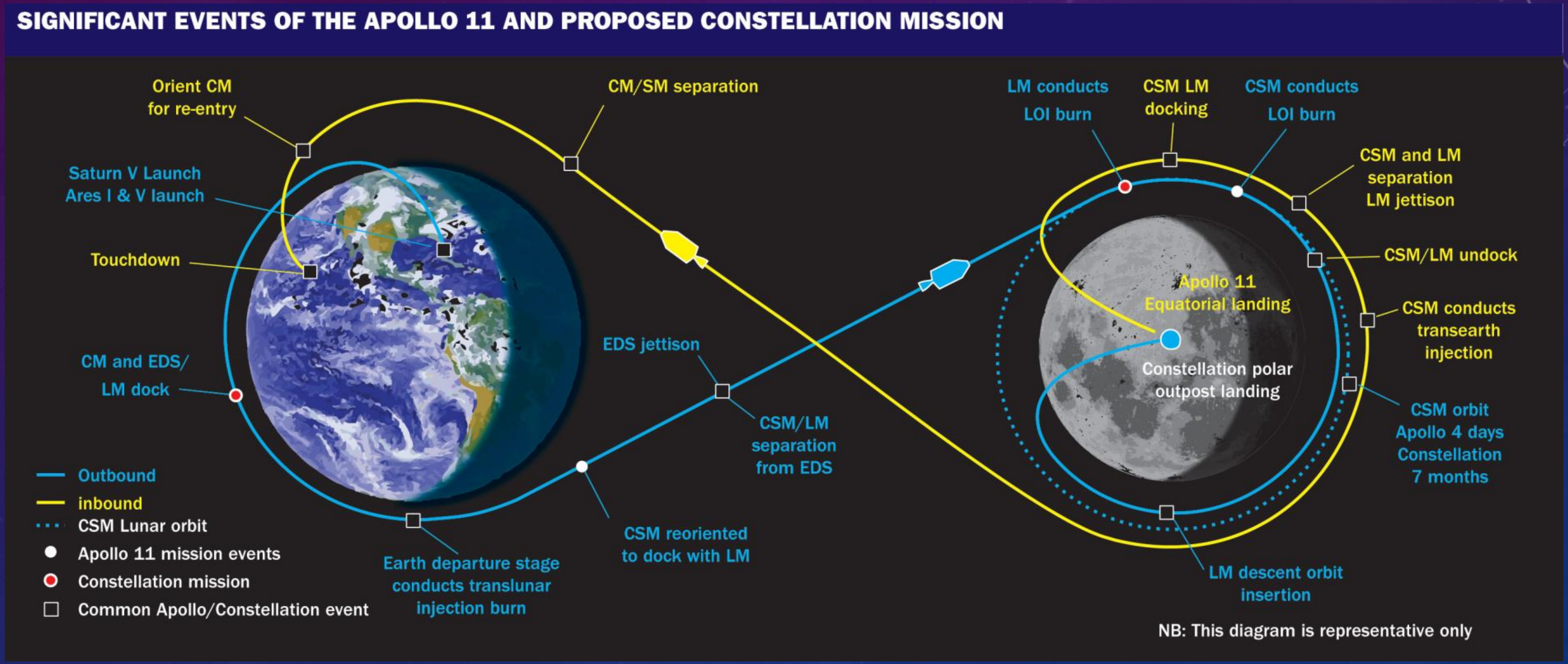
Apollo mission



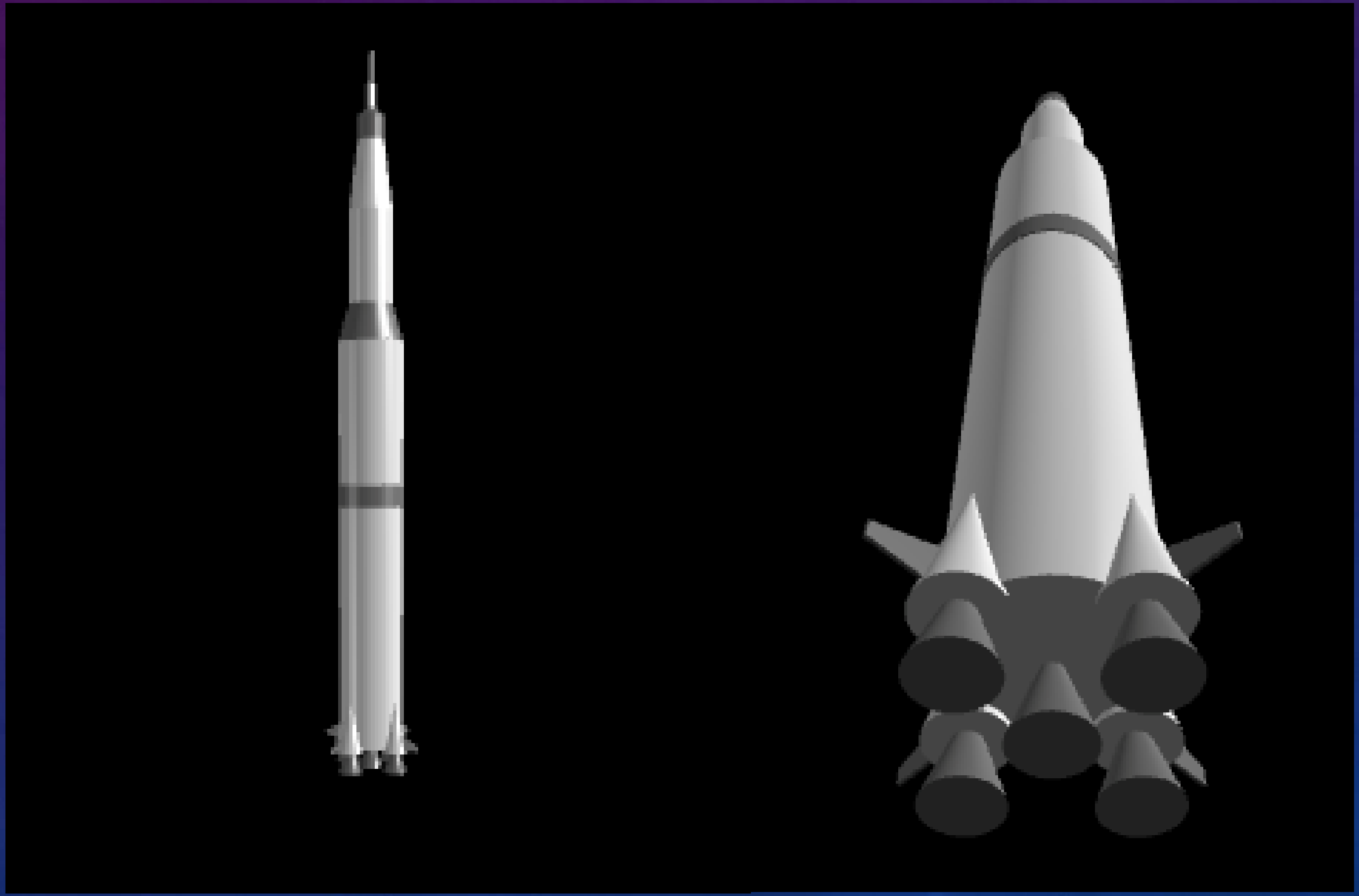
GOALS :

- Launching a multi-stage rocket
- Entering earth orbit
