
APOLLO XIII
EX LUNA, SCIENTIA

NASA TECHNICAL MEMORANDUM

INSTRUMENTATION LABORATORY

CASE FILE COPY

TITLE ORBITAL ROCKET GUIDANCE IN RUBY

MODEL NO. SATURN V

CONTRACT NO. NAS8-5608, Schedule Part IIa, Volume I DRL 049, Item 11

ref-08464

Attn: Acquisition Branch

Approved: Milton B. Trageser Date 5/1/63
MILTON B. TRAGESER, DIRECTOR
APOLLO GUIDANCE AND NAVIGATION PROGRAM

Approved Roger B. Woodbury Date 5/1/63
ROGER B. WOODBURY, ASSOCIATE DIRECTOR
INSTRUMENTATION LABORATORY

Nate Berkopec

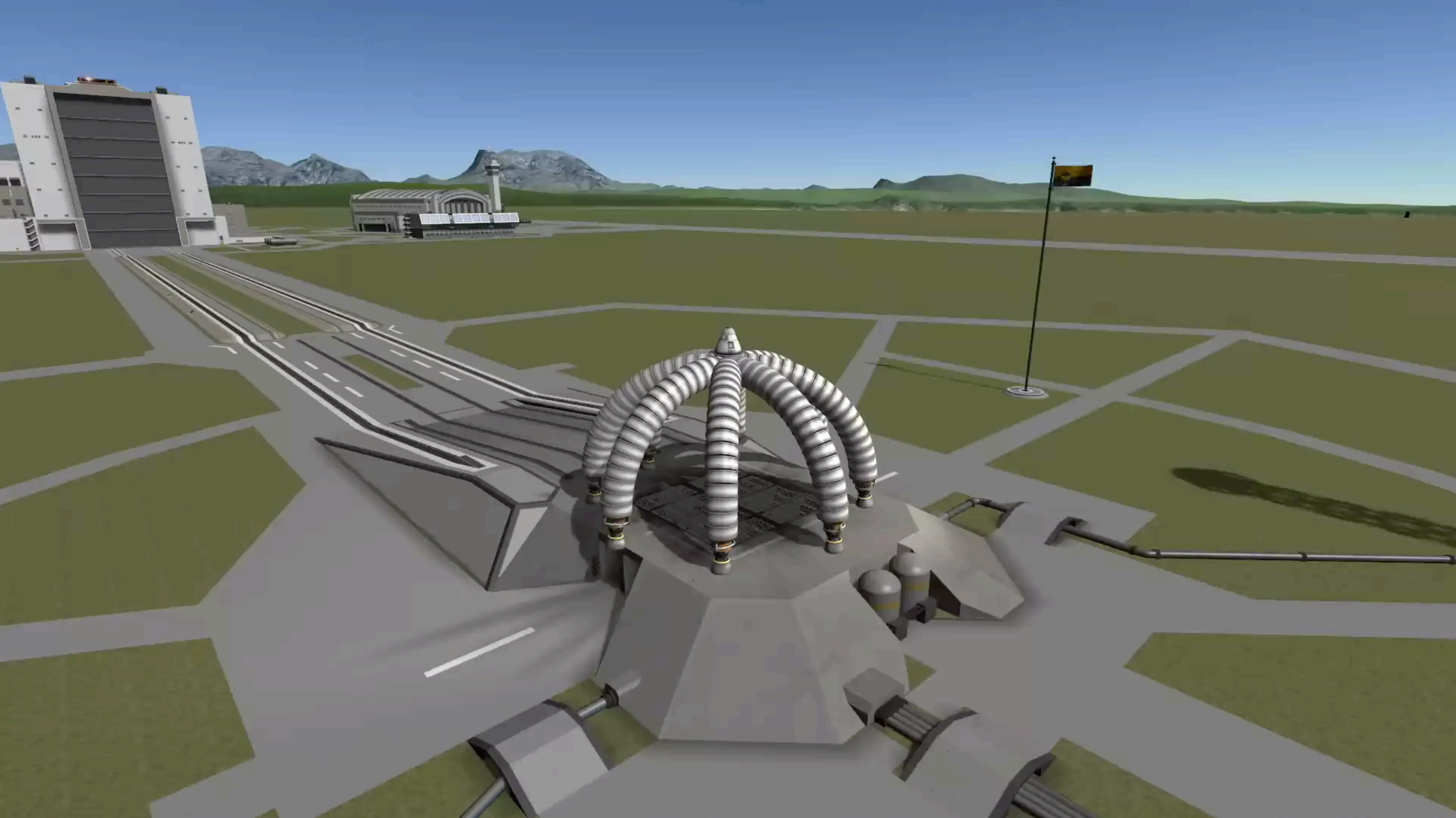
speedshop

Speedshop is a Ruby on Rails performance consultancy that optimizes the full stack - frontend, backend and environment - to generate revenue and cut scaling costs for businesses on Rails. It's not uncommon for Speedshop clients to halve their server costs and improve perceived load times by 300%. Fast sites are profitable sites. Speed is a feature.

Products and Services

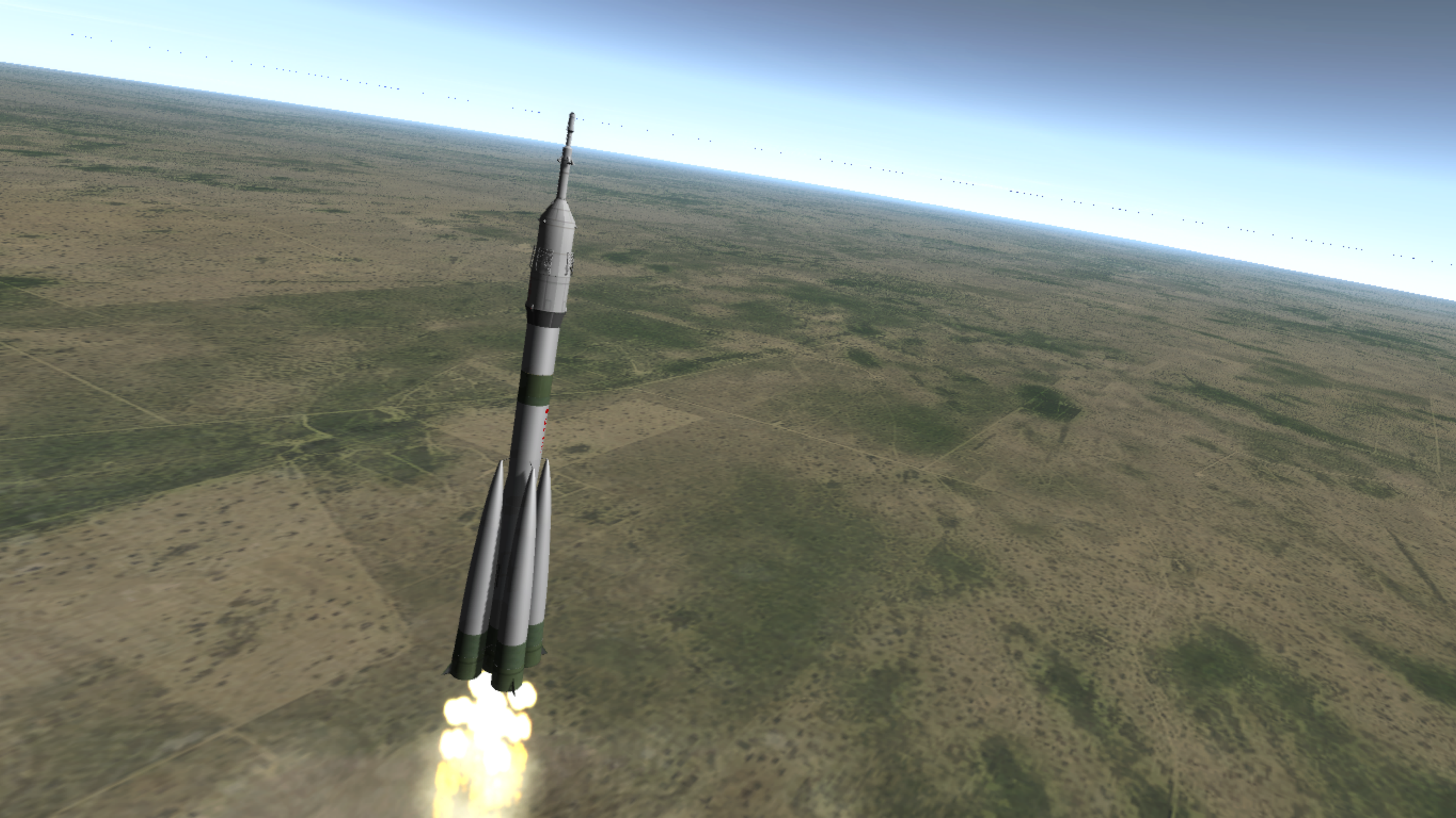
- **The Complete Guide to Rails Performance**, an in-depth 370 page book and 17 hours of HD screencasts and interviews with top experts, including DHH himself.
- **Speedshop Blog**, the number one Ruby on Rails performance blog on the 'net.


KERBAL
SPACE PROGRAM



Dzhanibekov Effect


D1-4
T-HANDLE
J1
GUIGNÉ
D1-5



README.md

kRPC

kRPC allows you to control Kerbal Space Program from scripts running outside of the game, and comes with client libraries for many popular languages.

- Documentation
- Forum release thread

Links for Developers

- Forum development thread
- Travis CI page
- Travis CI build outputs

```
require 'krpc'
require 'pry'

CLIENT_NAME = "Console"
HOST_IP = "192.168.1.6"
$client = KRPC::Client.new(name: CLIENT_NAME, host: HOST_IP).connect!

vessel = $client.space_center.active_vessel
ctrl = vessel.control

binding.pry
```

