Public



From First Rotating Detonation Rocket Engine Flight to Hypersonic RDRE Flight
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Andrew Duggleby, Ph.D., P.E.
Venus Aerospace
Houston, TX



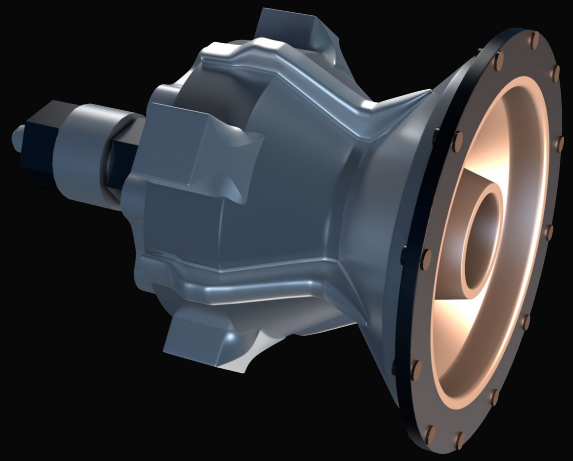
ROTATING DETONATION ROCKET ENGINE (RDRE)

A fundamentally new combustion approach that enables higher efficiency, simpler architectures, and step-change in propulsion performance.

HOW THE RDRE WORKS

The RDRE employs a detonation wave propagating around an annular combustor to generate thrust.

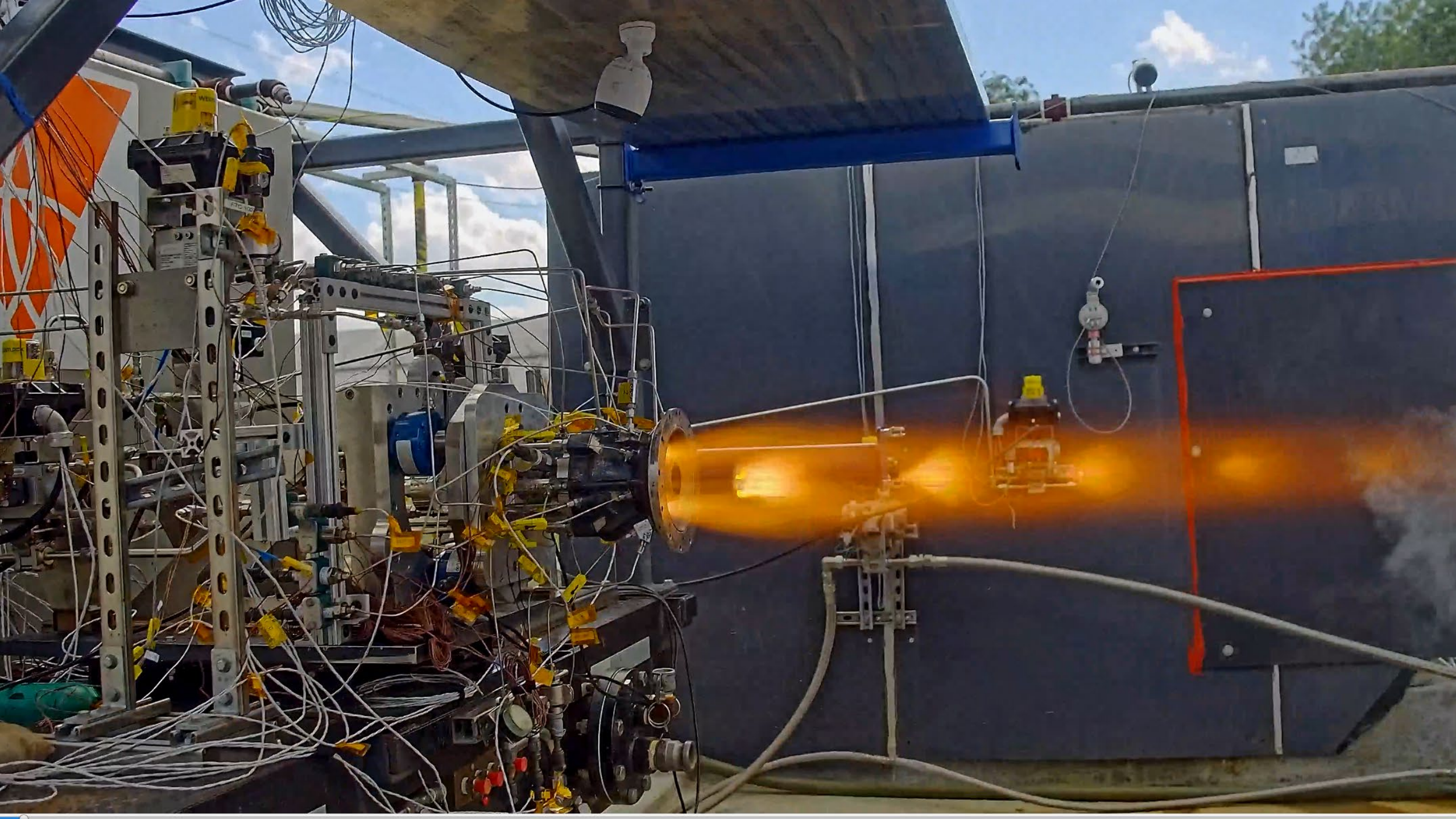
The detonation wave travels supersonically, enabling breakthroughs in speed, efficiency, thrust-to-weight ratio, engine size, and range.