- Entering moon orbit

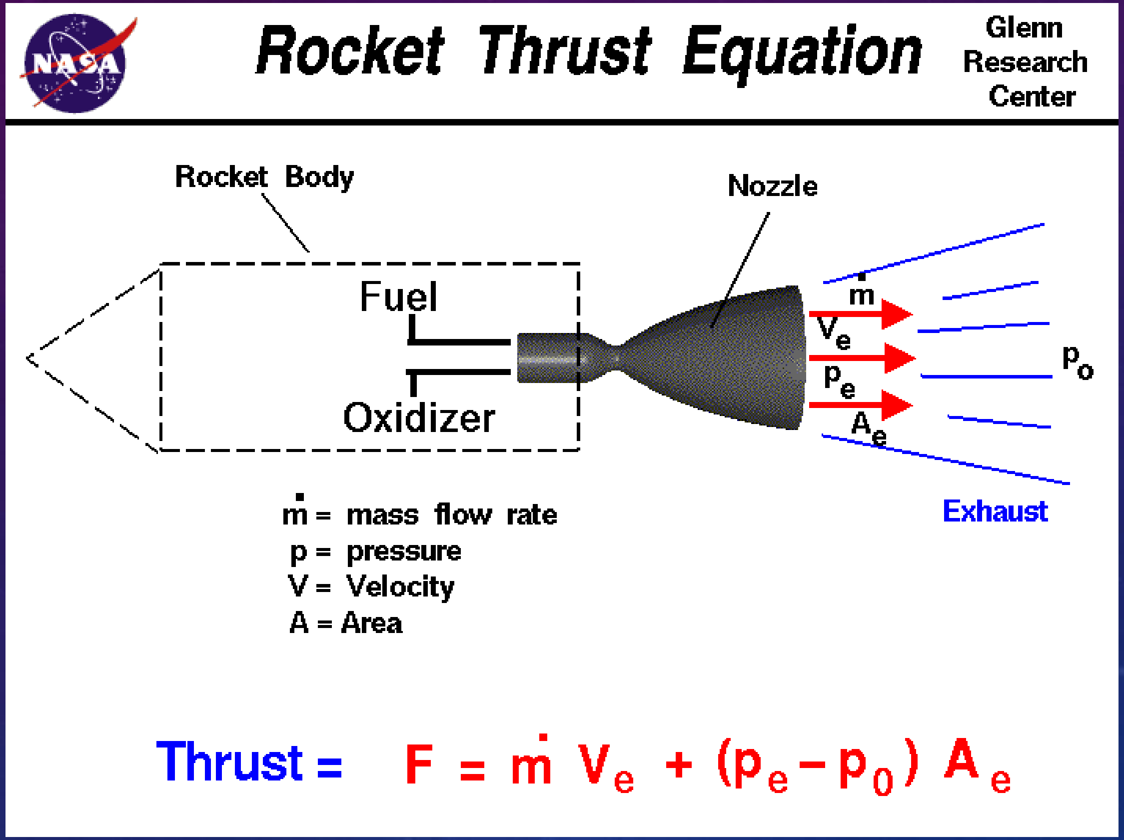
SATURN V

HOW WE BUILT

Compound 18 cones, 5 cylinders, 12 boxes and 3 extrusions.