Real-time
Reliable
Simple

SOUNDING ROCKETS

JANUARY 1965

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

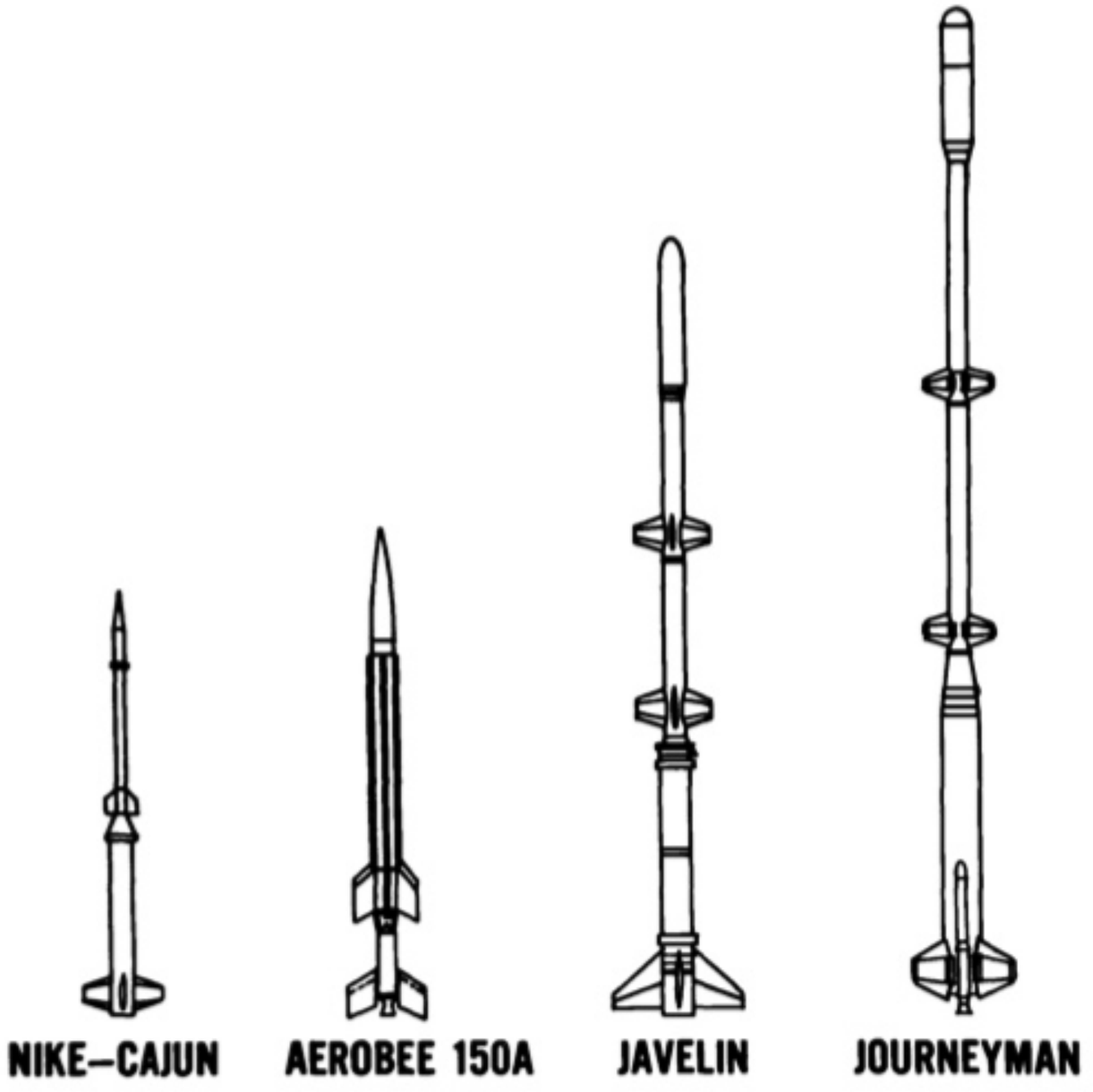
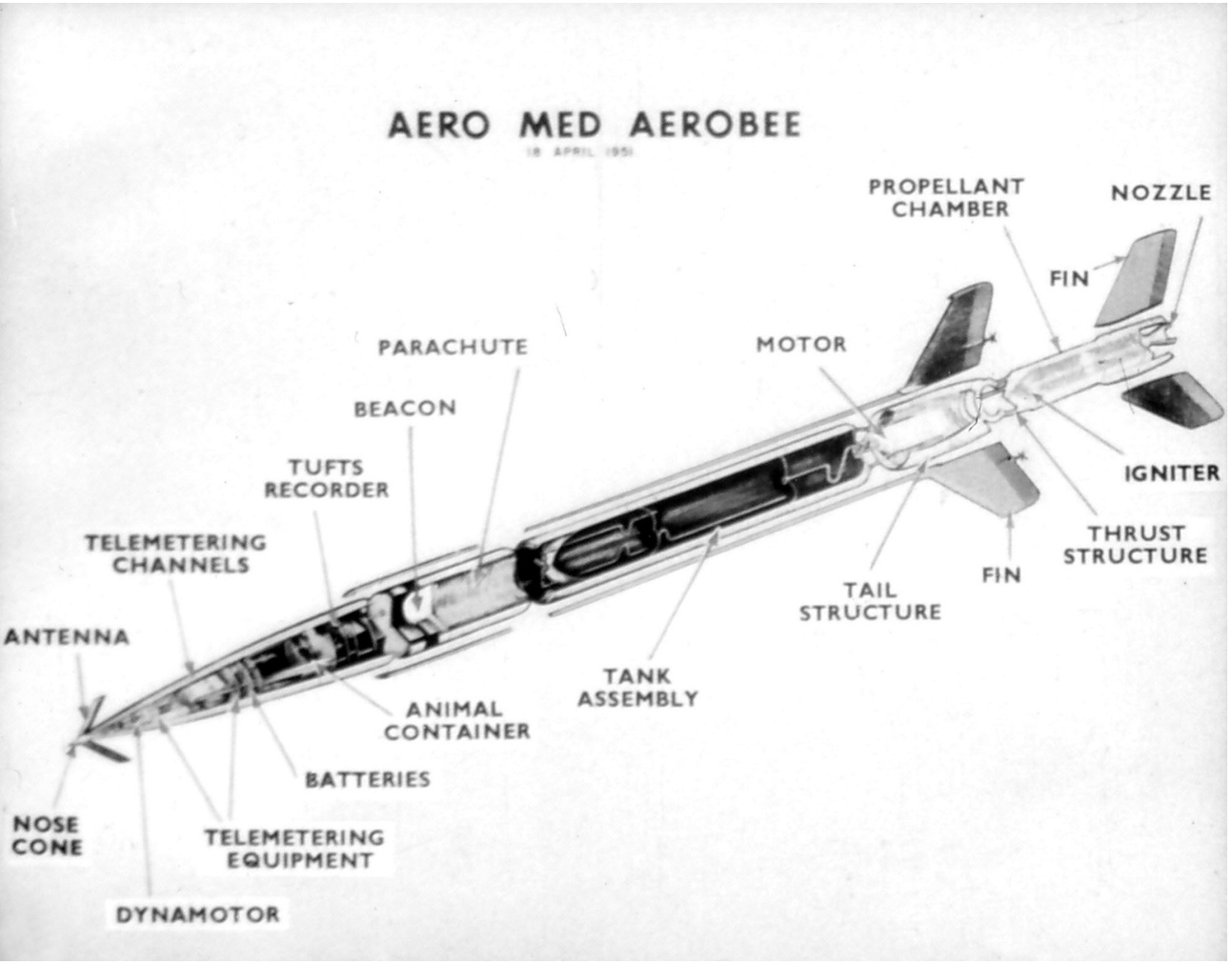


Figure 4–Four Sounding Rocket Systems



1. Detach the launch pylon when thrust is maximum.
2. Seconds before booster cuts out, light the second stage.
3. Separate the booster stage.

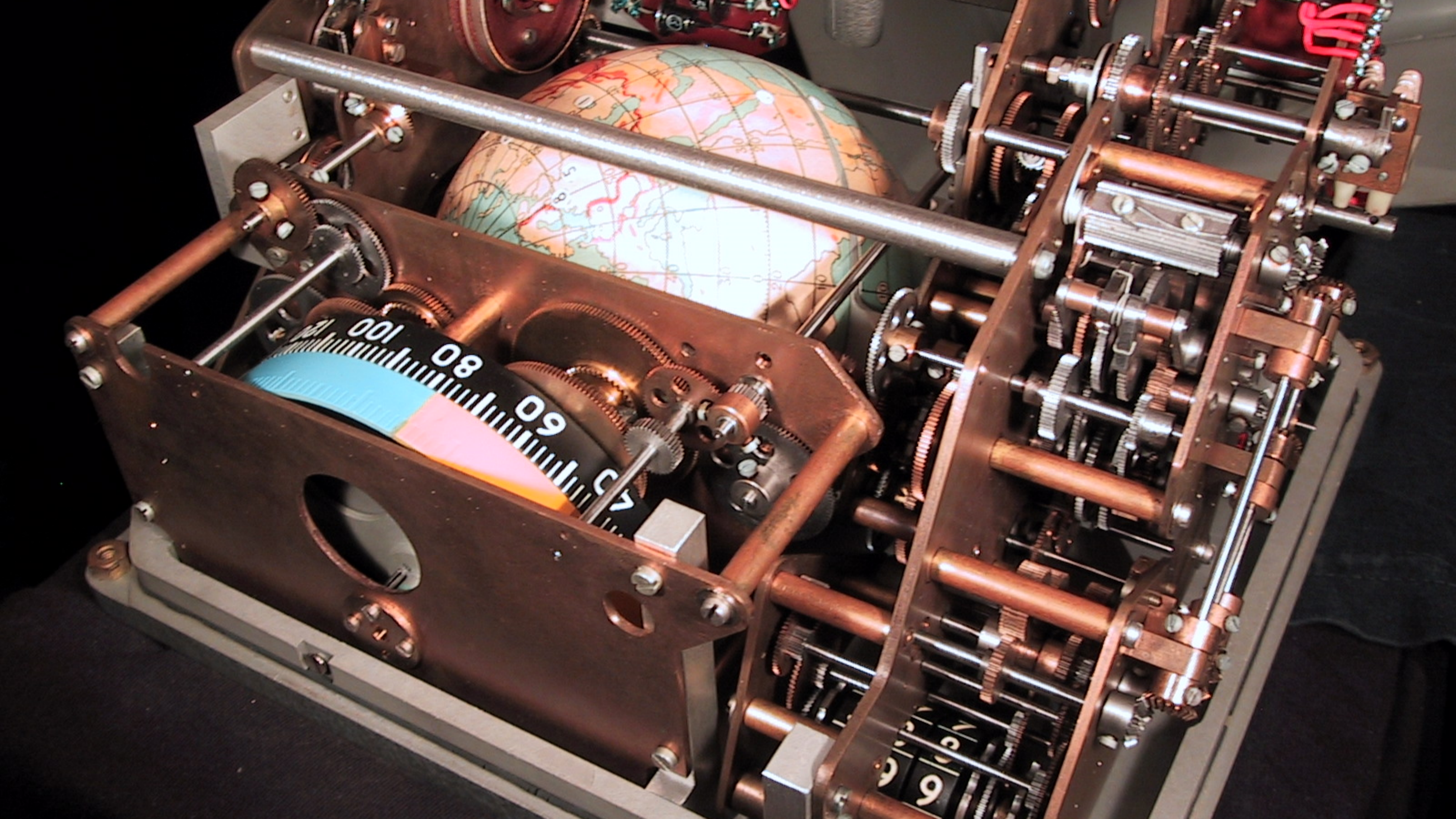
```
require 'krpc'

$client = KRPC::Client.new(name: "Nate", host: "47.17.226.27").connect!
```

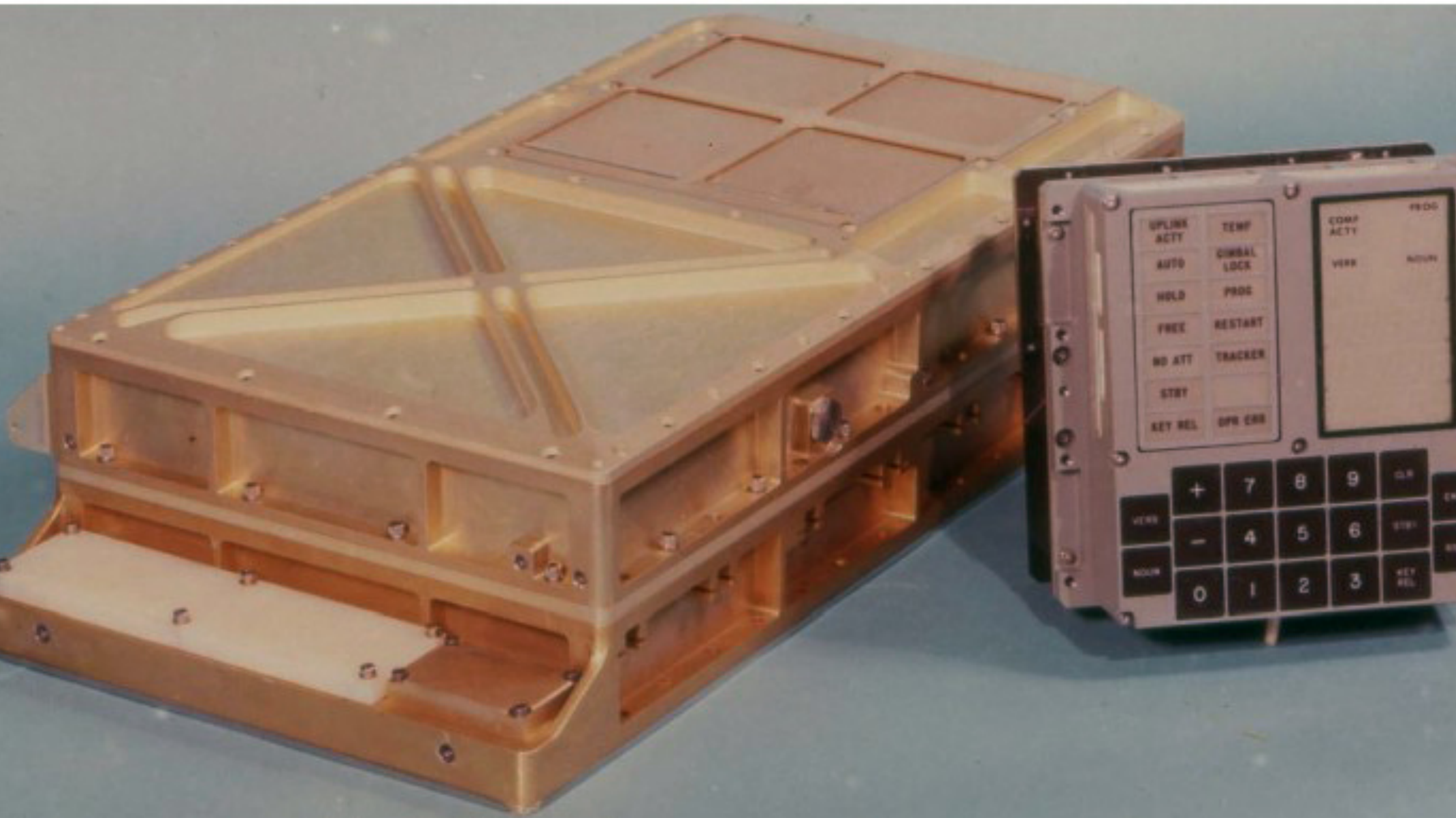
```
ctrl.activate_next_stage # Ignition
until vessel.thrust >= vessel.max_thrust * 0.6
  # spin/wait
end
ctrl.activate_next_stage
```

```
first_stage_fuel_tank = first_stage.propellants.first
first_stage_fuel_tank_max = first_stage.total_resource_capacity

until first_stage_fuel_tank_max * 0.1 > first_stage_fuel_tank.current_amount
  sleep(0.1)
end

ctrl.activate_next_stage

until first_stage_fuel_tank.current_amount == 0
    sleep(0.1)
end

ctrl.activate_next_stage
```