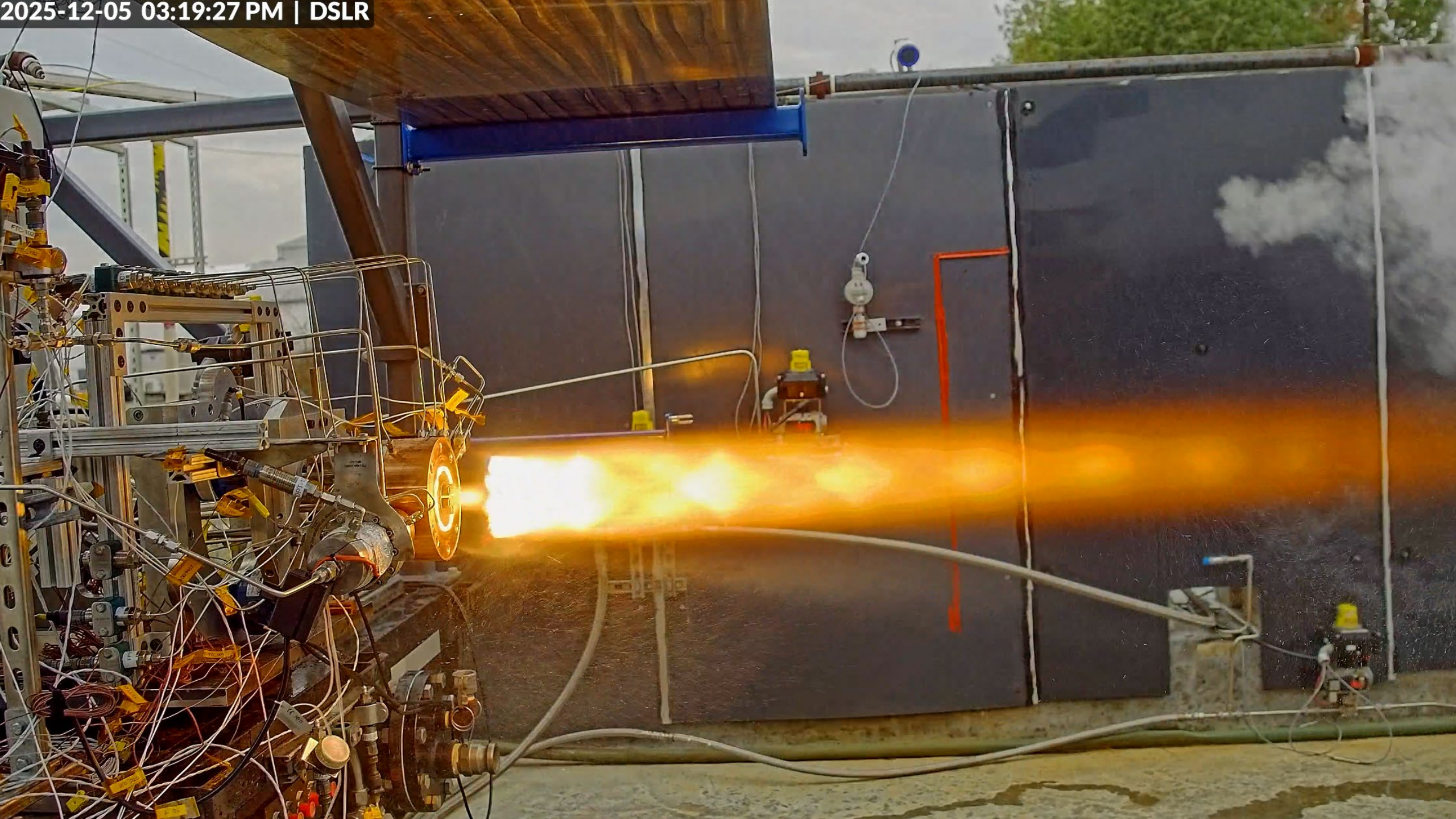


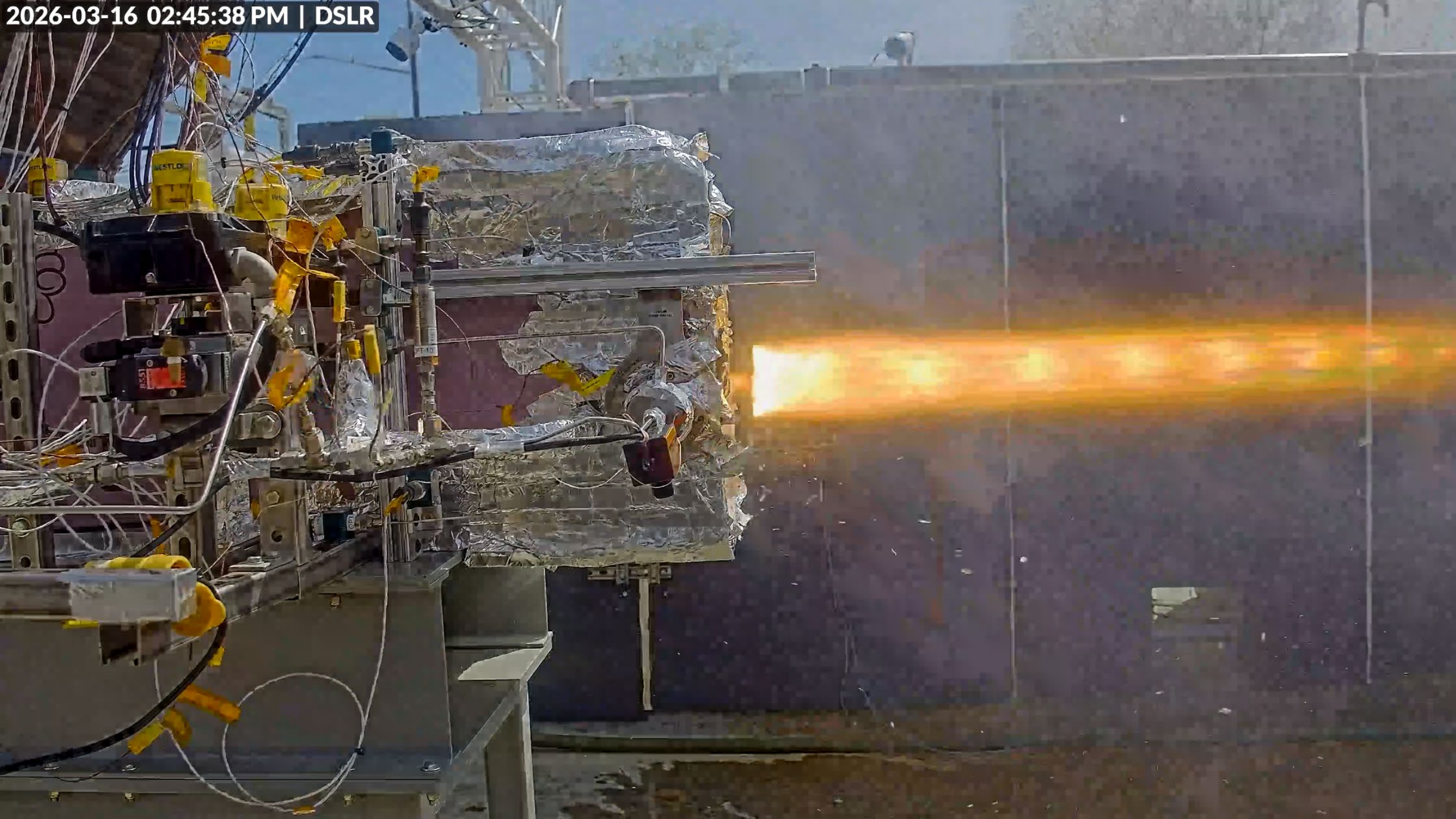
WHAT SETS THE RDRE APART