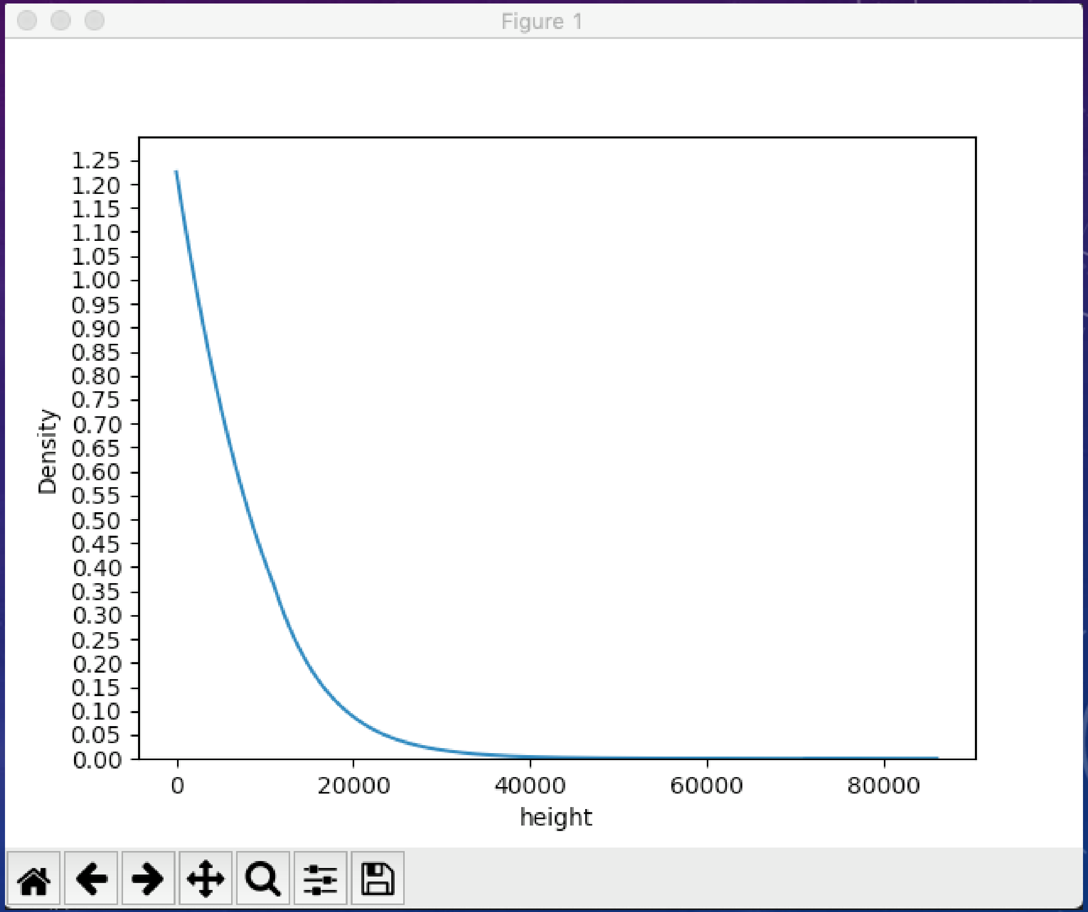
THRUST


Rocket Thrust Equation
Glenn Research Center
Rocket Body
Nozzle
Fuel
Oxidizer
ṁ
Ve
pe
Ae
po
Exhaust
ṁ = mass flow rate
p = pressure
V = Velocity
A = Area
Thrust = F = ṁ Ve + (pe − p0) Ae

DENSITY OF AIR

$$\rho = \rho_b \cdot \left[\frac{T_b}{T_b + L_b \cdot (h - h_b)} \right]^{\left(1 + \frac{g_0 \cdot M}{R^* \cdot L_b}\right)}$$