T+ 0y, 0d, 00:00:03
MET
D+ 0.00000s
PersistentRotation
Apoapsis Height
Time to Apoapsis
Periapsis Height
Time to Periapsis
Pitch
Inclination
TWR
DeltaV (S1)
DeltaV (S2)
DeltaV Total
Time to Atmosphere
Insufficient Avionics, Locking Controls (support
0.000t, vessel 1.587t)
Altitude (Terrain)
Vertical Speed
Horizontal Speed
G-Force
Situation
Biome
Impact Biome
Heading
Impact Time
MechJeb
[x] Science! Here and Now
Flying low over Earth's Shores
Principia
2017101919-Chasles-0-g549227645d17aff78fbd2b5b45daa0df15190609
Max history length:
1.05e06 s
Plotting frame selection (Earth-Centred Earth-Fixed)...
Flight plan...
↑ Prediction Settings ↑
Tolerance:
1.0e-2 m
Steps:
1.02e3
↓ KSP features ↓
↓ Logging Settings ↓
↓ Reset Principia ↓
Surface
360.3m/s
HDG
250°
STAGE
002
SolidFuel
SolidFuel
SolidFuel
SolidFuel


THE
COMPUTER
AND
MANNED
SPACE FLIGHT




UPLINK ACTY
TEMP
COMP ACTY
PROG
AUTO
GIMBAL LOCK
VERB
NOUN
HOLD
PROG
FREE
RESTART
NO ATT
TRACKER
STBY
KEY REL
OPR ERR
+
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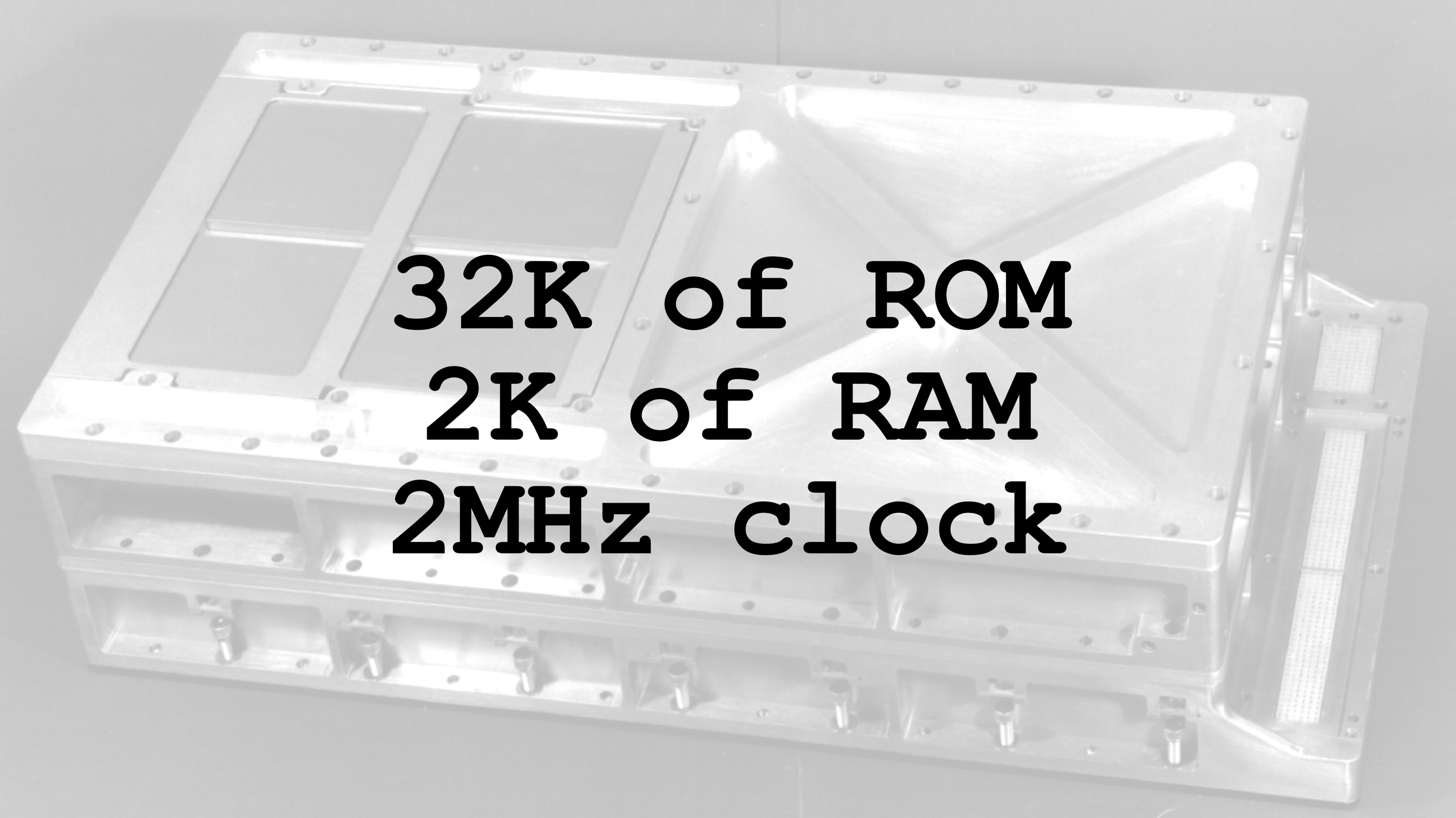
8
9
−
4
5
6
0
1
2
3


32K of ROM
2K of RAM
2MHz clock

I Am Devloper @iamdevloper · 22h

1969:

-what're you doing with that 2KB of RAM?

-sending people to the moon

2017:

-what're you doing with that 1.5GB of RAM?

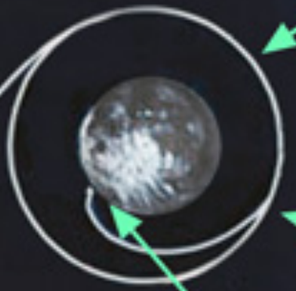
-running Slack

280 19K 41K

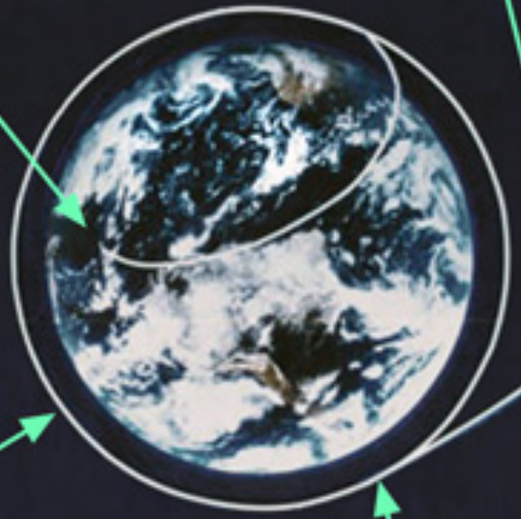
The project studied is the software development for the Apollo Primary Guidance, Navigation, and Control system by the Charles Stark Draper Laboratory of MIT. The project output has been the computer programs used on board the Apollo Spacecraft. The cost of this effort, from January 1962 to January 1971, has been about $57 million. The cost to reach the primary objective of the project, the first lunar landing in July 1969 was about $45 million.