- Scalable from 2,000 - 50,000 lbs of thrust
- Reusable
- No moving parts
- 3D-printed
- Standard materials

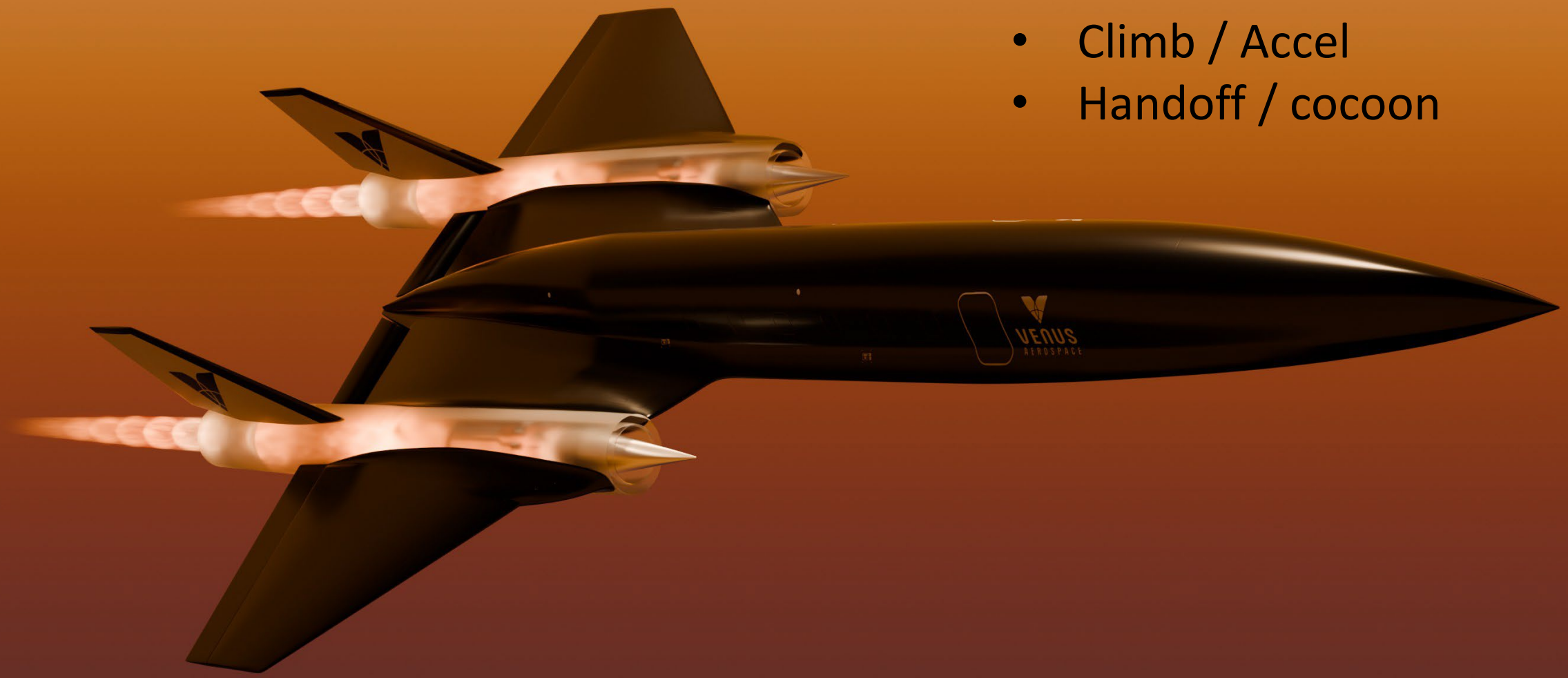
15% | **More efficient than any legacy rocket engine***