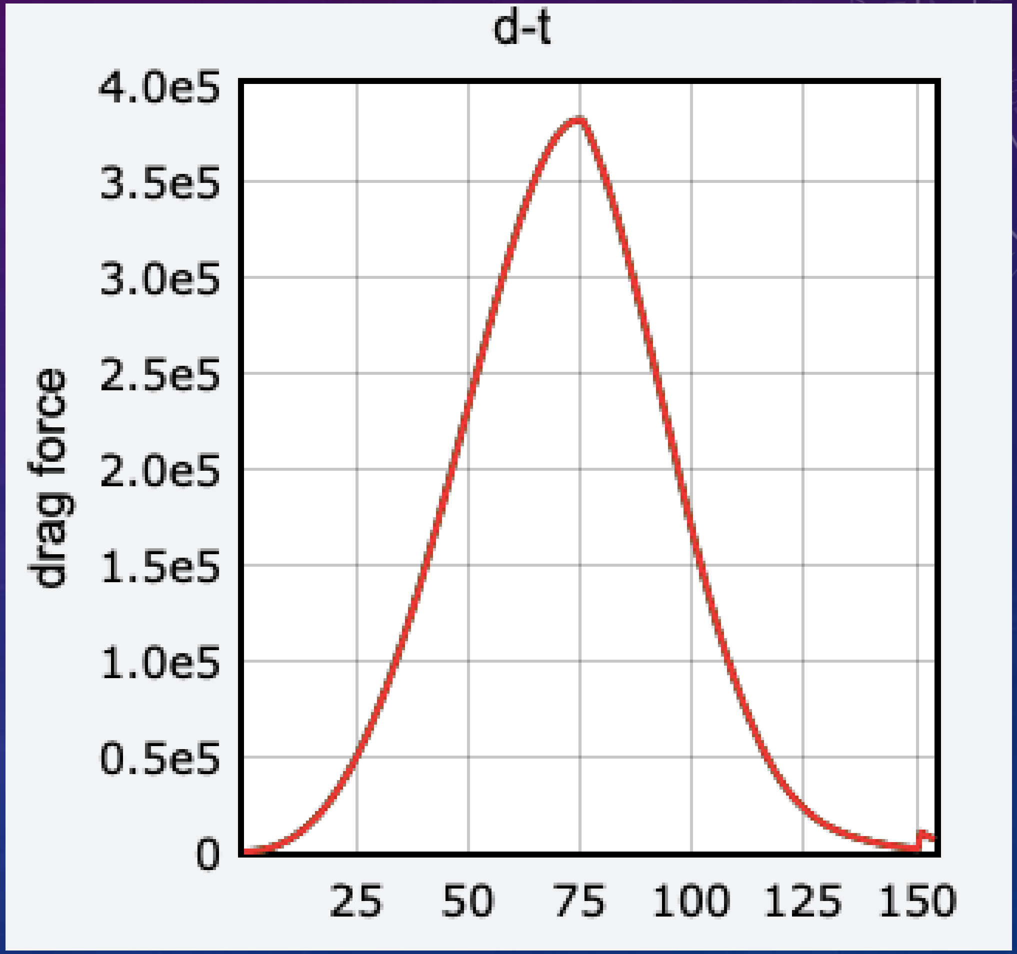
$$\rho = \rho_b \cdot \exp\left[\frac{-g_0 \cdot M \cdot (h - h_b)}{R^* \cdot T_b} \right]$$