LAUNCH

LUNAR ORBIT INSERTION



DESCENT
ORBIT
INSERTION



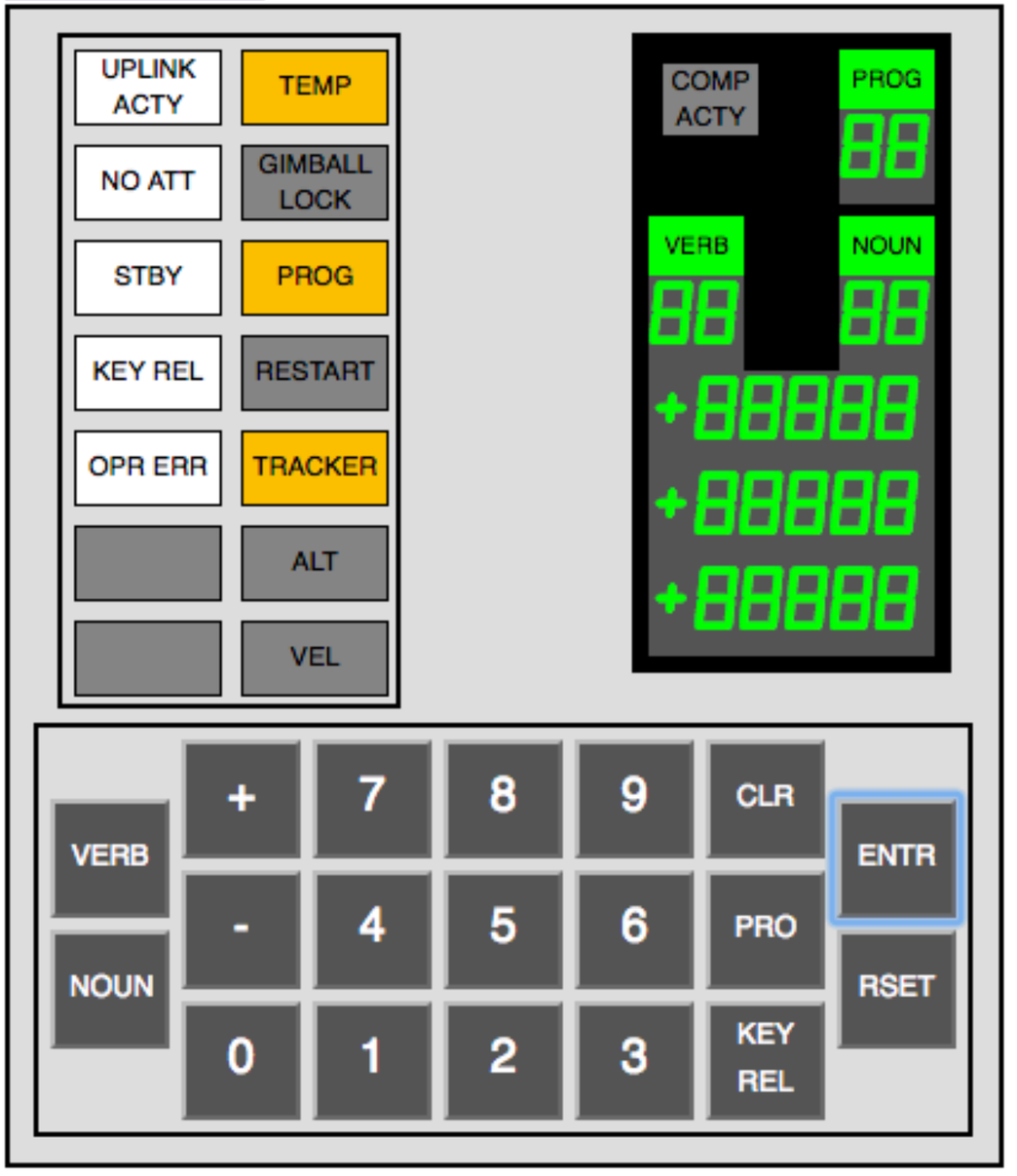
EARTH ORBIT

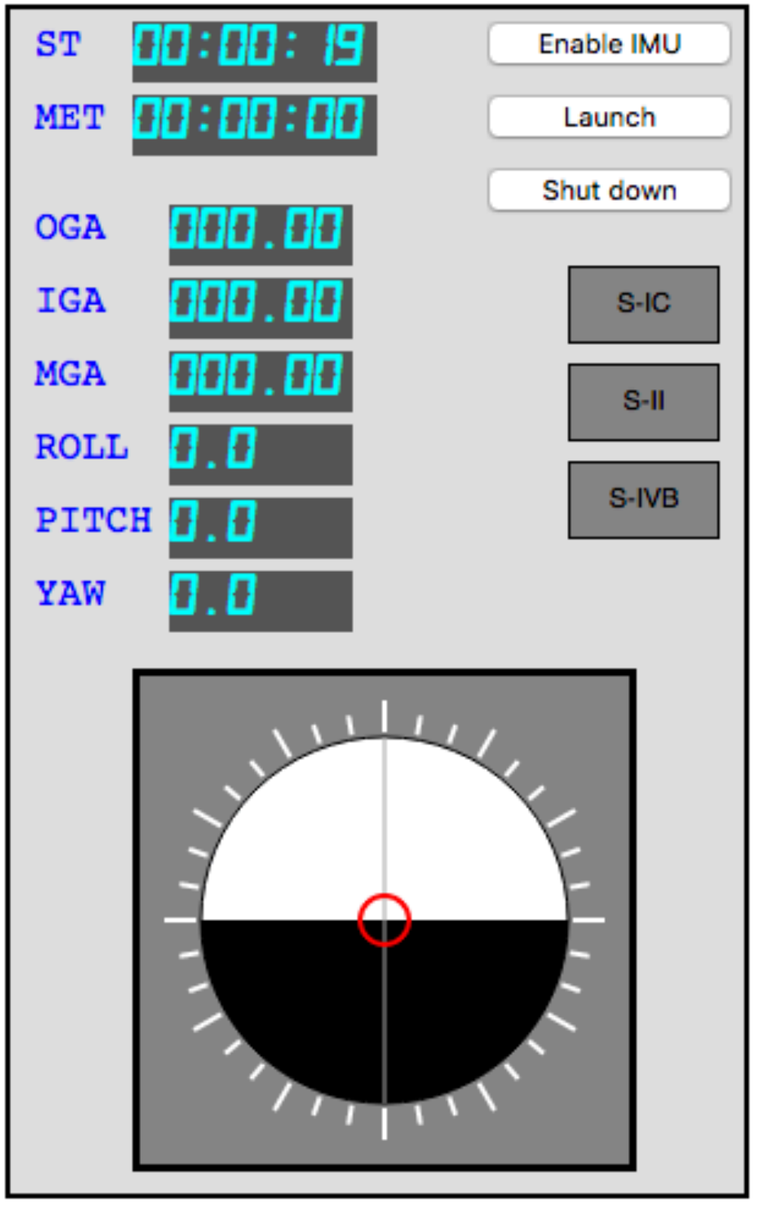
TRANS-LUNAR INJECTION

DESCENT AND LANDING

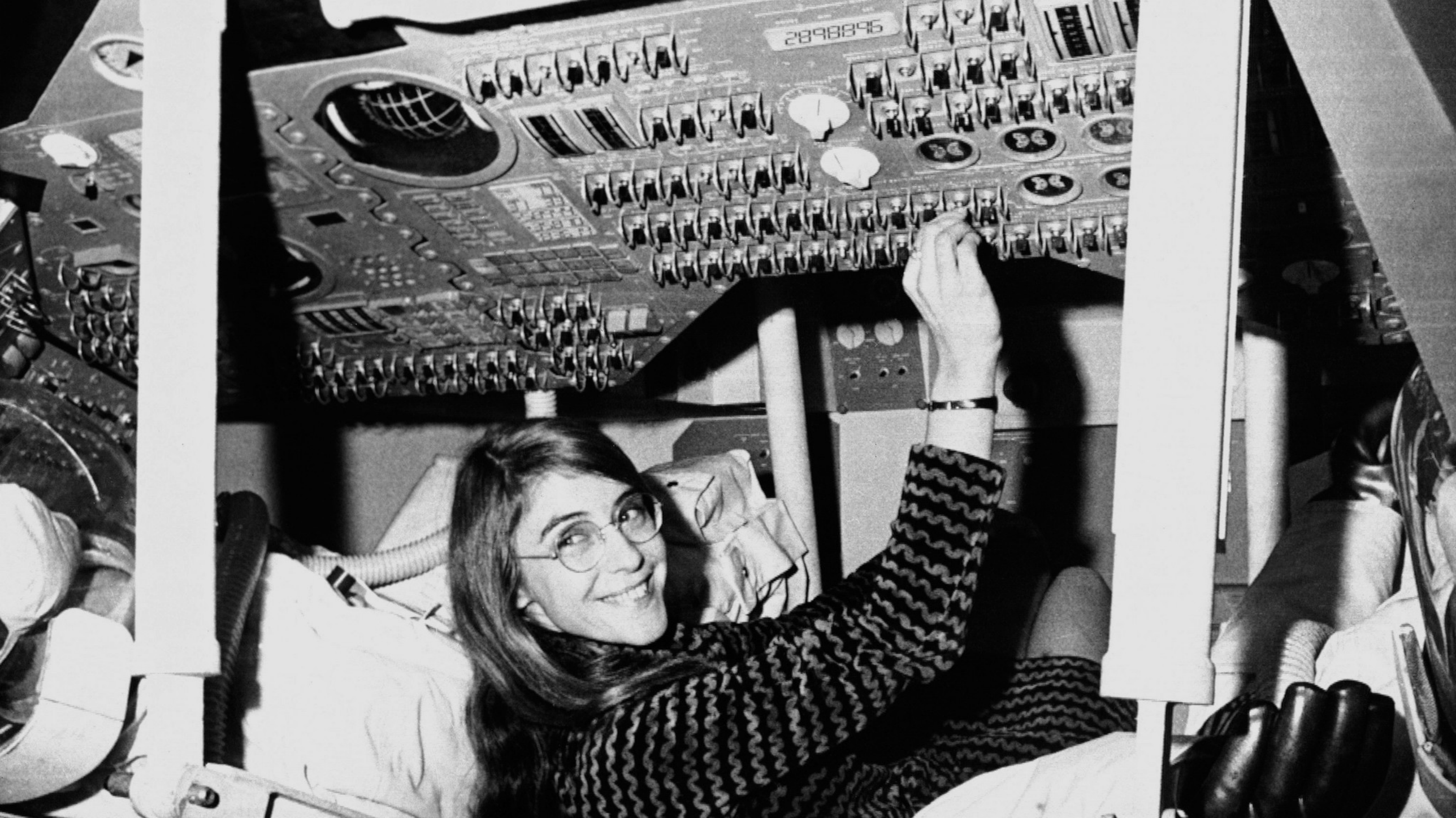
Moonjs: An Online Apollo Guidance Computer (AGC) Simulator

Launch checklist






MT0A
CR1A
MT1A
MT2A
CR1A
CP1A
CP1A
TY1A
CR1A
LP1A
MT2A


2898896

Original Apollo 11 Guidance Computer (AGC) source code for the command and lunar modules.

agc nasa apollo

203 commits | **1** branch | **0** releases | **49** contributors

Branch: **master** | **New pull request** | **Create new file** | **Upload files** | **Find file** | **Clone or download**

Feliix42 committed with **wopian** Proof-read TVCRESTARTS (#302) ... Latest commit `e796f1c` 10 days ago

Comanche055	Proof-read TVCRESTARTS (#302)	10 days ago
Luminary099	Comment typos	4 months ago
.editorconfig	Add EditorConfig	9 months ago
CONTRIBUTING.md	Move extensions/formatting to top	8 months ago
README.es.md	Translate README to Spanish (#300)	16 days ago
README.md	Add links to Spanish README from other languages (#301)	16 days ago
README.pt_br.md	Add links to Spanish README from other languages (#301)	16 days ago
README.zh_cn.md	Add links to Spanish README from other languages (#301)	16 days ago

BURN_BABY_BURN

PINBALL_GAME_BUTTONS_AND_LIGHTS

```
# LUNAR_LANDING_GUIDANCE_EQUATIONS.agc

TC     BANKCALL   # TEMPORARY, I HOPE HOPE HOPE
CADR   STOPRATE   # TEMPORARY, I HOPE HOPE HOPE
```

```
# THE_LUNAR_LANDING.agc

CAF CODE500      # ASTRONAUT:     PLEASE CRANK THE
TC  BANKCALL     #                SILLY THING AROUND
CADR  GOPERF1
TCF GOTOP00H     # TERMINATE
TCF P63SPOT3     # PROCEED SEE IF HE'S LYING

P63SPOT4  TC  BANKCALL  # ENTER INITIALIZE LANDING RADAR
CADR  SETPOS1

TC  POSTJUMP     # OFF TO SEE THE WIZARD ...
```

Check continuity on O2 cryogenic tanks before allowing stir #3

Closed **LeoTindall** opened this issue on Jul 7, 2016 · 211 comments

LeoTindall commented on Jul 7, 2016

A customer has had a fairly serious problem with stirring the cryogenic tanks with a circuit fault present. To reproduce:

1. Build CSM
2. Perform mission up to translunar coast
3. During translunar coast, attempt to stir cryo tanks

If a wiring fault exists, the issue may be replicated. Be aware that this may be hazardous to the tester attempting it.

👍 323	👎 11	😄 1065	🎉 104	😕 20	❤️ 103

"He basically made it up out of whole cloth. But it was brilliant."