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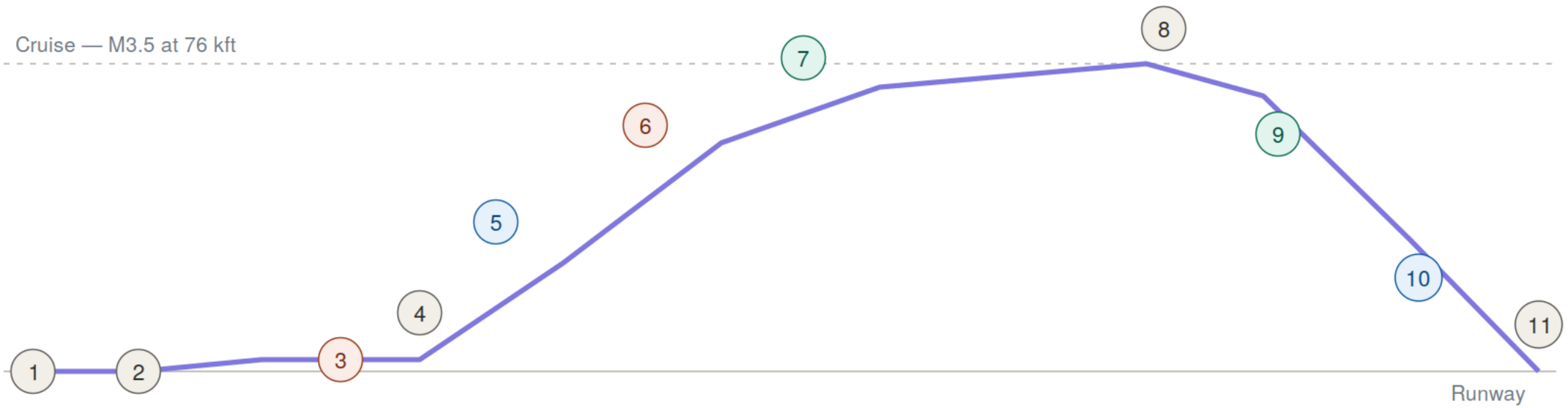

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- Mach 4
- “Off-Design”
  - Wing: Take-off
  - Tires
  - Climb / Accel
  - Handoff / cocoon