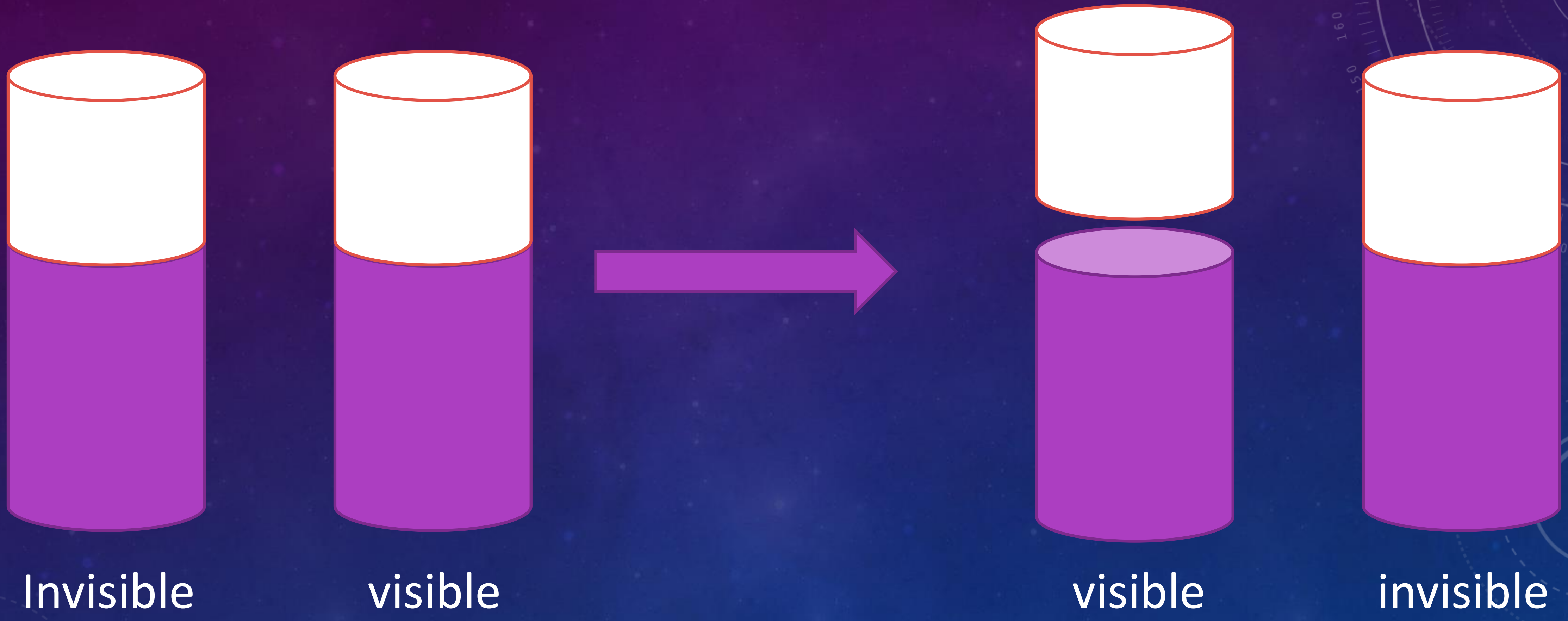
DRAG FORCE

$$F_D = \frac{1}{2}\rho v^2 C_D A$$

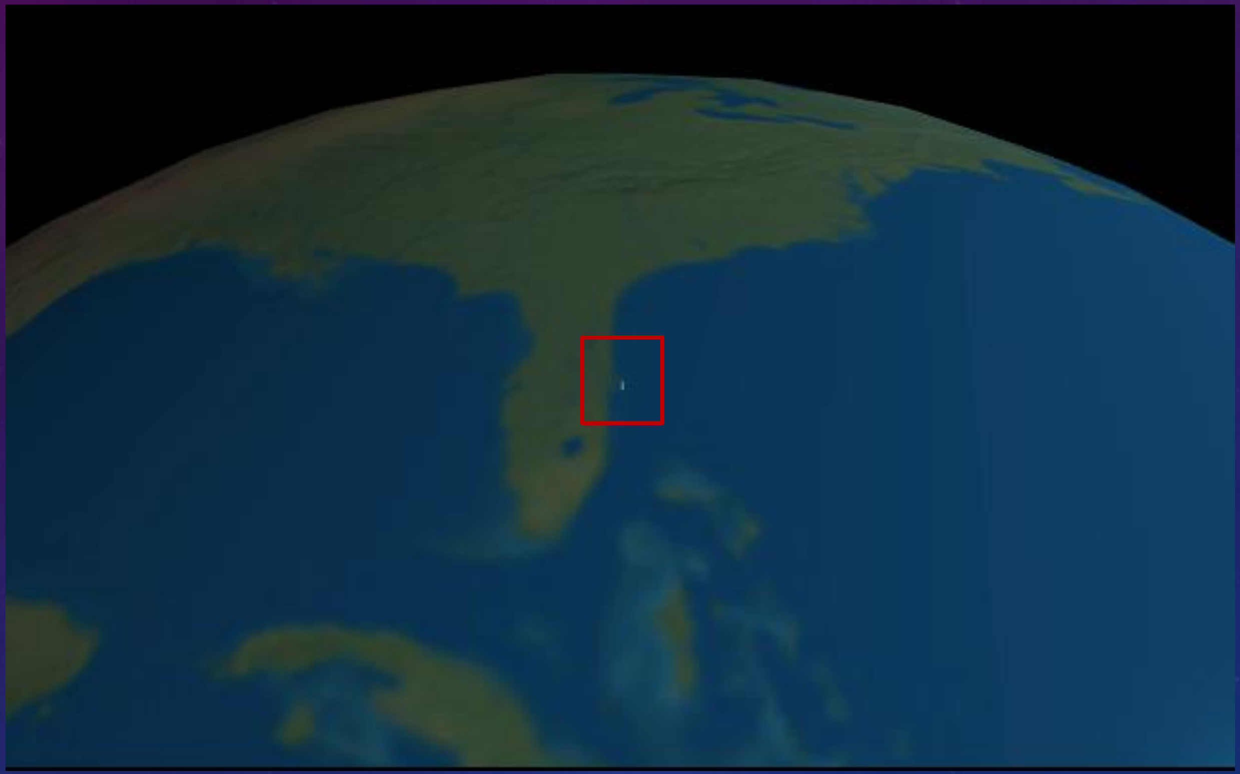
$$C_D = 0.2$$



MULTI-STAGE PROCESSING



Right position with right rotation speed



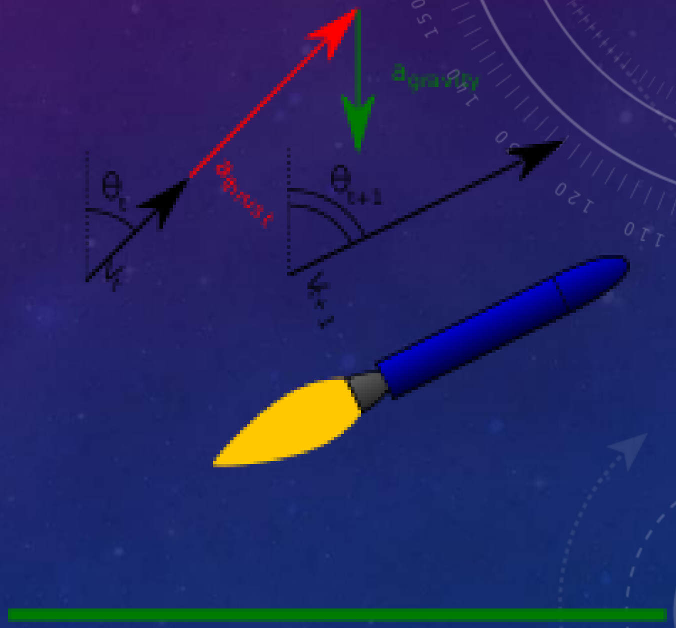
ANGLE

gravity turn + pitchover angle

```
if rocket1.fuel_mass > 0  :

    rocketL.r.up   = rotate(rocketL.r.up,angle=-25*dt*pi/18000)