Don Eyles, AGC engineer on Laning


AM

```ruby
module RGC
  class Executive
    class CoreSet
      def initialize
        @mpac = Array.new(7) { Array.new(15) { 0 } } # [[0,0,0,0 ...], ...]
        @loc = nil # Program location, last executed line
        @priority = 0 # Priority
      end

      def available?
        @priority == 0
      end
    end

    def core_set_table
      @core_set_table ||= Array.new(6) { CoreSet.new }
    end
  end
end
```

```
module RGC
  class Executive
    def request_core_set_for(priority: 1, job:)
      available_set = core_set_table.find { |cs| cs.available? }

      available_set.job = Fiber.new { job.new(available_set).run }
      available_set.priority = priority
    end
  end
end

executive = RGC::Executive.new
executive.request_core_set_for(priority: 10, job: GravityTurnJob)
```

```ruby
module RGC
  class Job
    attr_reader :core_set
    extend Forwardable
    def_delegators :core_set, :mpac, :priority, :vessel, :ctrl, :executive,
                   :adapter, :client

    def initialize(core_set)
      @core_set = core_set
    end
  end
end
```

```
class CoreSetPrinterJob < RGC::Executive::Job
  def run
    loop do
      puts ""
      puts executive.core_set_table.map { |cs| cs.priority }
      Fiber.yield
    end
  end
end
```

```
module RGC
  class Executive
    def main
      # Highest priority in first slot
      core_set_table.sort_by!(&:priority).reverse!
      core_set = core_set_table.first
      result = core_set.job.resume if core_set.priority > 0
      if result == :kill # Fiber.yield :kill
        core_set.priority = 0
        core_set.mpac = {}
        core_set.job = nil
      end
    end
  end
end
```

```ruby
module RGC
  class Executive
    attr_reader :waitlist
    def initialize
      @waitlist = Array.new(7) { { time: nil, job: nil } }
    end

    def delay_job(job, time)
      job.priority = 0 - job.priority
      empty = waitlist.find { |task| task[:time] == nil }
      soft_reset! unless empty
      empty[:time] = time
      empty[:job] = Proc.new { job.priority = 0 - job.priority }
    end

    def run_waitlist_tasks
      ready_tasks = waitlist.select { |task| task[:time] && task[:time] <= Time.now }
      ready_tasks.each do |task|
        task[:job].call
        task.keys.each { |k| task[k] = nil }
      end
    end
  end
end
```

```
module RGC
  class Executive
    def initialize
      at_exit do
        File.open("agc_task_dump", 'w') do |file|
          file.write(Marshal.dump(core_set_table))
        end
      end
      if File.exists?("agc_task_dump")
        @core_set_table = Marshal.load(File.read("agc_task_dump"))
      end
    end
  end
end
```

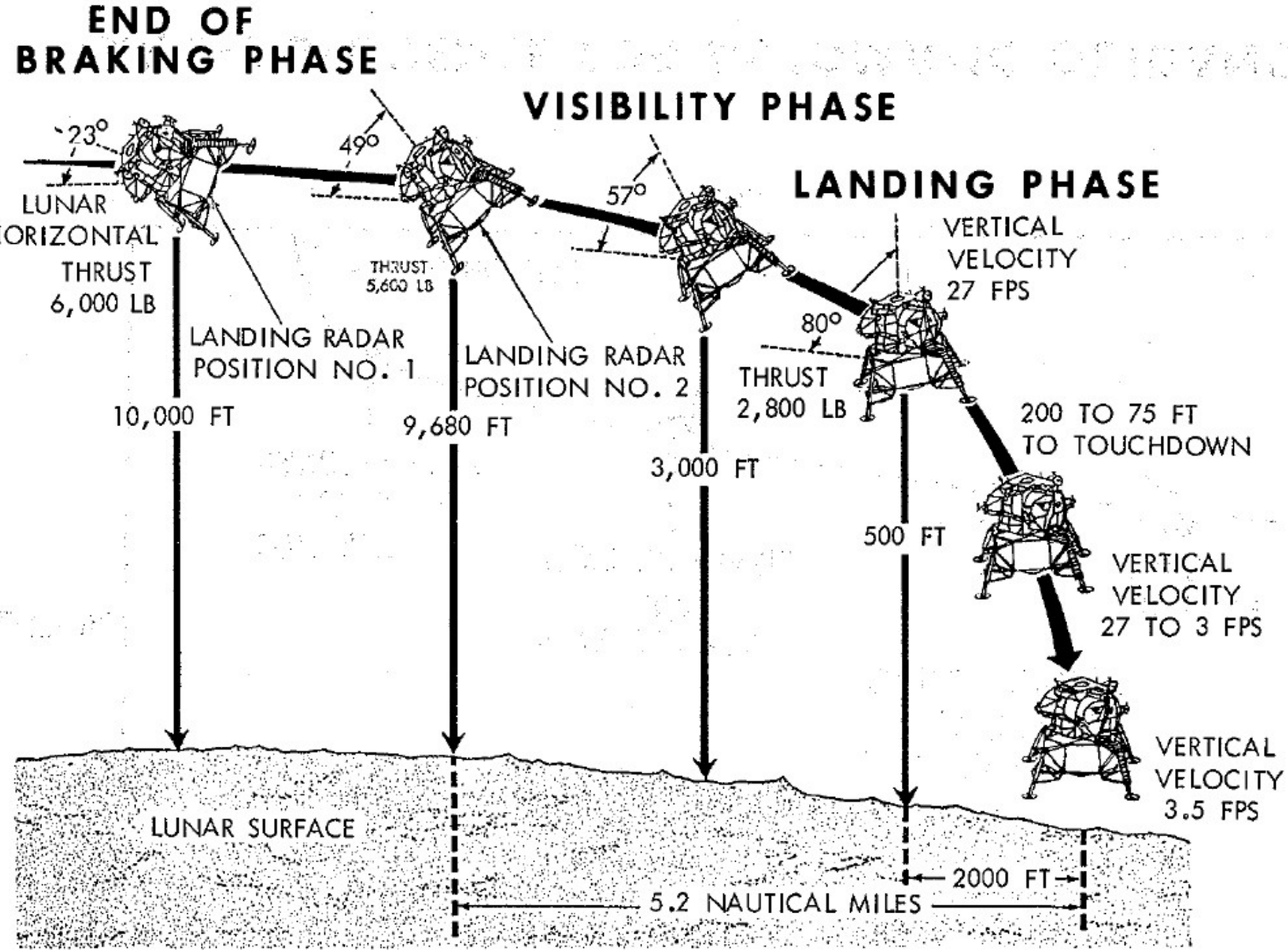
```
module RGC
  class Executive
    def soft_reset!
      @core_set_table = Array.new(6) { CoreSet.new(self) }
      @waitlist = Array.new(7) { { time: nil, job: nil } }
    end
  end
end
```

```ruby
module RGC
  class Executive
    def initialize
      Thread.new do
        while true
          sleep 1
          abort "Night Watchman abort!" if $last_time_exec_ran <= Time.now - 1
        end
      end
    end

    def main
      $last_time_exec_ran = Time.now
      # ...
    end
  end
end
```