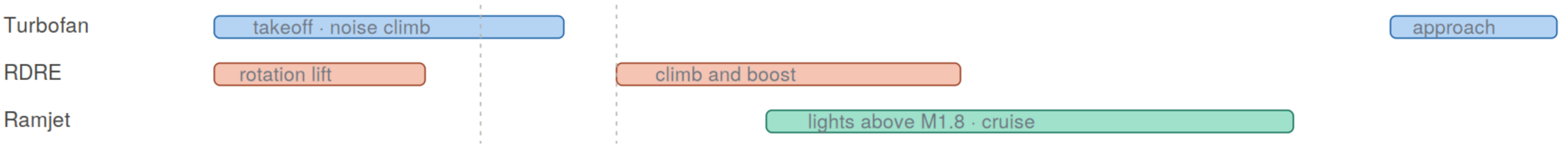


Mission profile

Eleven phases · three engines · horizontal axis is not to scale



ENGINE ACTIVITY



1 Ground roll to 150 kt, tire-limited

2 Rotate — canted RDRE carries lift

3 Level accel at 10 ft to 400 kt

4 RDRE off — noise abatement

5 Turbofan climb, 7.3% gradient

6 RDRE relight, climb and boost

7 Ramjet lights, RDRE tapers off

8 Top of descent

9 Ramjet off below M1.8

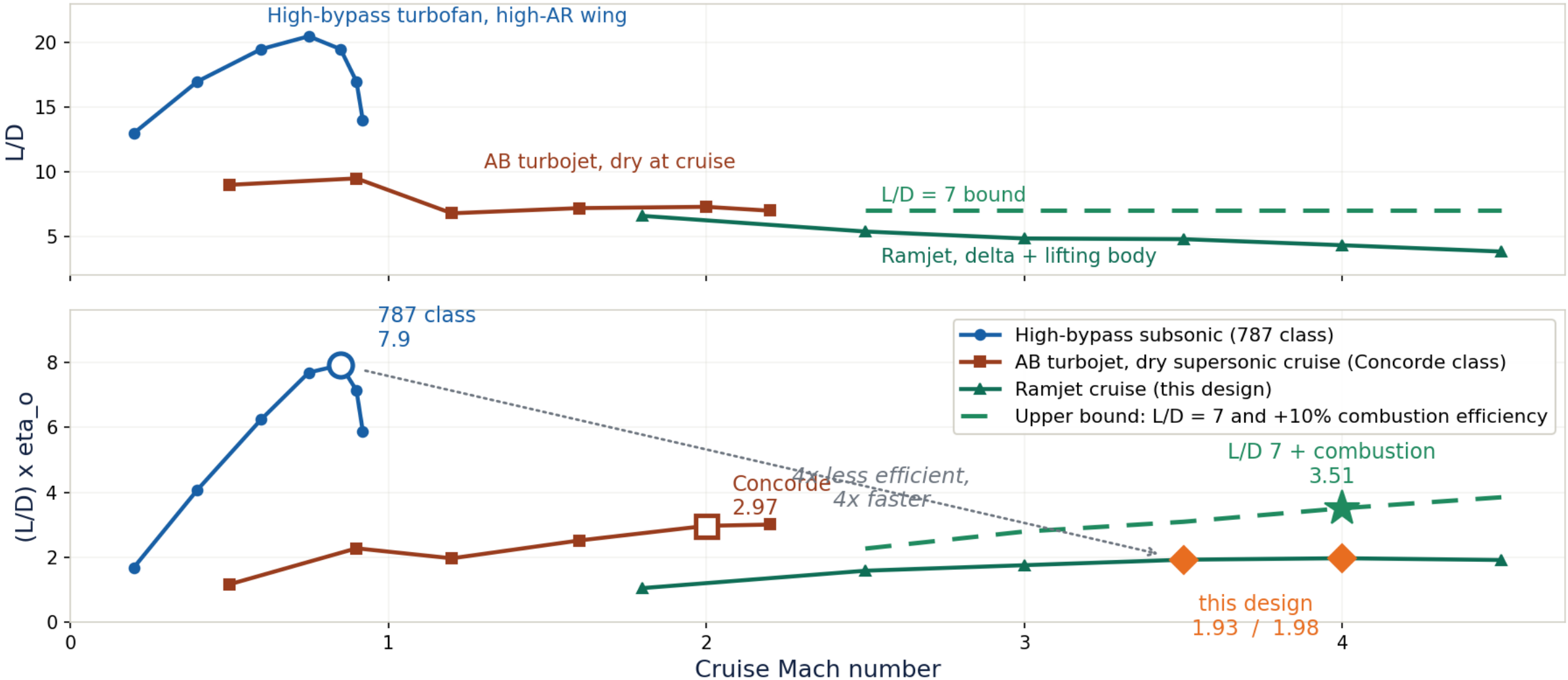
10 Turbine restart

11 Land at 155 kt

Takeoff is 2394 m and ~90 s of a 1 h 50 m flight.

Range parameter across the speed range

Each family plotted only where it can actually cruise. Efficiency falls roughly fourfold from subsonic to M3.5 - that is the price of speed.



Subsonic and Concorde curves are representative of their class, not converged designs.
This design is the converged closure; markers at M3.5 and M4.0 are fully re-optimised.