    total_mass = rocket1.total_mass() + rocket2.total_mass() + rocket3.total_mass()
    dm = rocket1.mass_flow_rate * dt
    thrust = rocket1.exit_speed*norm(rocketL.r.up)*dm/dt
```



Rocket.up = Rocket.v ?

torque ?

```
rocket1L.r.up  = rocket1.v
rocket23L.r.up = rocket2.v
```

ENTERING ORBIT

V_T >= First cosmic velocity

Turn off

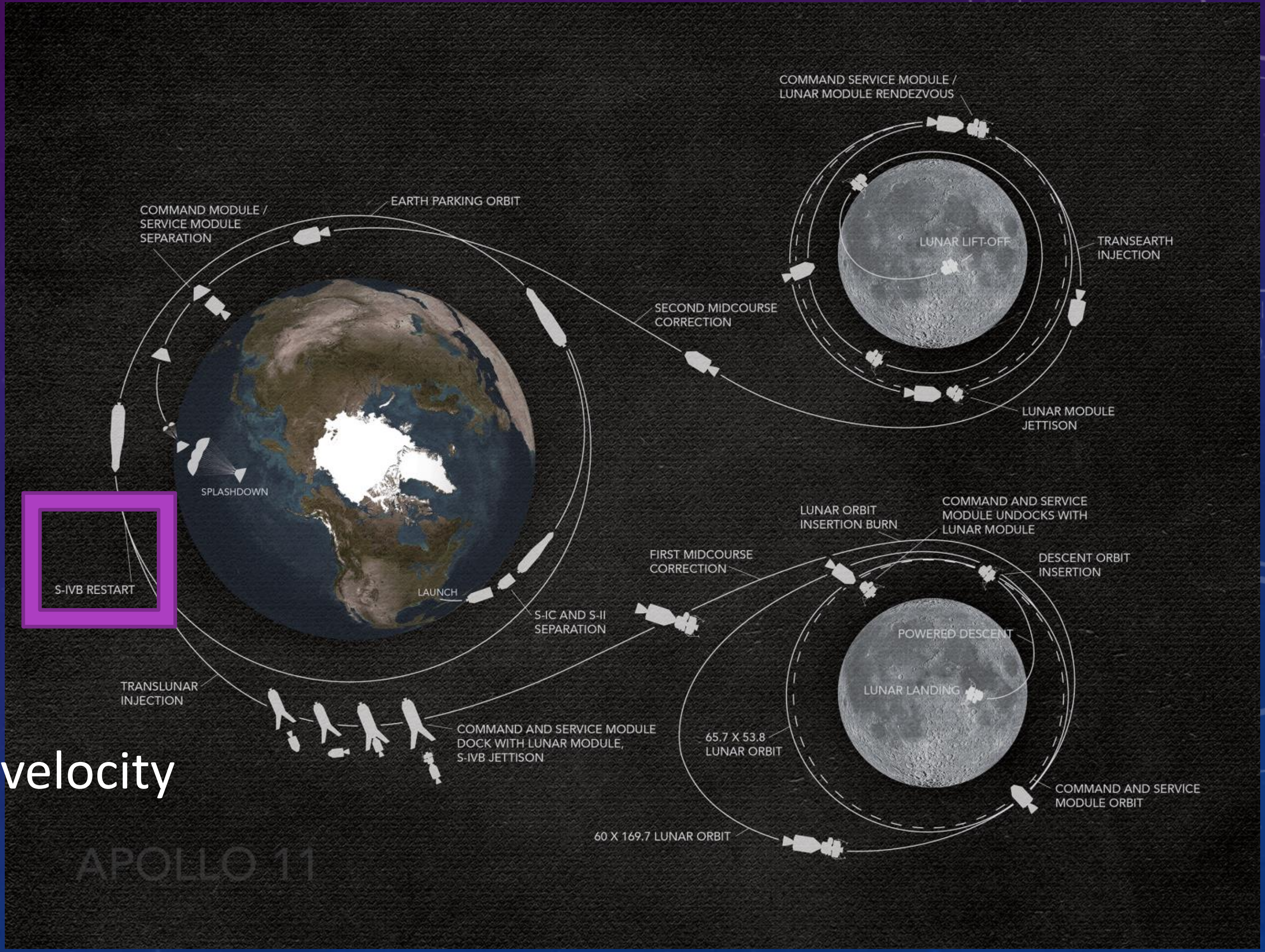
V_T <= First cosmic velocity
(Under certain angle range)