63
16 68
3180
6390
3990
+
7
8
9
CLR
ENTR
−
4
5
6
PRC
0
1
2
3

Guidance
Navigation
Control

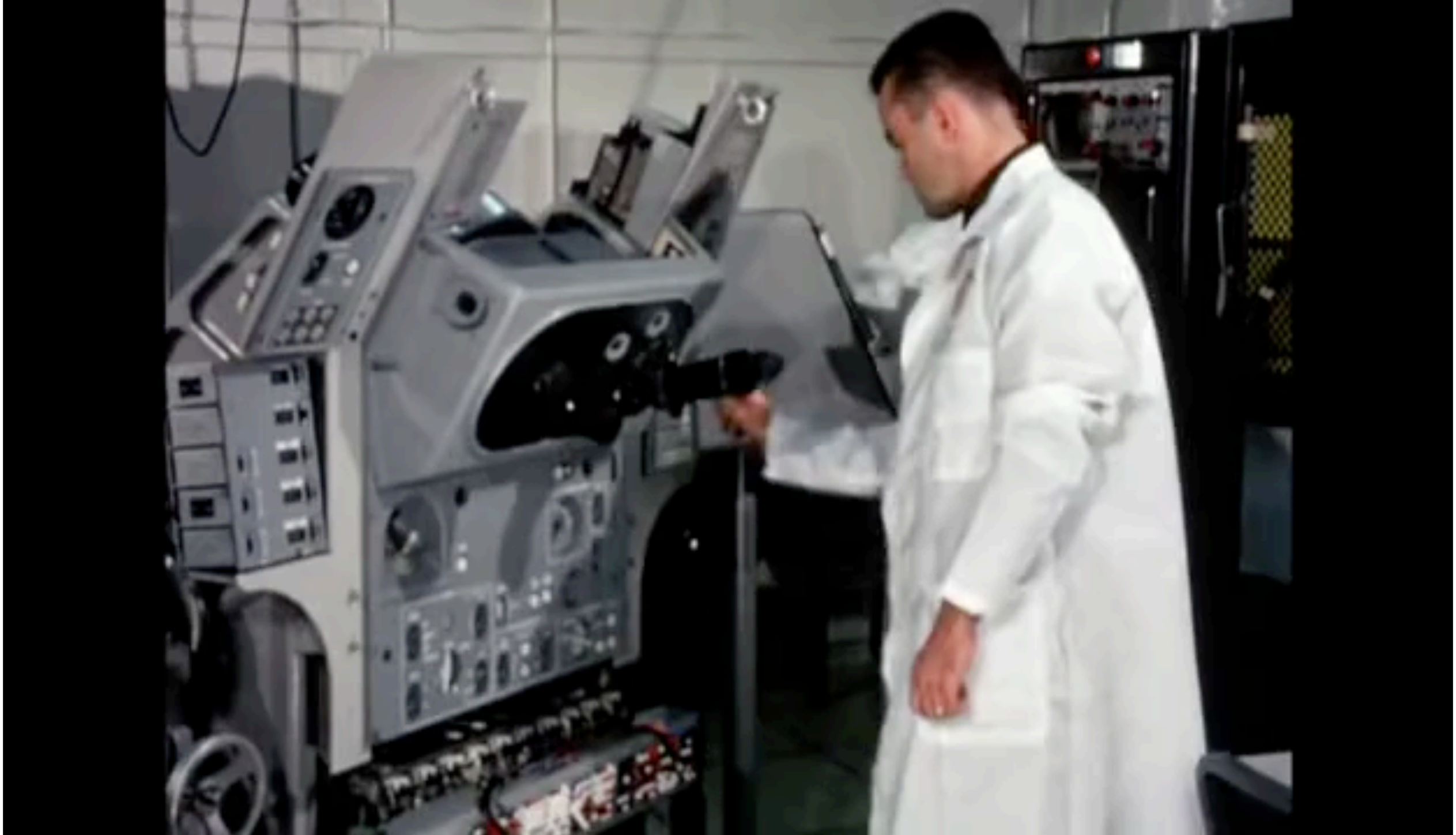
Guidance



NOMINAL DESCENT TRAJECTORY
FROM HIGH GATE TO TOUCHDOWN

-more-

Navigation



Control

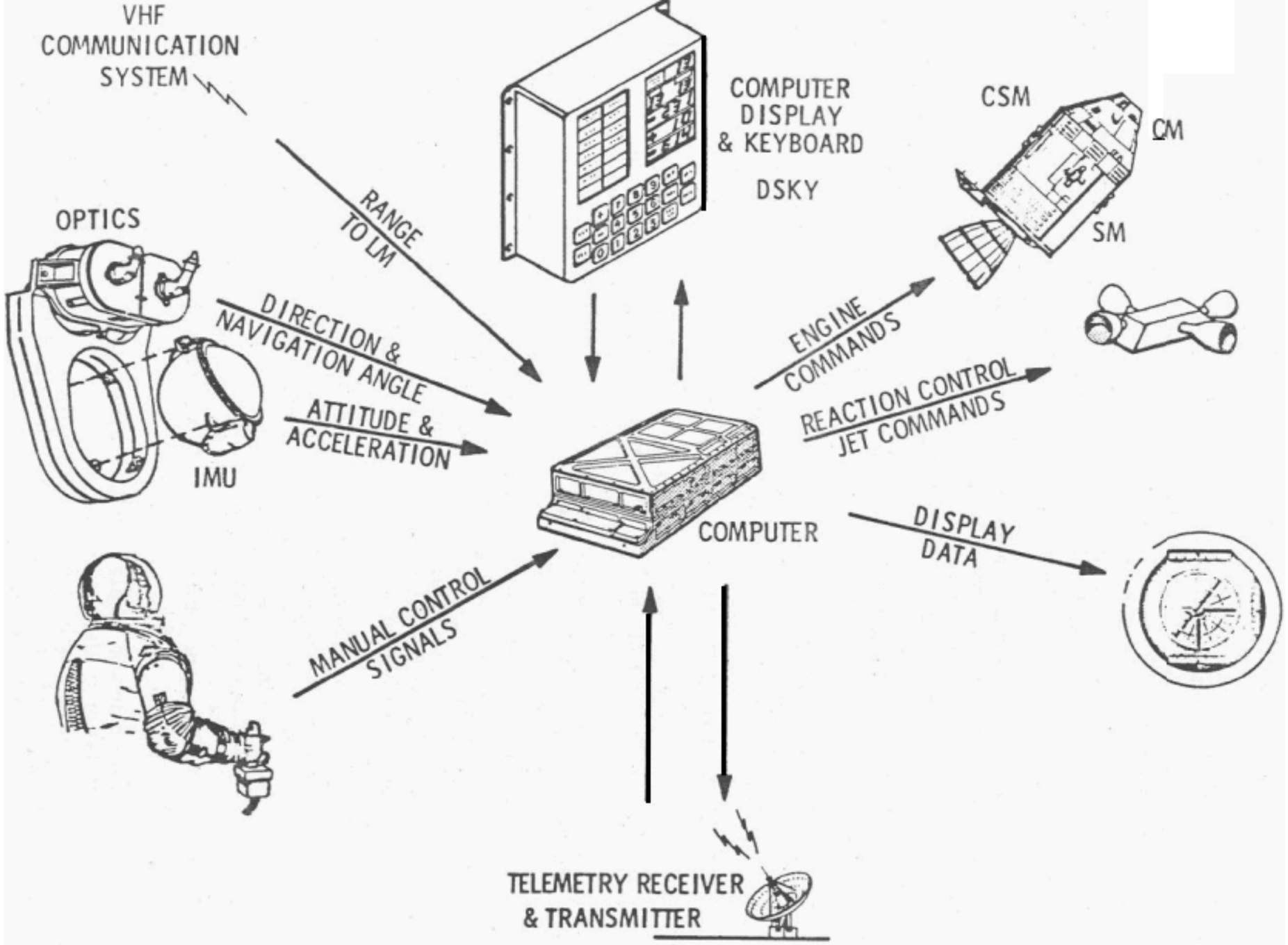
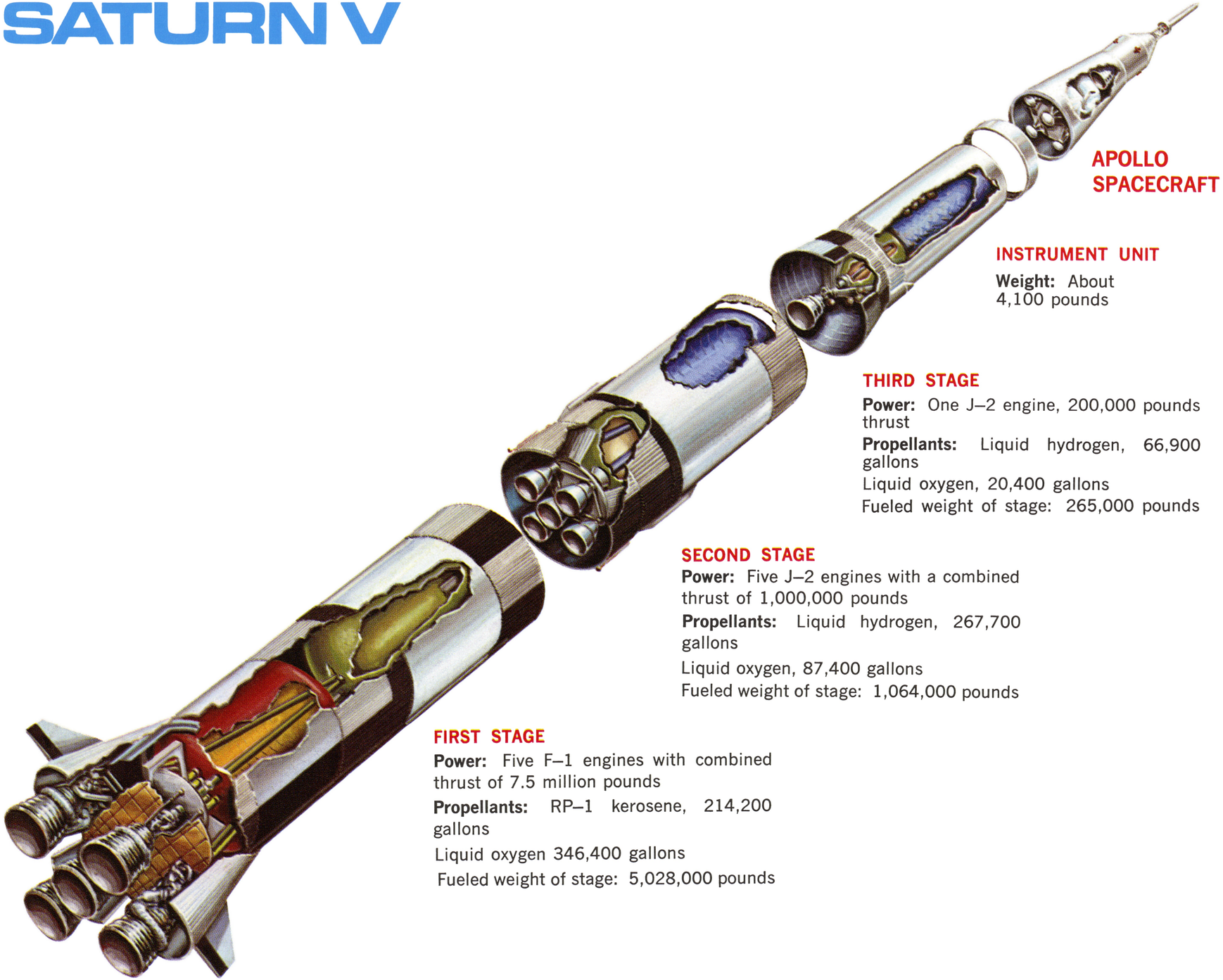


Figure 1 The GN & C System Schematic


USA

SATURN V



APOLLO SPACECRAFT

INSTRUMENT UNIT

Weight: About 4,100 pounds

THIRD STAGE

Power: One J–2 engine, 200,000 pounds thrust

Propellants: Liquid hydrogen, 66,900 gallons

Liquid oxygen, 20,400 gallons

Fueled weight of stage: 265,000 pounds

SECOND STAGE

Power: Five J–2 engines with a combined thrust of 1,000,000 pounds

Propellants: Liquid hydrogen, 267,700 gallons

Liquid oxygen, 87,400 gallons

Fueled weight of stage: 1,064,000 pounds

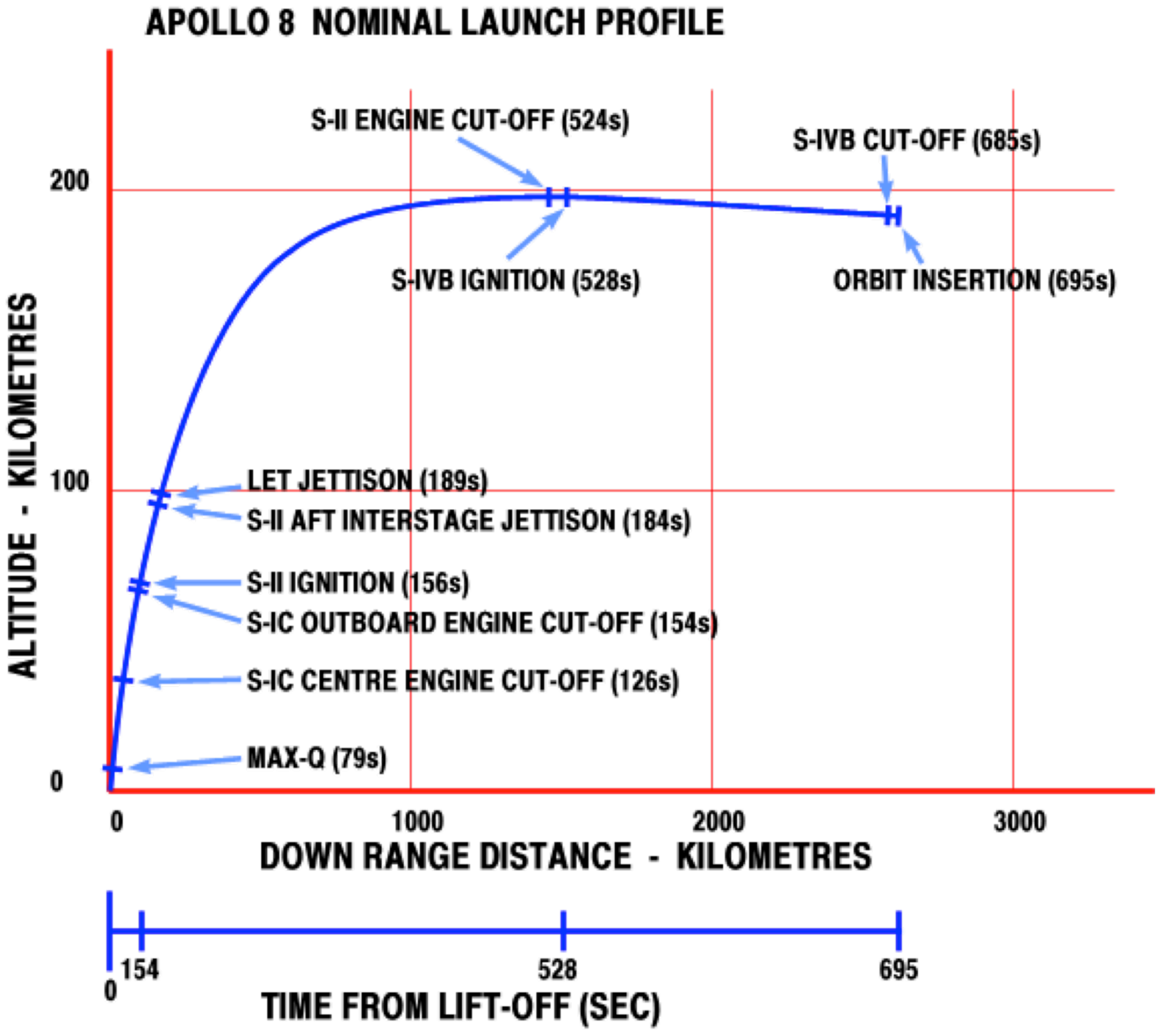
FIRST STAGE

Power: Five F–1 engines with combined thrust of 7.5 million pounds

Propellants: RP–1 kerosene, 214,200 gallons

Liquid oxygen 346,400 gallons

Fueled weight of stage: 5,028,000 pounds


APOLLO 8 NOMINAL LAUNCH PROFILE
S-II ENGINE CUT-OFF (524s)
S-IVB CUT-OFF (685s)
S-IVB IGNITION (528s)
ORBIT INSERTION (695s)
200
100
0
ALTITUDE - KILOMETRES
LET JETTISON (189s)
S-II AFT INTERSTAGE JETTISON (184s)
S-II IGNITION (156s)
S-IC OUTBOARD ENGINE CUT-OFF (154s)
S-IC CENTRE ENGINE CUT-OFF (126s)
MAX-Q (79s)
0
1000
2000
3000
DOWN RANGE DISTANCE - KILOMETRES
0
154
528
695
TIME FROM LIFT-OFF (SEC)

Gravity Turn: "Open Loop" Guidance

2.1.2 Launch Vehicle Constraints

The launch vehicle constraints are:

a. The guidance-command angle rate shall not exceed one degree per second in pitch and yaw (First-stage tilt program and upper-stage guidance program).

b. The maximum command attitude in the yaw plane shall not exceed 45 degrees.