Mach 4.0 design point

30 seats · turbofan + RDRE + fixed-geometry ramjet · converged, landing and flutter active

65.5 t
MTOW
3.4 t payload · 70% propellant

3971 mi
Max range
(L/D)·eta_o = 1.977

2666 mph
Cruise, 79.2 kft
Faster than any crewed aircraft

1 h 41 m
New York – London block time
Concorde 3 h 30 m · subsonic 7 h

AIRFRAME

Wing area	85.7 m²
Sweep	26.2°
Thickness t/c	5.33%
Fuselage	46.0 × 2.30 m
Fineness	20
Cross-section	flat-bottom D
Gear / upsweep	2.52 / 2.95 m

PROPULSION

RDRE total	562 kN
— per chamber	4 × 141 kN
— mass at T/W 60	955 kg
Ramjet capture	2.31 m²
— geometry	fixed inlet + nozzle
Turbofan	subsonic, no AB
eta_o at cruise	0.456

AERO & LIMITS

L/D at cruise	4.33
Cruise alpha	5.05°
Body lift share	35.5%
Approach speed	155 kt — ACTIVE
Flutter margin	1.500 — ACTIVE
Acreage skin	432°C — Ti-6242
Inlet Tt2	654°C

VERSUS M3.5

+2.1% MTOW · +2.1% range · +15% speed · +125°C skin. Same wing, same body, same architecture. Wing and sweep are set by landing and flutter, which do not care about cruise Mach — the aircraft adapts by climbing 3 kft and growing the inlet 24%. A cruise-point choice, not a configuration change.

Block time includes 617 mi of non-cruise (departure, acceleration, descent) at 37 min.
Minimum-MTOW closure, four cold starts, |g_red| 2e-3, monotonicity-verified. Assumed: eta_b 0.94, flutter stiffness k=2.5 to Concorde, spillage K(M) estimated.

Upper bound — L/D 7 + better combustion

Waverider aerodynamics and a cruise-optimised ramjet. NOT a converged design — a bound on what the architecture could reach.

33.4 t
MTOW — down 49%
from 65.5 t at L/D 4.33

5322 mi
Range — up 34%
192 mi margin on SFO–Tokyo

3.51
(L/D) x eta_o
18% above Concorde, at 2x speed

2 h 18 m
SFO – Tokyo block time
Same-day return: home by 15:35

WHAT CHANGES

MTOW	65.5 → 33.4 t
Propellant fraction	0.70 → 0.65
Propellant mass	45.8 → 21.7 t
Payload fraction	5.2 → 10.2%
Range	3971 → 5322 mi
Payload, seats, Mach	unchanged

PMF 0.65 is a far easier structural target. The two gains break the compounding loop that was forcing 70% propellant.

WHAT IT DEMANDS

C_D at cruise	0.0245 → 0.0151
Reduction required	38%
eta_o from combustion	0.456 → 0.502

Current M4 drag budget:

friction	0.0095
drag due to lift	0.0105
wave	0.0020
inlet / spillage	0.0025

Removing drag due to lift ENTIRELY still leaves L/D 7.6: L/D 7 needs compression lift, not a better delta.

NETWORK UNLOCKED

SFO – Tokyo	5130 mi · 2 h 18 m
JFK – São Paulo	4750 mi · 2 h 06 m
LAX – Tokyo	5478 mi · out by 156
London – Joburg	5634 mi · out by 312
JFK – London	3459 mi · 1 h 41 m

Pacific and South American day trips become possible. Same-day return with 4 h on the ground: depart 07:00, 4 h 37 m of flying, home by 15:35.

OPEN RISKS

Low-speed CLmax assumed unchanged. Landing is the ACTIVE constraint on every version of this aircraft; waveriders are historically poor at low speed. If CLmax falls the wing grows and mass saving reverses.
Volumetric efficiency not assessed. 21.7 t of propellant must fit a compression-surface body.

Wing area, sweep, thickness, flutter margin and RDRE thrust are deliberately NOT quoted: the closure loop tops out near L/D 4.8 on a delta plus lifting body and cannot produce this configuration. Range from the Breguet form at eta_o 0.502; mass from a fixed-payload scaling closure. A 10% combustion gain is taken as a 10% eta_o gai

Questions?