Turn on

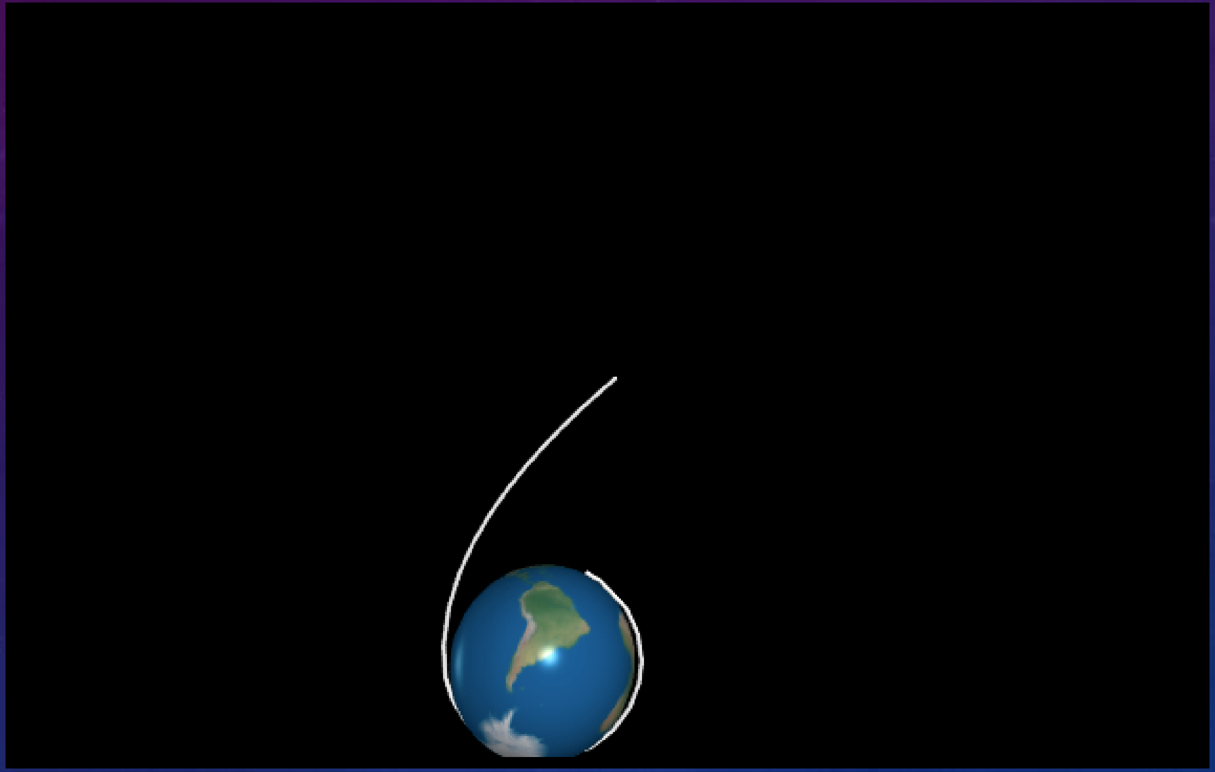
V_T >= First cosmic velocity
(Under certain angle range)