BOEING

TITLE SATURN V LAUNCH VEHICLE GUIDANCE EQUATIONS, SA-504

MODEL NO. SATURN V

CONTRACT NO. NAS8-5608, Schedule
Part IIa, Volume I
DRL 049, Item 11

ref- 08464

```
def linear_tangent_pitch(fractional_time)
  initial_angle_in_rad = 5 * (Math::PI / 180)
  final_angle_in_rad = 88 * (Math::PI / 180)
  angle_in_rad = Math.atan(
    Math.tan(initial_angle_in_rad) -
      (Math.tan(initial_angle_in_rad) - Math.tan(final_angle_in_rad)) * fractional_time
  )
  # Constants chosen here make the path vaguely match actual Saturn V
  90 - (angle_in_rad * (180/Math::PI) - (32 * (1 - fractional_time))
end
```

The second integral of equation (36) is

$$\eta_T = \eta_1 + \dot{\eta}_1 (T_1 + T_2) - \frac{1}{2} g^* (T_1 + T_2)^2 \cos \phi^* + \left\{ \sin \tilde{\chi}_\xi - K_1 \cos \tilde{\gamma}_\xi \right\}$$

$$\left\{ T_2 V_{ex_1} \ln \left(\frac{\tau_1}{\tau_1 - T_1} \right) + V_{ex_1} \left[T_1 - (\tau_1 - T_1) \ln \left(\frac{\tau_1}{\tau_1 - T_1} \right) \right] \right.$$

$$\left. + V_{ex_2} \left[T_2 - (\tau_2 - T_2) \ln \left(\frac{\tau_2}{\tau_2 - T_2} \right) \right] \right\} + K_2 \cos \tilde{\chi}_\xi$$

$$\cdot \left[T_2 V_{ex_1} \left[\tau_1 \ln \left(\frac{\tau_1}{\tau_1 - T_1} \right) - T_1 \right] + T_1 V_{ex_2} \left[T_2 - (\tau_2 - T_2) \ln \left(\frac{\tau_2}{\tau_2 - T_2} \right) \right] \right.$$

$$- V_{ex_1} \left\{ \frac{T_1^2}{2} - \tau_1 \left[T_1 - (\tau_1 - T_1) \ln \left(\frac{\tau_1}{\tau_1 - T_1} \right) \right] \right\} - V_{ex_2} \left\{ \frac{T_2^2}{2} \right.$$

$$\left. \left. - \tau_2 \left[T_2 - (\tau_2 - T_2) \ln \left(\frac{\tau_2}{\tau_2 - T_2} \right) \right] \right\} \right] . \qquad (40)$$

S-IC YAW MANEUVER

$x_Z = 0^\circ$ $\quad 1.0 > t_c$

$x_Z = 1.25^\circ$ $\quad 1.0 \leq t_c < 8.75$

$x_Z = 0^\circ$ $\quad 8.75 \leq t_c$

```
vessel.auto_pilot.target_pitch_and_heading(88.75, 90)

executive.delay_job(core_set, Time.now + 7.75)
Fiber.yield

vessel.auto_pilot.target_pitch_and_heading(90, 90)
```


CAM 12
NASA HD
194 16:52:06.734

1. Ignition, pad lift-off
2. Yaw away from tower
3. Accelerate to 100 m/s, pitch 5 degrees.
4. Disable pitch control, wait until dynamic pressure is low.
5. Begin "closed-loop" guidance, burn until periapsis is above 100km.


T+ 0y, 0d, 00:00:00
MET
Local Control
Apoapsis Height 118.4m
Time to Apoapsis 0.0s
Periapsis Height -6,362.5km
Time to Periapsis 14m 56.5s
000183 m
ATMOSPHERE
VERT SPD
Altitude (Terrain) 101.1m
Vertical Speed 64.78mm/s
Horizontal Speed 14.43mm/s
Biome Shores
Mach Number 0.00Ma
MechJeb
READY TO LAUNCH
4
FAR
KER
MJ
Surface 0.1m/s
HDG 090°
STAGE 015
ROLL
PITCH
YAW
Jebediah Kerman
Bill Kerman
Bob Kerman

```
rgc = RGC.new(adapter: { name: "KRPC" }, ip: "192.168.1.6")
rgc.executive.request_core_set_for(priority: 2, job: PreLaunchJob)
loop { rgc.executive.main }
```

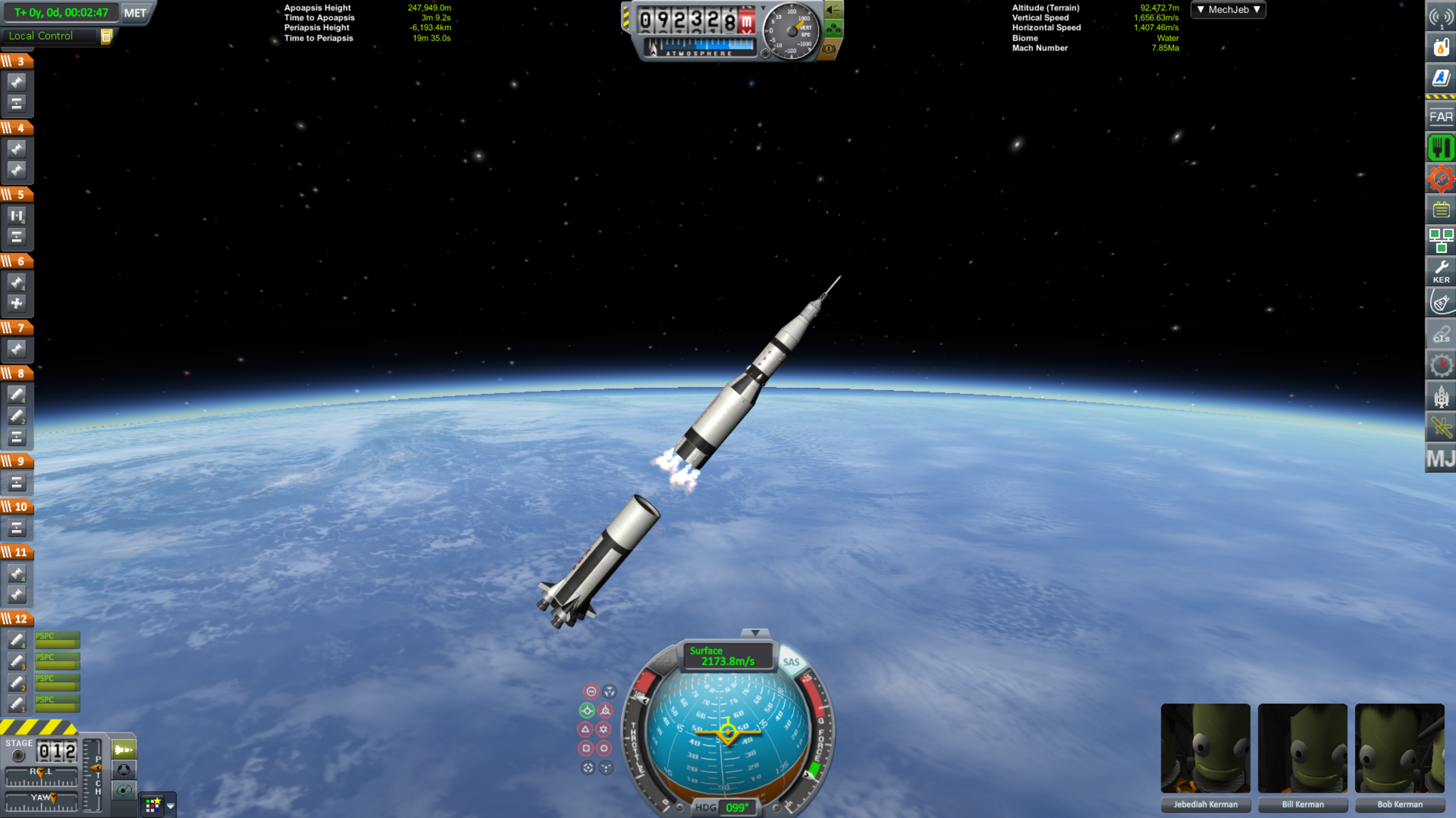

T+ 0y, 0d, 00:00:00
MET
Local Control
Apoapsis Height 118.4m
Time to Apoapsis 0.0s
Periapsis Height -6,362.5km
Time to Periapsis 14m 56.5s
000183 m
ATMOSPHERE
VERT SPD
Altitude (Terrain) 101.2m
Vertical Speed 155.97mm/s
Horizontal Speed 96.93mm/s
Biome Shores
Mach Number 0.00Ma
▼ MechJeb ▼
IGNITION!
FAR
KER
MJ
Kerosene
Kerosene
Kerosene
Kerosene
Kerosene
STAGE 015
ROLL
PITCH
YAW
Surface 0.2m/s
HEADING
G FORCE
HDG 262°
Jebediah Kerman
Bill Kerman
Bob Kerman

```
class LaunchJob < RGC::Executive::Job
  def run
    ctrl.activate_next_stage # Ignition

    until vessel.thrust >= vessel.max_thrust * 0.6
      executive.delay_job(core_set, Time.now + 0.1)
      Fiber.yield
    end

    ctrl.activate_next_stage
    executive.request_core_set_for(priority: 10, job: GravityTurnJob)
    executive.request_core_set_for(priority: 100, job: StagingJob)
    Fiber.yield :kill
  end
end
```


T+ 0y, 0d, 00:00:02
MET
Local Control
Apoapsis Height 142.5m
Time to Apoapsis 1.0s
Periapsis Height -6,362.5km
Time to Periapsis 14m 57.5s
000205 m
ATMOSPHERE
VERT SPD
Altitude (Terrain) 120.0m
Vertical Speed 10.02m/s
Horizontal Speed 732.26mm/s
Biome Shores
Mach Number 0.03Ma
▼ MechJeb ▼
LIFTOFF!
Kerosene
Kerosene
Kerosene
Kerosene
Kerosene
STAGE 014
ROLL
PITCH
YAW
Surface 10.0m/s
HDG 261°
Jebediah Kerman
Bill Kerman
Bob Kerman