Turn off

ESCAPE FROM EARTH

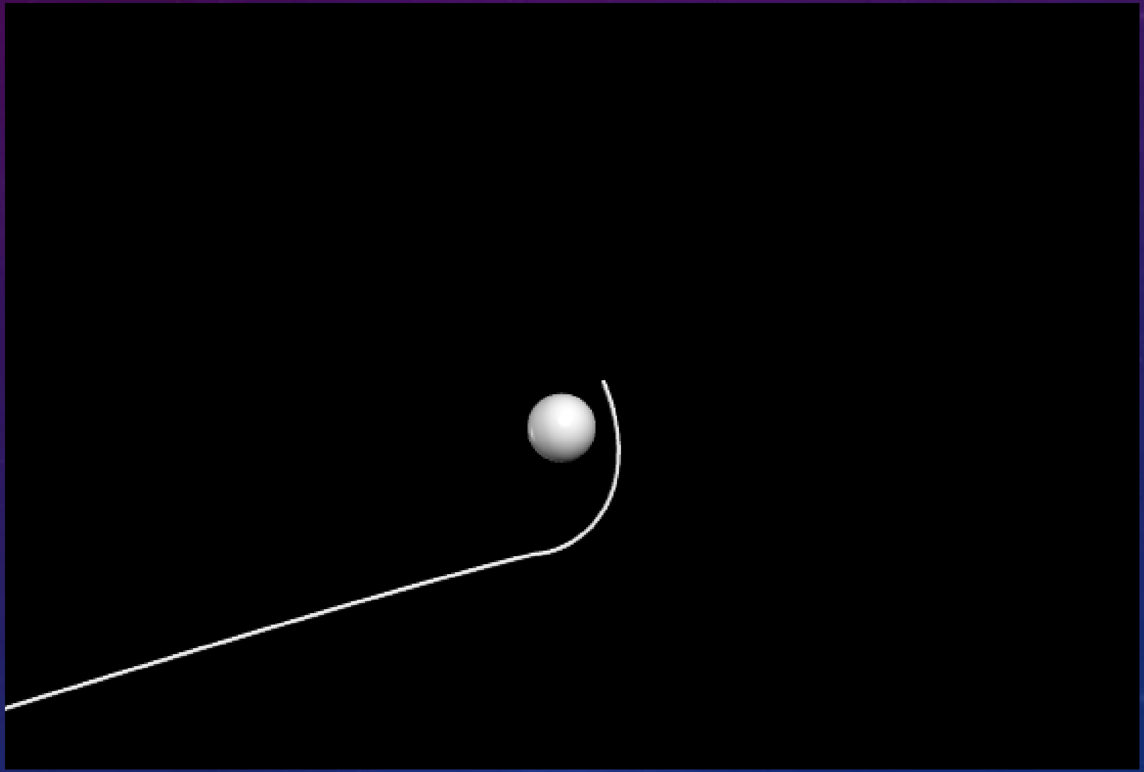


Turn on the engine
Till the rocket reaches the escape velocity

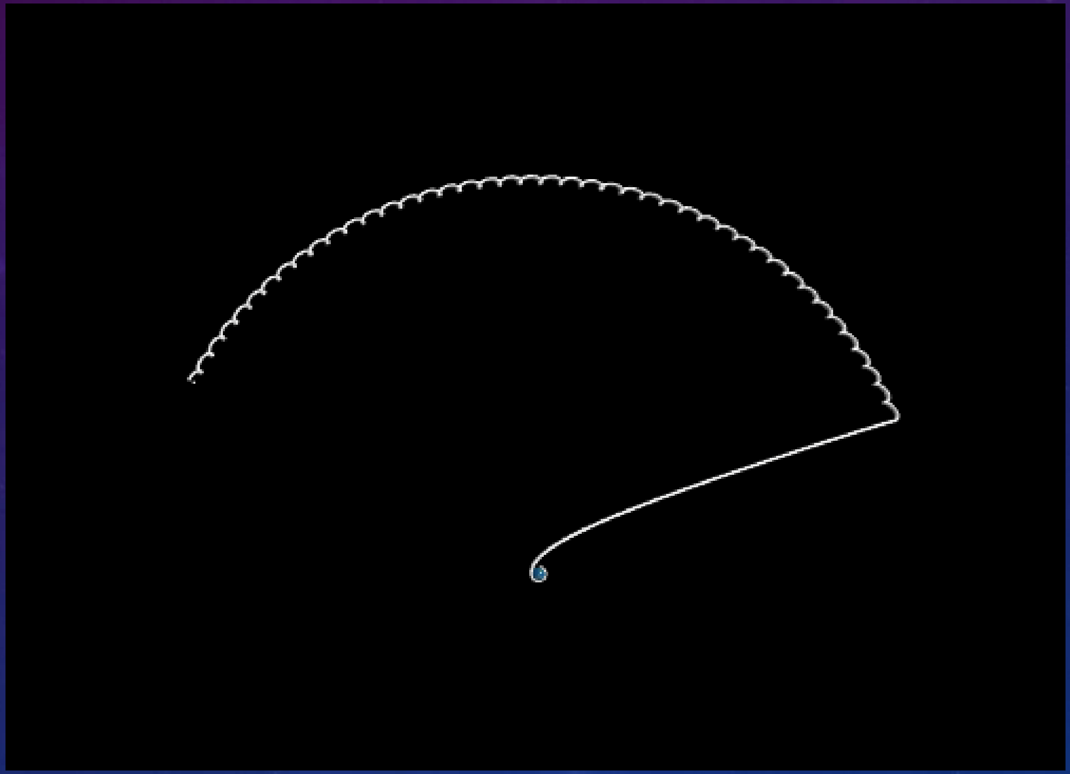


ENTERING MOON ORBIT

- Decelerate
- V <= first cosmic velocity of moon



AND HERE IT IS



WHAT WE LEFT

- Landing
- Flame

Short Demo video

https://youtu.be/3Op-GnzcrPo