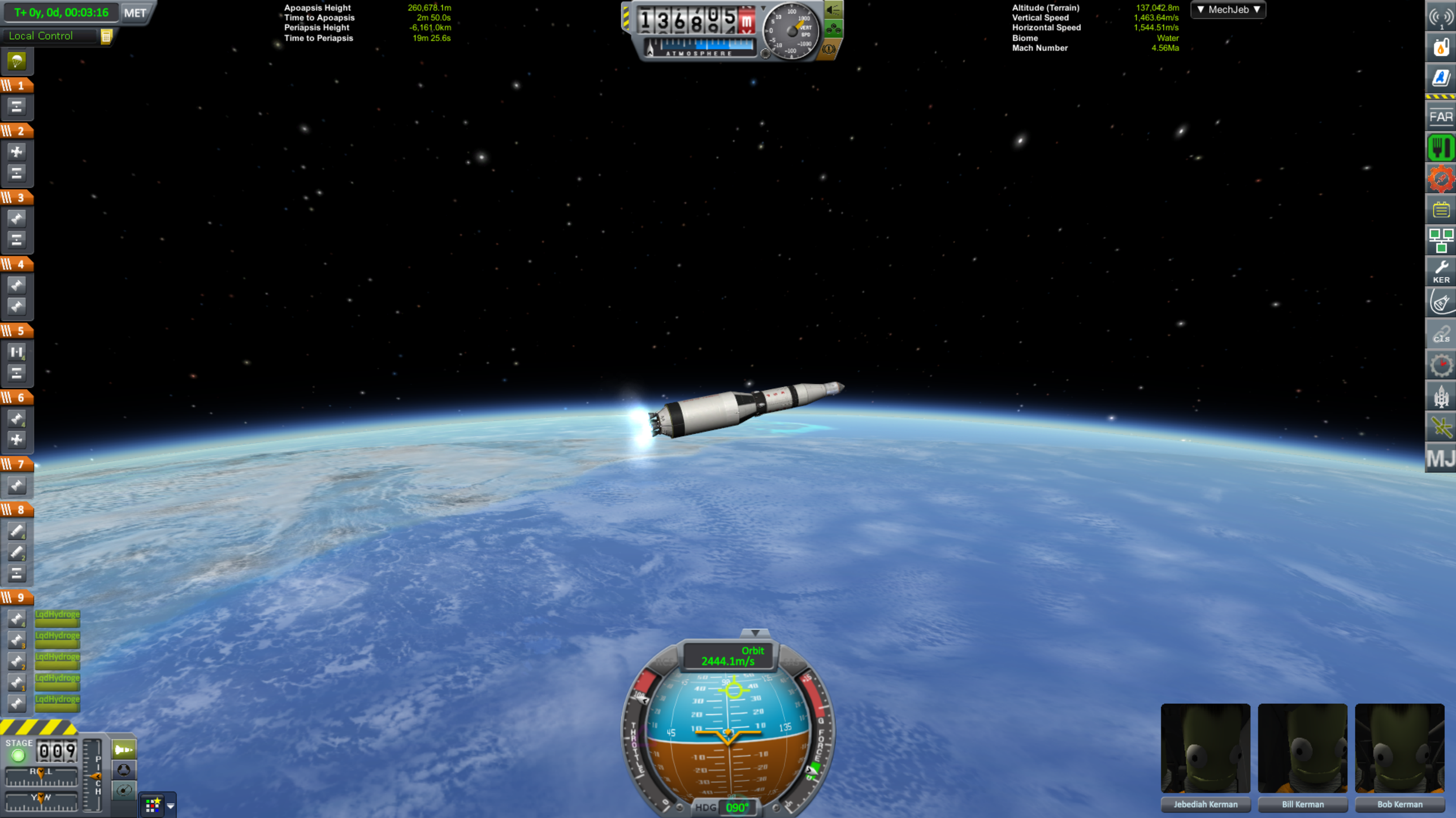

T+ 0y, 0d, 00:02:09
MET
Local Control
Apoapsis Height 91,523.2m
Time to Apoapsis 1m 41.5s
Periapsis Height -6,315.6km
Time to Periapsis 17m 7.3s
Altitude (Terrain) 43,116.3m
Vertical Speed 957.05m/s
Horizontal Speed 624.52m/s
Biome Shores
Mach Number 3.51Ma
MechJeb
FAR
KER
MJ
Kerosene
STAGE
Surface
1142.8m/s
SAS
HDG 099°
Jebediah Kerman
Bill Kerman
Bob Kerman

```
class GravityTurnJob < RGC::Executive::Job
  def run
    until vessel.flight(vessel.orbit.body.reference_frame).speed >= 100
      executive.delay_job(core_set, Time.now + 0.2)
      Fiber.yield
    end

    pitchover_angle = 84
    vessel.auto_pilot.target_pitch_and_heading(pitchover_angle, 90)
    core_set.priority = 50

    executive.delay_job(core_set, Time.now + 15)
    Fiber.yield

    vessel.auto_pilot.pitch_pid_gains = [0,0,0]
    executive.request_core_set_for(priority: 10, job: ClosedLoopGuidanceJob)
    Fiber.yield :kill
  end
end
```

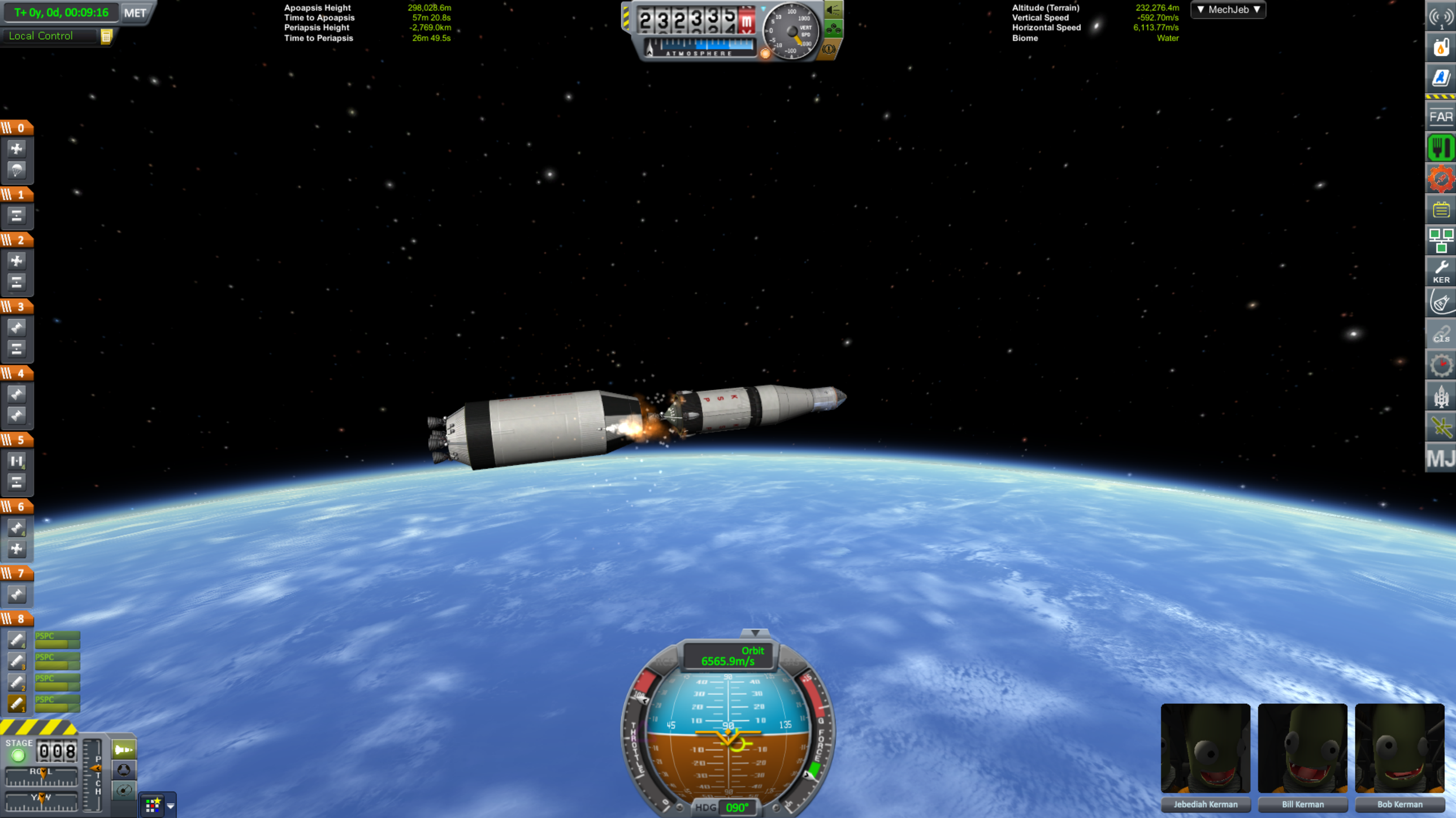

T+ 0y, 0d, 00:02:47
MET
Local Control
Apoapsis Height 247,949.0m
Time to Apoapsis 3m 9.2s
Periapsis Height -6,193.4km
Time to Periapsis 19m 35.0s
092328 m
ATMOSPHERE
Altitude (Terrain) 92,472.7m
Vertical Speed 1,656.63m/s
Horizontal Speed 1,407.46m/s
Biome Water
Mach Number 7.85Ma
▼ MechJeb ▼
FAR
KER
cls
MJ
Surface 2173.8m/s
SAS
HDG 099°
STAGE 012
ROLL
YAW
PITCH
PSPC
PSPC
PSPC
PSPC
Jebediah Kerman
Bill Kerman
Bob Kerman


T+ 0y, 0d, 00:02:55
MET
Local Control
Apoapsis Height 249,953.4m
Time to Apoapsis 3m 2.6s
Periapsis Height -6,191.5km
Time to Periapsis 19m 29.2s
ATMOSPHERE
Altitude (Terrain) 105,324.4m
Vertical Speed 1,595.57m/s
Horizontal Speed 1,412.21m/s
Biome Water
Mach Number 7.08Ma
▼ MechJeb ▼
FAR
KER
cls
MJ
LqdHydroge
STAGE
009
ROLL
PITCH
YAW
Orbit
2422.2m/s
HDG 095°
Jebediah Kerman
Bill Kerman
Bob Kerman

```
class StagingJob < RGC::Executive::Job
  def run
    engines = vessel.parts.engines.map { |e| [e, e.part.stage] }.each_with_object({}) do |i, sum|
      sum[i[1]] ||= []
      sum[i[1]] << i[0]
    end

    loop do
      if engines[ctrl.current_stage]
        if engines[ctrl.current_stage].any? { |e| !e.has_fuel }
          # Fueled stage has run out
          vessel.control.activate_next_stage
        end
      else
        # Interstage fairing
        vessel.control.activate_next_stage
      end

      executive.delay_job(core_set, Time.now + 0.5)
      Fiber.yield
    end
  end
end
```


T+ 0y, 0d, 00:03:16
MET
Local Control
Apoapsis Height 260,678.1m
Time to Apoapsis 2m 50.0s
Periapsis Height -6,161.0km
Time to Periapsis 19m 25.6s
136805
m
ATMOSPHERE
Altitude (Terrain) 137,042.8m
Vertical Speed 1,463.64m/s
Horizontal Speed 1,544.51m/s
Biome Water
Mach Number 4.56Ma
▼ MechJeb ▼
FAR
KER
MJ
LqdHydroge
STAGE
009
ROLL
PITCH
YAW
Orbit
2444.1m/s
HDG 090°
Jebediah Kerman
Bill Kerman
Bob Kerman

```
class ClosedLoopGuidanceJob < RGC::Executive::Job
  def run
    until vessel.flight.dynamic_pressure <= 50
      executive.delay_job(core_set, Time.now + 2)
      Fiber.yield
    end

    until vessel.orbit.periapsis_altitude >= 100_000
      percent_mission = vessel.met / 705
      vessel.auto_pilot.target_pitch_and_heading(
        linear_tangent_pitch(percent_mission),
        90
      )
      executive.delay_job(core_set, Time.now + 0.3)
      Fiber.yield
    end

    ctrl.throttle = 0
    Fiber.yield :kill
  end
end
```


T+ 0y, 0d, 00:09:16
MET
Local Control
Apoapsis Height 298,028.6m
Time to Apoapsis 57m 20.8s
Periapsis Height -2,769.0km
Time to Periapsis 26m 49.5s
ATMOSPHERE
Altitude (Terrain) 232,276.4m
Vertical Speed -592.70m/s
Horizontal Speed 6,113.77m/s
Biome Water
▼ MechJeb ▼
FAR
KER
MJ
Orbit
6565.9m/s
HDG 090°
STAGE
008
PSPC
Jebediah Kerman
Bill Kerman
Bob Kerman


T+ 0y, 0d, 00:13:13
MET
Local Control
Apoapsis Height 526,117.6m
Time to Apoapsis 5m 54.3s
Periapsis Height 262,161.4m
Time to Periapsis 9m 45.4s
291236 m
ATMOSPHERE
Altitude (Terrain) 291,227.3m
Vertical Speed -95.20m/s
Horizontal Speed 7,365.64m/s
Biome Water
MechJeb
FAR
KER
MJ
LqdHydroge
PSPC
PSPC
PSPC
PSPC
STAGE 007
ROLL
YAW
PITCH
RCS
Orbit 7793.6m/s
SAS
HDG 104°
Jebediah Kerman
Bill Kerman
Bob Kerman


T+ 0y, 0d, 00:12:59
MET
Local Control
Apoapsis Height 526,117.6m
Time to Apoapsis 56m 7.8s
Periapsis Height 262,161.4m
Time to Periapsis 9m 59.0s
Altitude (Terrain) 292,530.3m
Vertical Speed -97.02m/s
Horizontal Speed 7,363.98m/s
Biome Water
▼ MechJeb ▼
kRPC Server
Server online
Stop server
Address: 192.168.1.6
Show Info
RPC port: 50000 Stream port: 50001
Subnet 255.255.255.0, auto-accepting new
No clients connected
KER
MJ

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